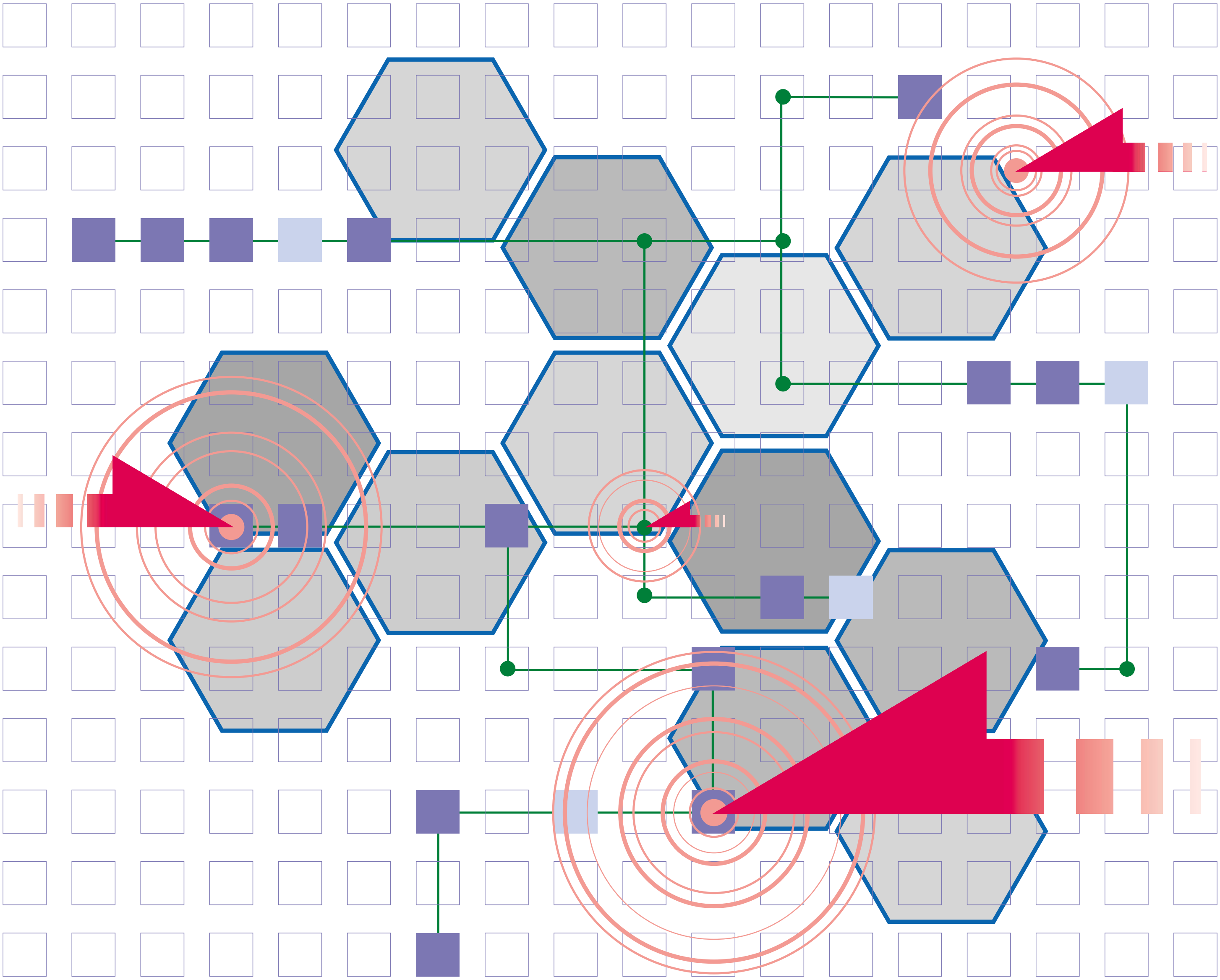
Discover What's Possible™

ELECTRONIC
MEASURING INSTRUMENTS



2004

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Request for measuring instruments not appearing
in this catalog will also be accepted.

OUTLINE OF ANRITSU CORPORATION

Anritsu Corporation's predecessor, Anritsu Electric Co. Ltd., was created by the 1931 merger of Kyoritsu Denki, which grew out of Sekisansha Co., founded in 1895 as a manufacturer of wire communication equipment, and Annaka Denki Seisakusho, established in 1900 as a pioneer in wireless communication equipment. The company name was changed to Anritsu Corporation in 1985 to reflect the firm's status as an international enterprise.

With a history in wire and wireless communications equipment, Anritsu has contributed to the enhancement of society through its numerous products, which include equipment for "original and high-level" communication equipment, instrumentation and control equipment, information terminals, and manufacturing equipment. In particular, Anritsu has grown to be recognized as a world leader in measurement systems for wireless communications as well as optical and super high-speed digital communications. Customers in well over 100 countries use Anritsu products in a diverse range of industrial areas.

To ensure that Anritsu products are of the highest quality, the Anritsu Group is establishing a quality system conforming to international standards, and has become registered as an ISO9001 quality assurance corporation by JQA.

Meanwhile, Anritsu head office and Tohoku Anritsu Corporation have earned ISO14001 environmental management certification, demonstrating our dedication to preserving the natural environment.

It is now apparent that the focus of Anritsu's attention, the mobile and Internet areas, are about to evolve even further. And in addition to broadband and IP, the entrance of digital broadcasting and intelligent home appliances means the arrival of a ubiquitous network society where people are able to enjoy all types of services anytime, anywhere.

In order to be both the best partner for our customers and to continue to evolve, Anritsu is putting the "original and high-level" technology and intelligence coming from our 100-year history toward this ubiquitous network society. We have transformed ourselves into an "Intelligent Solution Creator." By providing electronic, information communication and measurement solutions that directly contribute to the success of our customers' businesses, Anritsu is supporting the evolution of a ubiquitous network society.

Established	March 17, 1931
Paid-up capital	¥14,043,000,000
Employees	3,720 (worldwide)

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See page 4 for sales network.

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http://www.anritsu.com

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Three easy ways to find the information you need.

- Use the Alphabetical Index on pages 7 to 10.
- Use the Model Number Index on pages 11 to 16 to locate a specific instrument by model number.

Standard products

All measuring instruments appearing in this catalog are standard products. For information on non-standard instruments please contact us.

New products

Identifies products developed and introduced in the period from July 2002 to June 2003.

CE

Measuring instruments whose outline views are marked with CE conform to EMC (EN61326, EN61000-3-2) and LVD(EN61010-1 Safety) standards. As For EMC and LVD, a part of standards will be revised on and after January 1, 2004, and some of equipment become compliant with those standards on and after January 1, 2004. Please contact your Anritsu sales representatives for the compliance status.

Anritsu Eco Product
Lightweight
Power saving
Small size

Products conformed to environment-friendly criteria uniquely set by ourselves is called "Anritsu Eco Product".
For the details of the mark and environment-friendly criteria, please refer to Anritsu Corporation home page.
(URL: http://www.anritsu.co.jp/English)

Specification changes

We reserve the right to discontinue any item without notice and to change specifications at any time without incurring any obligation to incorporate new features in instruments or parts previously sold.

Accessories

Two types of accessories are available: Supplied and Optional. All instruments include the cost of supplied accessories, including fuses and one operation (or instruction) manual in English. The cost of optional accessories, however, is not included and, therefore, the optional accessories will be supplied only on request.

• Measuring cords
The measuring cord in the accessory column is indicated in the sequence of Connector · Cord · Connector.
A type S connector is compatible to a type N.

Numerical values used in this catalog

All numerical values are expressed according to the following units:

• Output voltage of signal generator
The output voltage expressed in a unit of dB or dBµ is calibrated in terms of e.m.f. (open circuit output voltage). 1 µV is equal to 0 dB or 0 dBµ.

• Input power of level meter
The input power is expressed in a unit of dBm which is terminated by nominal impedance. 0 dBm is equal to 1 mW.
Even if the input power is applied to the "high" impedance input terminal, the indicated value is calibrated as mentioned above.

• Power supply voltage
Any rated voltage between 100 V and 240 V is available. Normal operation can be obtained within ±10% of each rated voltage (however, maximum permissible operating voltage is 250 V).

• Ambient temperature, rated range of use
"Ambient temperature, rated range of use" in the specifications represents the range of ambient temperature which guarantees values given in specifications.

• External dimensions
External dimensions are indicated in width, height, and depth in millimeters, and do not include controls, fittings, or stands.

Technical publications

In this catalog you will notice that an outline of usage, noteworthy points, and standards has been prepared. If further information is required please contact us directly. We will be happy to send you the technical publications of your choice.

Order by model number

When ordering, please specify the model number and name of the instrument desired, for example, “MP1570A SONET/SDH/PDH/ATM Analyzer.” To prevent misunderstandings, include all necessary specifications and specific instructions in your order. That is to say, include all special options or features such as special color, nonstandard power line voltage, etc. To expedite your order we suggest that you contact us directly.

Shipment

Generally, instruments will be shipped within two months of receipt of your order. In the case of “Custom-made products” mentioned in the footnotes, shipment may take from 4 to 7 months. Every endeavor will be made to maintain delivery dates, but no liability is accepted for loss, damage, or delay of instruments, for reasons which are out of our control.

Terms

Unless previous terms have been arranged, we will use one of the following:

- Full payment in advance of shipment
- Sight draft against an irrevocable confirmed letter of credit

Quotations and pro forma invoices

FOB, CIF, C&F, etc., quotations and pro forma invoices are available on request. The instrument price includes packing a charge.

Inspection surcharge

An inspection surcharge is applied to all orders requiring inspection by government agencies or individually appointed inspectors at our factory.

Special products made-to-order

Requests for remodeling standard products for special use will be accepted, but only after detailed discussions.

Returning instrument for repairs

When returning the instrument to Anritsu for repairs, the following suggestions will help us return it to you in the shortest possible time:

- Send complete instructions about what you would like done to the instrument.
- If possible, include the “symptoms” or “defects”.
- Indicate the return address, and, if different, the address to be used for billing purposes.

All repairs and recalibrations are carried out at our factory.

Extension service

The normal warranty term is one year, but may be extended to three or five years as an option when purchasing equipment. For three or five years extension service, please ask your local Anritsu Field Office or Sales Representative for price and availability.

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MS-DOS is a registered trademark of Microsoft Corporation.

Windows is a registered trademark of Microsoft Corporation.

IBM is a registered trademark of International Business Machines Corporation.

i386/i486 are registered trademarks of Intel Corporation.

APC-3.5 is a registered trademark of Amphenol North America, a division of Bunker Ramo Corporation.

K Connector and V Connector are registered trademarks of Anritsu Company.

LabWindows and LabVIEW are registered trademarks of National Instruments.

LRL/LRM-Calibration method of Rhode & Schwartz, Germany

Bluetooth and the Bluetooth logos are trademarks owned by the Bluetooth SIG, Inc., U.S.A. and licensed to the Anritsu Corporation.

Loctite is a registered trademark of Loctite Corporation.

Kovar is a registered trademark of Westinghouse Electric & Manufacturing Company.

cdma2000® is a registered trademark of the Telecommunications Industry Association (TIA –USA),

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WARRANTY

All other express warranties are disclaimed and all implied warranties for this product including the warranties of merchantability and fitness for a particular purpose are limited in duration to a period of one year from the date of delivery. In no event shall all Anritsu group be liable to the customer for any damages, including lost profits, or other incidental or consequential damages arising out of the use or inability to use this product.

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FAX: +(66)0-2502-3150-2

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FAX: +58-212-7933429

• Vietnam

SYSTEM & TECHNOLOGIES VIETNAM LTD
Unit # B236, Binh Minh Hotel
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FAX: +84-4-9-344-111

• Zimbabwe

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MD1230A Data Quality Analyzer/MD1231A IP Network Analyzer/MT7407A Multislot Chassis

MD1230A Family

The MD1230A Family achieves all this network monitoring and performance testing in one device with efficiency and cost savings.
The MD1230A Family comes in 3 chassis types matched to user needs. Measuring modules operate in all 3 chassis, so one or more chassis can be selected based on usage requirements without incurring extra module expense.

(For further information see page 144)

Network Performance Tester

MP1590A

The MP1590A is a measuring instrument capable of testing PDH, DSn, SDH/SONET and OTN equipment as well as jitter making measurements with only one unit. It also can perform OTN, SDH/SONET testing using the input wavelength from an external Tunable Laser Source. Jitter measurement and external optical input functions are provided by plug-in units that can be used in various combinations as needed.

(For further information see page 187)

For High Speed Testing of 802.11 WLAN Devices

MT8860A WLAN Test Set

2.4 to 2.5 GHz and 4.8 to 6 GHz

The MT8860A WLAN Test Set from Anritsu is an integrated test set dedicated to testing WLAN devices in the 2.4 GHz and 4.8 to 6 GHz Industrial Scientific and Medical (ISM) frequency bands.
MT8860A provides a high-speed measurement solution that is suitable for both production testing and design proving. The user interface is implemented through the supplied *LANLook* software package. *LANLook* runs on a standard PC and uses a conventional Windows interface for both instrument configuration and results displays. *LANLook* communicates with the MT8860A through a GPIB interface.

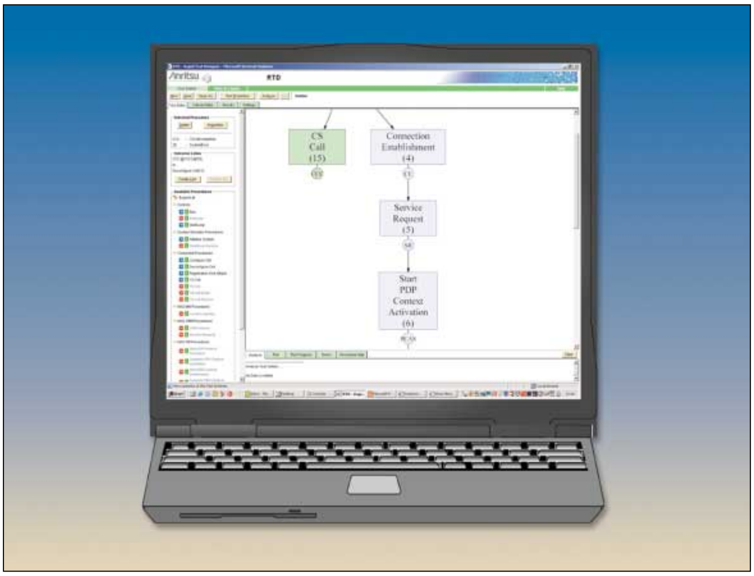
(For further information see page 265)

Development and Testing of 3G Terminals

MX786201A W-CDMA Rapid Test Designer (RTD)

The Rapid Test Designer (RTD) is a revolutionary new tool which aims to speed up the testing of WCDMA devices significantly by greatly simplifying the way in which tests are created, executed and analysed. This revolutionary test tool hides much of the complexity of testing 3GPP protocols and allows the user to concentrate on testing specific functions and protocols within the UE without having to be an expert on all the protocol layers. The intuitive graphical interface also avoids the need for the users having to learn a specialist test language, or needing a detailed knowledge of how to drive the system simulator. It is built upon Anritsu's many years of experience in testing 3GPP protocols with the leading UE vendors.
The RTD system consists of a Personal Computer running a Windows operating system, connected to the Anritsu MD8480B W-CDMA Signalling Tester (system simulator). The RTD is also available as an upgrade for existing users of Anritsu's MD8480B and MX785201A (PTS) products.

(For further information see page 302)



A Multi-Function Base Station Test Tool for Greater Flexibility and Technician Productivity

MT8212A Cell Master

25 MHz to 4.0 GHz

Cell Master MT8212A is a comprehensive, one-box base station test tool for deploying, maintaining and troubleshooting wireless base stations. Combining the functionality of a cable and antenna analyzer (25 MHz to 4.0 GHz), spectrum analyzer (10 MHz to 3.0 GHz), power meter, and T1/E1 analyzer into one lightweight, handheld test set - eliminates the need for field engineer and field technician to carry, manage and learn multiple test sets. MT8212A measurement capability includes precision return loss, VSWR, cable loss, distance-to-fault, signal identification, interference analysis, channel power, adjacent channel power ratio, field strength, occupied bandwidth, transmitter power and T1/E1 measurements. Patented RF interference rejection enables accurate, repeatable measurements in the presence of high RF activity. PC data analysis software enables assessment of system trends, problems, and performance in addition to professional report generation.

(For further information see page 306)

For Analyzing Cable and Antenna Problems

S331D Site Master

25 MHz to 4 GHz

The Site Master Model S331D combines the functionality of a 25 MHz to 4 GHz cable and antenna analyzer with an optional T1/E1 analyzer in a lightweight, handheld test tool.

(For further information see page 310)

For Analyzing Cable and Antenna Problems

S332D Site Master

25 MHz to 4 GHz

The Site Master model S332D adds a 100 kHz to 3 GHz spectrum analyzer to a 25 MHz to 4 GHz cable and antenna analyzer with an optional 100 kHz to 3 GHz power meter in a lightweight, handheld test tool. The S331D and S332D are the most versatile instruments available to address wireless market needs.

(For further information see page 310)

Fast, Accurate, Repeatable, Portable Spectrum Analysis

MS2711D Spectrum Master

100 KHz to 3.0 GHz

The Spectrum Master Model, MS2711D, is an enhancement over the current MS2711B for deploying, maintaining and troubleshooting wireless base stations and Wi-Fi (802.11) systems. One button measurements and optional bias tee, transmission measurement, power meter and frequency converter controller module offer the most flexible and complete measurement solution for the wireless market.

(For further information see page 316)

Spectrum Analyzer

MS2687B

9 kHz to 30 GHz

The IMT-2000 (2 GHz band) service for third-generation mobile radio communication has started. Bluetooth, or Wireless LAN, has been adopted for close-range radio communication between portable remote terminals and peripheral equipment, and R&D of MMAC, IEEE802.11a, and HyperLAN2 for higher speed access have been conducted in various countries.

The MS2681A/2683A/2687B spectrum analyzer delivers optimum performance over a wide dynamic range (156 dB, typical value), wide resolution bandwidth (20 MHz), to high-speed sweep (refresh rate of 20 times/s), required for evaluating next-generation radio communication systems and devices.

It can be used not only as a spectrum analyzer but also to perform various measurements easily and quickly by installing measurement software.

(For further information see page 322)

For Highly Accurate and Stable Optoelectronic Measurements

MN4765A O/E Calibration Module

40 MHz to 65 GHz

The MN4765A is a characterized, unamplified photodiode module. It is used as an optical receiver with the 37200C/37300C series VNAs to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E) to 65 GHz.

The MN4765A consists of an InGaAs photodiode that converts modulated optical signals to electrical signals, and includes additional circuitry for temperature and bias stability. The photodiode has exceptional bandwidth response to 65 GHz and a typical responsivity of 0.7A/W. The MN4765A is characterized for 1550 nm in both magnitude and phase using a NIST derived calibration standard.

(For further information see page 386)

For Performing Precise Calibrations of Vector Network Analyzers

3656 W1 Calibration and Verification Kit

40 MHz to 110 GHz

The 3656 W1 calibration and verification kit consists of precision components that are used to calibrate the ME7808A Broadband Vector Network Analyzer from 40 MHz to 110 GHz at its 1.0 mm coax test ports. The kit supports SOLT calibrations with opens, shorts and loads from 40 MHz to 65 GHz, and Triple Offset short calibrations from 65 to 110 GHz. The two calibrations are concatenated in the VNA, resulting in a continuous, broadband calibration. Two innovative adapters with interchangeable, male or female ends, are provided to facilitate calibrations for measuring non-insertable devices. The kit also includes verification devices for determining system accuracy of the VNA. A diskette containing factory measured test data is supplied for comparison with customer measured data.

(For further information see page 404)

The Ideal Signal Generator

MG3696A Signal Generator

0.1 Hz to 65 GHz / 110 GHz

Your microwave signal generation requirements have never been tougher, and yet your capital equipment budget has never been tighter. You need the most value you can get in a synthesizer, but you can't compromise performance. You need a synthesizer that meets today's needs yet can be upgraded at a reasonable cost to satisfy future requirements without shattering your test equipment budget. Anritsu's MG3690A series of synthesizers deliver the highest performance and the highest value available today.

(For further information see page 427)

For High Speed Modulated and Pulsed Power Measurements

ML2480A Series Wideband Peak Power Meters

10 MHz to 50 GHz*

The ML2480A series Power Meters are especially designed for accurate power measurements on high speed modulated measurements. The power meter combines advances in diode sensor technology with DSP to produce a compact and economical high speed peak power meter. A new color display is used to display the results in graphical or numerical format. The power meter incorporates features normally found in digital oscilloscopes to produce an easy to use high speed peak power meter. A high speed GPIB interface can be used for the rapid automation of the power measurement.

The ML2480A series have been designed to use the new MA2491A Wideband Sensor. The ML2480A is fully compatible with the wide range of Anritsu diode, fast thermal and universal sensors. See the section on the ML2430A Series Power Meters for more details on these sensors.

Two versions of the product are available; the ML2487A Single Input unit and the ML2488A Dual Input unit.

(For further information see page 443)

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* Frequency range is sensor dependent

Ideal for Optical Communication

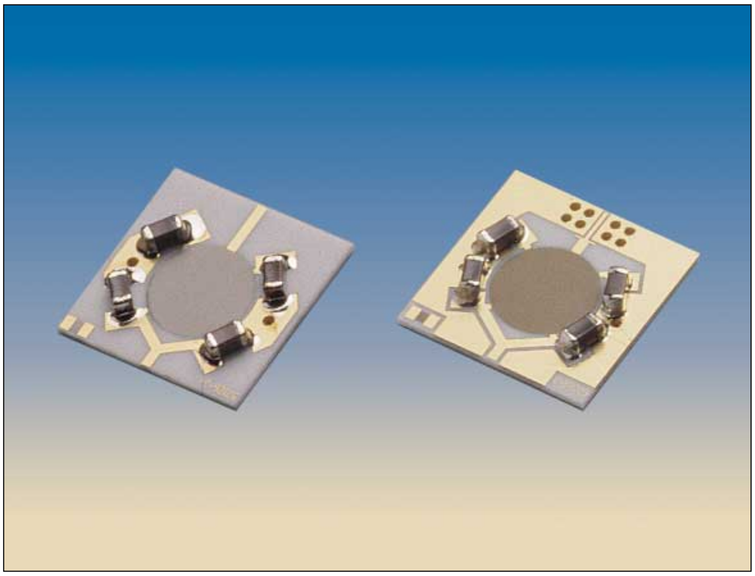
DBT60, DBT60CPW Bias Termination

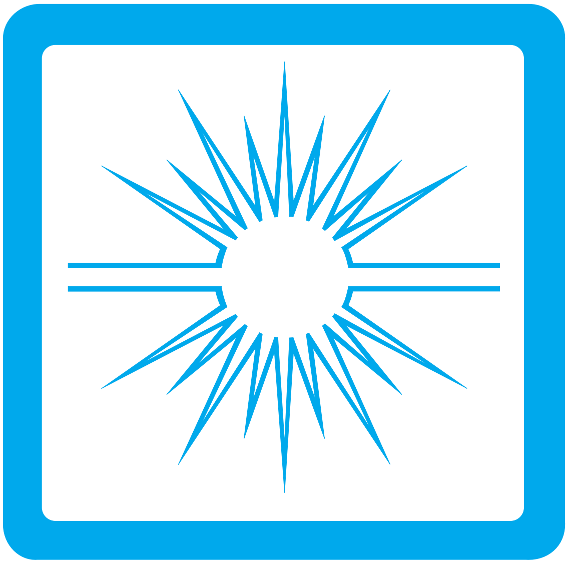
50 kHz to 65 GHz

The Bias Termination is designed to meet the stringent electrical performance requirements and small size of passive components in optical communication networks. A broad bandwidth of 50 kHz to 65 GHz, with very good return loss, makes it ideal to provide DC Bias in 40 Gbps optical modulators. In addition, the small size of the Bias terminations makes integration of the Biasing network easier.

The two different models available are DBT60 and DBT60CPW. Depending on the type of substrate configuration used within an Optical Modulator, one can use the DBT60 for 0.25 mm thick Microstrip or DBT60CPW for 0.25 mm thick CPW substrate. Bias Terminations can be customized to meet customer requirements for different substrate types, substrate thickness, frequency ranges, etc.

(For further information see page 528)





OPTICAL MEASURING INSTRUMENTS

Selection guide

Application Model		Optical power		Light source wavelength		Loss			Optical identification		Optical return loss measurement	Baseband characteristic				Fiber evaluation		Laser diode testing	Others	Remarks
		Low level	Medium/high level	Spectrum	Wavelength	High-loss	High accuracy	Loss-wavelength	Identification	Loss		End-to-end	Loop-back	O/E Converter and waveform	E/O Converter	Fault location	Splice loss			
Optical power meters	ML9001A	√	√			√	√				√						√			–100 to +10 dBm
	ML9002A		√				√				√						√			–70 to +20 dBm
Optical test set	MT9810B	√	√			√	√	√	√	√	√						√			0.75 to 1.7 µm
Multi channel box	MT9812B	√	√				√	√	√	√							√			0.75 to 1.7 µm
Optical loss test set	MS9020D		√				√		√	√	√						√			0.85/1.3/1.55 µm
Optical spectrum analyzer	MS9710B	√	√	√	√	√		√			√							√		0.6 to 1.75 µm
	MS9710C	√	√	√	√	√		√			√							√		0.6 to 1.75 µm
	MS9780A	√	√	√	√	√		√			√							√		0.6 to 1.75 µm
WDM tester	MS9715A	√	√	√	√			√												1.527 to 1.567 µm
Optical time domain reflectometers	MW9060A																√	√		1.31/1.55 µm (SM), 0.85/1.30 µm (GI)
	MW9076 series		√				√		√	√	√						√	√		1.31/1.45/1.55/1.625 µm (SM), 0.85/1.3 µm (GI)
Optical attenuators	MN938A					√														0.85/1.3 µm
	MN9605C					√														1.31/1.55 µm
	MN95D					√														1.3 µm
	MN924C					√														1.3/1.55 µm
Programmable optical attenuator	MN9625A/9626A					√														1.2 to 1.65 µm
Optical channel selectors	MN9662A/9664A/ 9672A/9674A																		√	1.2 to 1.65 µm
Optical directional coupler	MN9604C/D										√								√	1.25 to 1.60 µm
Bare fiber connectors	MA9014A, MP922B																		√	
Fiber adapter	MA9013A																		√	
Optical accessories	Optical fiber cord, adapter, dummy fiber, optical fiber cutter, jacket stripper, mode scrambler																		√	

Optical connector options for Anritsu optical measuring instruments

A variety of optical connectors are used with optical fibers worldwide. Specify the option number, model name, and number of the optical connector from the table below according to the type of optical connector you use. If no specification is made, an FC-type connector will be supplied.

For combinations marked with "√" symbols in the table, the required instrument can be supplied according to the order. For connectors without "√" symbols or which do not appear in the table, consult your sales representative. For measuring equipment with more than one control panel, specify only the connector connected to the measured fiber. Be sure to consult us before ordering, particularly for optical connectors for single-mode fibers, to avoid trouble with connectors not fitting.

Optical connectors may be designed for either flat-polished or PC-polished ends. Some measuring instruments use connectors only for PC-polished ends; consult the literature on the instrument before specifying the connector option.

Model			Connector option number																				
			21	22	23	25	26	27	31	32	33	34	35	37	38	39	40	41	42	43	45	46	47
			NEC D4	AT & T Biconical*1	Amphenol 906*2	FC-APC*3	SC-APC*3	E-2000*1	EC*3	MU	LC	Diamond*4	Amphenol 905	FC-PC*1	ST	DIN 47256	SC	TOCP 172*2	HFS-13/A (GI)*2	HMS-10/A (SM)*1	FC	HFS-25/A	HRL-10 (APC)*3
LED sources (for MS9020D)	MS0901A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MS0902A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MS0903A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MS0904A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MS0906A		√	√	√							√	√	√	√	√	√	√	√	√	√		
LD sources (for MS9020D)	MS0902D													√			√				√		
	MS0903D													√			√				√		
	MS0908A													√*5	√*5	√*5	√*5			√*5			
	MS0909A													√*5	√*5	√*5	√*5			√*5			
Optical power sensors (for ML9002A and MS9020D)	MA9421A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MA9423A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MA9621A		√	√	√							√	√	√	√	√	√		√	√	√		
	MA9721A		√	√	√							√	√	√	√	√	√		√	√	√		
	MA9723A		√	√	√							√	√	√	√	√	√		√	√	√		
Optical power sensors (for ML9001A)	MA9411A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MA9611A		√	√	√							√	√	√	√	√	√		√	√	√		
	MA9612A		√	√										√	√	√	√		√	√	√		
	MA9711A		√	√	√							√	√	√	√	√	√	√	√	√	√		
	MA9712A		√	√	√							√	√	√	√	√	√	√		√	√		
	MA9714B													√*5	√*5	√*5	√*5			√*5			
Optical power sensors (for MS9020D)	MA9622A													√*5	√*5	√*5	√*5			√*5			
Optical power sensors (for MT9810B)	MU931422A								√	√			√	√	√	√			√			
	MU931431A								√	√			√	√	√	√			√			
	MA9331A								√	√			√	√	√	√			√			
	MA9332A								√	√			√	√	√	√			√			
	MA9333A								√	√			√	√	√	√			√			
Optical return loss measuring unit	MS0907A (for MS9020D)													√	√*1	√*1	√*1			√			
Optical test set	MT9810B													√*5	√*5	√*5	√*5			√*5			
Multi channel box	MT9812B													√*5	√*5	√*5	√*5			√*5			
Adapter	MP92B		√	√	√					√	√	√	√	√	√	√	√	√		√	√		
	MA9001B		√	√	√					√	√	√	√	√	√	√	√	√		√	√		
	MA9004A		√	√	√							√	√	√	√	√	√	√	√	√	√	√	
	MA9005A		√	√	√					√	√	√	√	√	√	√	√	√	√	√	√	√	
	MA9005B									√	√			√	√	√	√						
	MA9008A									√	√			√	√	√	√						
	MA9013A		√												√	√	√		√		√		
Optical spectrum analyzer	MS9710B					√	√	√	√					√*5	√*5	√*5	√*5			√*5			√
	MS9710C					√	√	√	√					√*5	√*5	√*5	√*5			√*5			√
	MS9780A							√						√*5	√*5	√*5	√*5			√*5			
WDM tester	MS9715A							√	√					√*5	√*5	√*5	√*5			√*5			
Optical time domain reflectometer	MW9060A	MW0944B	√*5	√								√*5		√	√*5	√*5	√*5			√			√
		MW0945B	√	√								√			√	√	√			√	√		
		MW0947B	√	√								√			√	√	√			√	√		
		MW0967B	√	√	√							√			√	√	√		√		√		
	MW9076 series					√	√							√	√	√	√			√			√
Optical attenuators	MN95D		√	√								√		√	√	√	√		√		√		
	MN924C		√	√								√			√*6	√*6	√*6			√	√*6		
	MN9605C													√*5	√*5	√*5	√*5			√*5			
	MN938A		√	√								√		√	√	√	√		√		√		

Continued on next page

OPTICAL MEASURING INSTRUMENTS

Model		Connector option number																				
		21	22	23	25	26	27	31	32	33	34	35	37	38	39	40	41	42	43	45	46	47
		NEC D4	AT & T Biconical*1	Amphenol 906*2	FC-APC*3	SC-APC*3	E-2000*1	EC*3	MU	LC	Diamond*4	Amphenol 905	FC-PC*1	ST	DIN 47256	SC	TOCP 172*2	HFS-13/A (GI)*2	HMS-10/A (SM)*1	FC	HFS-25/A	HRL-10 (APC)*3
Programmable optical attenuator	MN9625A/9626A				√	√							√	√	√	√			√	√		√
Optical channel selectors	MN9662A/9664A/9672A/ 9674A												√*5	√*5	√*5	√*5			√*5			√
Optical direc-tional coupler	MN9604C												√	√	√	√			√			
	MN9604D				√	√																√
Optical fiber cord for baseband measurements		√																		√		
Dummy fiber cord for optical loss measurements		√											√							√		
Mode scrambler	MZ106C												√			√				√		

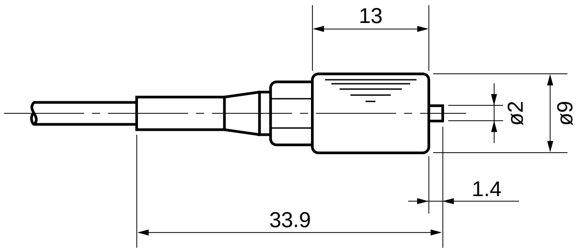
*1: Ferrule type; PC
*2: Ferrule type; Flat
*3: Ferrule type; APC (angled PC)
*4: Ferrule diameter; 3.5 mm, M9 x 0.5 screw
*5: Ferrule type; PC (user replaceable and cleanable)
*6: Ferrule type; Flat (user replaceable and cleanable)

No marking: Ferrule type; Flat and PC.

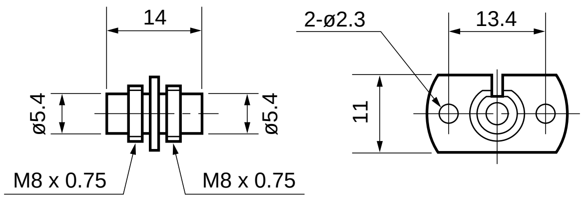
Unit in mm

Option 21: Type D4 connector (flat, convex: PC)

Plug

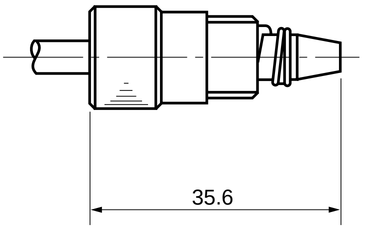


Adapter

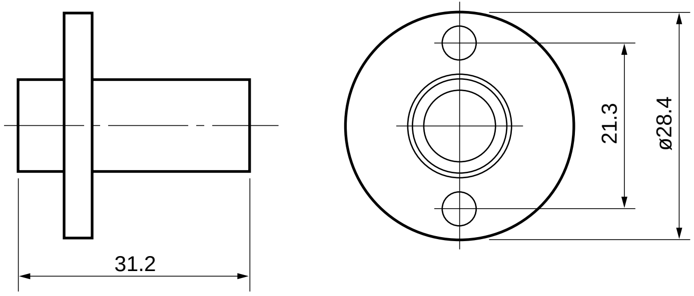


Option 22: AT&T Biconical connector (convex: PC)

Plug

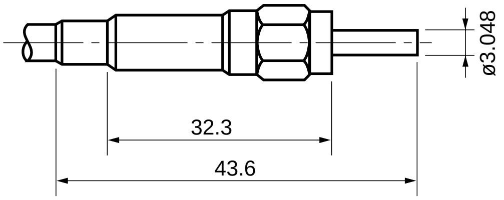


Adapter

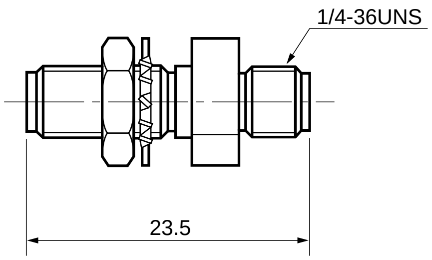


Option 23: Amphenol type 906 connector (flat)

Plug

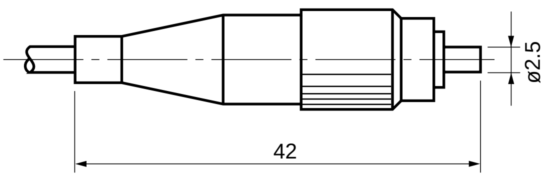


Adapter

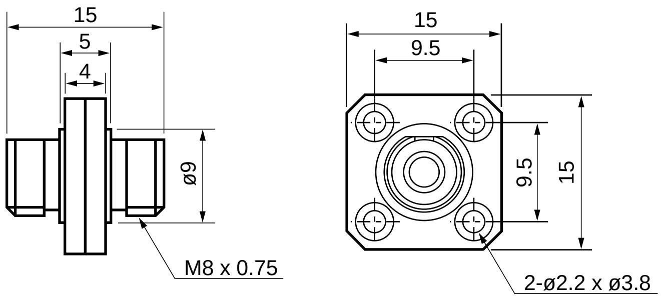


Option 25: FC-APC (angled convex), Option 37: FC-PC (convex)
Option 45: FC (flat)

Plug



Adapter

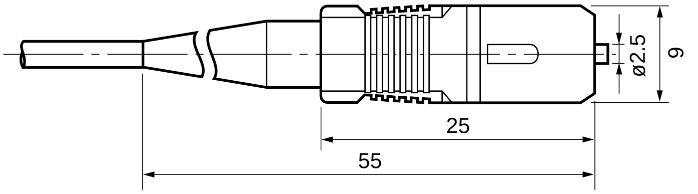


Unit in mm

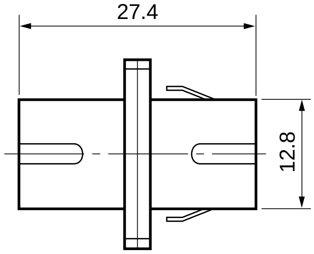
Option 26: SC-APC (angled convex)

Option 40: SC connector (flat, convex: PC)

Plug

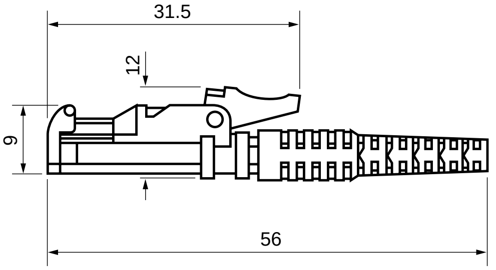


Adapter

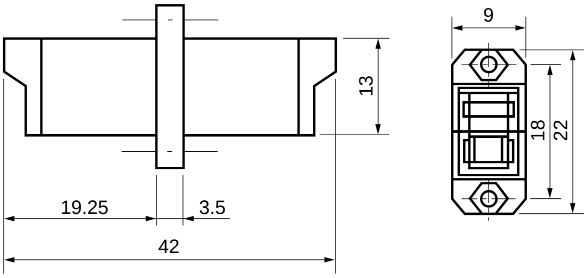


Option 27: E-2000 (convex: PC, angled convex: APC)

Plug

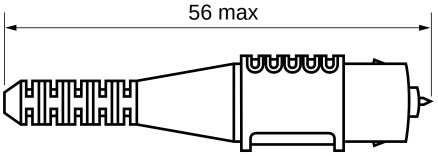


Adapter

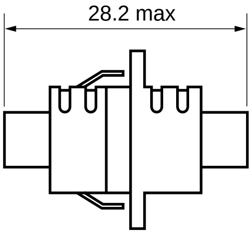


Option 31: EC (angled convex: APC)

Plug

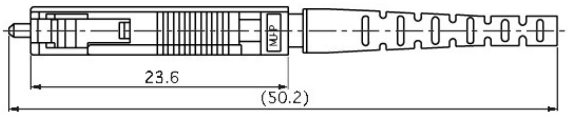


Adapter

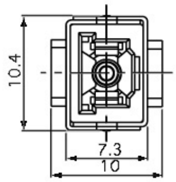


Option 32: MU

Plug



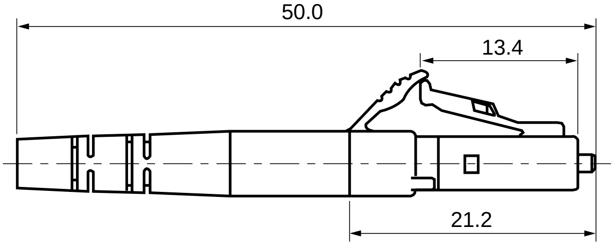
Adapter



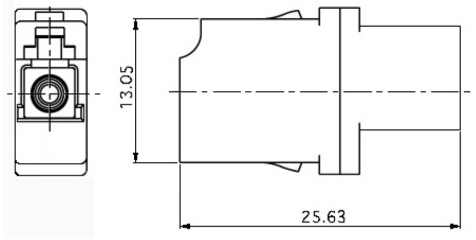
Unit in mm

Option 33: LC

Plug



Adapter

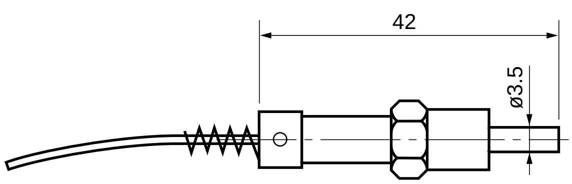


Option 34: Diamond connector

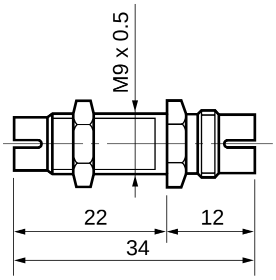
GI: HFS-3 (flat)

SM: HMS-0 (convex: PC)

Plug



Adapter

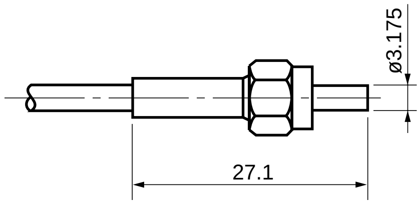


Option 35: Amphenol type 905 connector, HP SMA connector

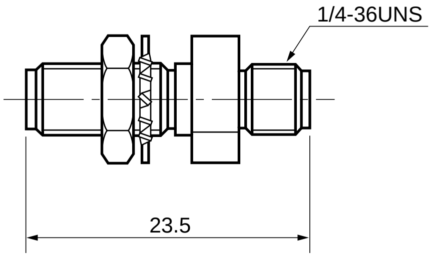
Amphenol type 905: Flat

HP SMA: Convex (PC)

Plug

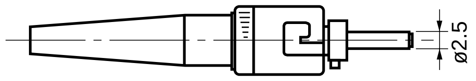


Adapter

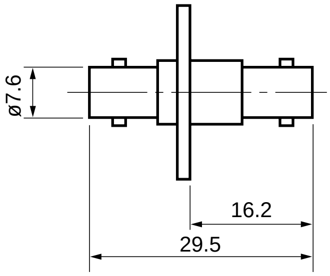


Option 38: ST connector (flat, convex: PC)

Plug

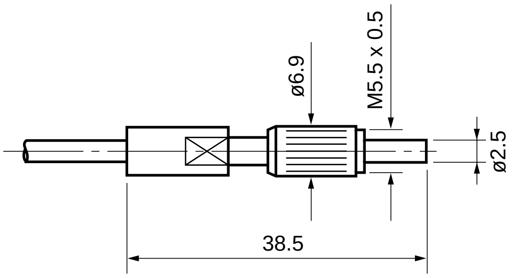


Adapter

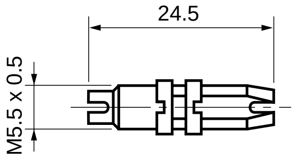


Option 39: DIN connector (flat, convex: PC)
Option 47: HRL-10 (angled convex)

Plug

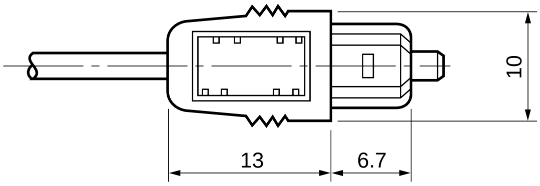


Adapter



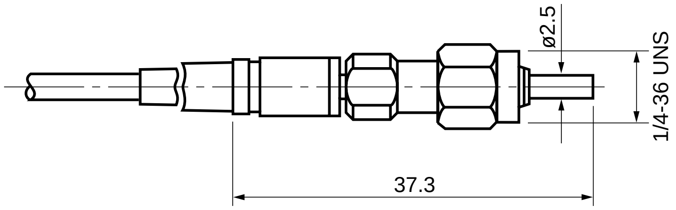
Option 41: TOCP 172 (flat)

Plug

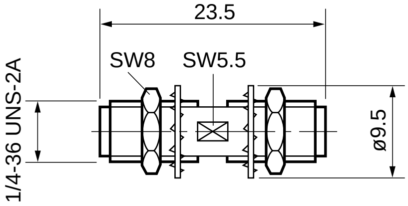


Option 42: HFS-13/A (GI, flat)

Plug

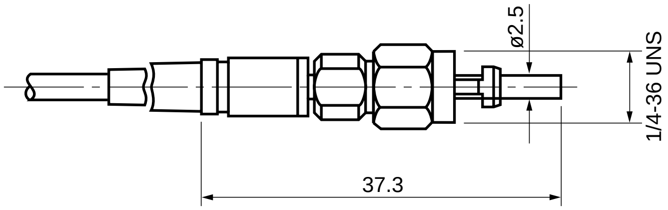


Adapter

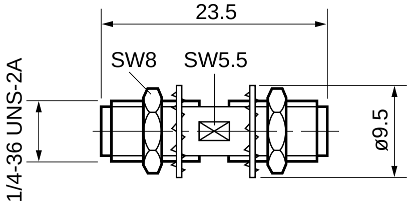


Option 43: HMS-10/A (SM, convex: PC)

Plug

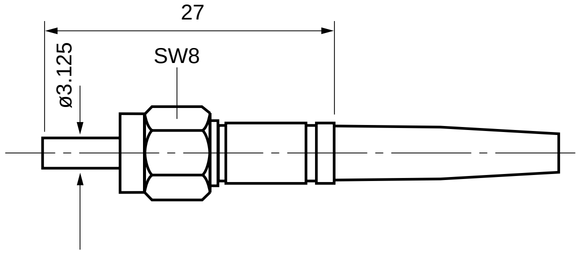


Adapter

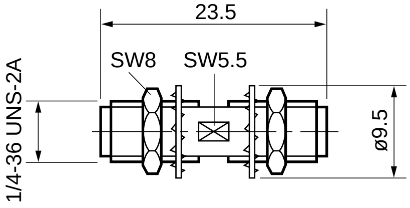


Option 46: HMS-25/A

Plug



Adapter



OPTICAL POWER METER

ML9001A

0.38 to 1.8 μm

GPIB

A Variety of Optical Sensors such as Si, Ge and InGas

The ML9001A is a single-channel digital-display optical power meter. It ensures accuracy and linearity over a wide wavelength range and greatly improves measurement reliability. It also has an improved basic performance. For example, measurements can be made over the wide level range from –100 to +20 dBm because internal reflection in the power sensors has been suppressed. The ML9001A also has many new functions that make it easier to use than other power meters. It can be used for all optical power measurements such as optical fiber loss measurement and optical device performance evaluation.

Features

- **Enables high-accuracy measurement**

The ML9001A accurately and automatically calibrates all the power sensors within the specified wavelength range and ensures a ±5% accuracy at –23 dBm. It also has a ±0.15 dB linearity (–23 dBm reference value). The ML9001A extends the guaranteed accuracy range of the measured values and enables high-accuracy measurement.

- **One power sensor for repeater maintenance and long-distance fiber loss measurement**

The MA9612A Optical Power Sensor has ultra-high sensitivity. Its measurement level range is –100 to ±3 dBm in the 1.3 μm band and it can sense either continuous light or modulated light. A single MA9612A can measure the near-end and far-end outputs of a repeater as well as measure long-distance fiber losses.

- **Interchangeable optical connectors**

The optical connectors of all the power sensors accept adapters. This system allows the optical connectors to be interchanged so the ML9001A can be quickly used with various optical connectors. Since the internal coating of the optical power sensors suppresses reflected light, measurement errors are reduced in beam measurement (with or without an optical fiber).

- **Reduced measurement time**

The ML9001A has a much better response speed and stability than conventional optical power meters. With GPIB, it can measure at 30 ms/point so the measurement time can be reduced to less than 50% of conventional automatic measurement.

Specifications

- **ML9001A Optical Power Meter**

Indicator

Display	4 digit, W, W$_{(REL)}$, dBm, dB$_{(REL)}$ selectable
Calibration coefficient	Adjustable
Recorder output	1 V/full-scale, linear output
Range select	Manual selection and automatic ranging
Measurement mode	Continuous and modulated light*1
Wavelength sensitivity correction	Automatic correction in 1 nm steps
Data memory	Max. 1000 data via GPIB
Dimensions and mass	213 (W) x 88 (H) x 250 (D) mm, ≤4 kg

Sensor

Model	MA9411A	MA9611A	MA9612A
Wavelength range	0.38 to 1.15 µm	0.75 to 1.7 µm	
Element	Si photodiode	InGaAs photodiode	
Active area diameter	9.5 mm	–	
Input type	Direct to photodiode	Connector[*2]	
Dimensions and mass	40 (W) x 32 (H) x 62/73 (D) mm, ≤400 g	40 (W) x 32 (H) x 65 (D) mm, ≤400 g	61 (W) x 42 (H) x 110 (D) mm, ≤800 g

Model	MA9711A/A1	MA9712A	MA9714B
Wavelength range	0.75 to 1.8 µm		
Element	Ge photodiode	Cooled-Ge photodiode	
Active area diameter	5 mm		–
Input type	Direct to photodiode		Connector[*3]
Dimensions and mass	40 (W) x 32 (H) x 62/73 (D) mm, ≤400 g	42 (W) x 47 (H) x 110 (D) mm, ≤500 g	47 (W) x 61 (H) x 128 (D) mm, ≤800 g

Overall

Model		MA9411A	MA9611A	MA9612A
Optical power measurement range	Continuous light	–70 to +10 dBm[*4] (0.1 nW to 10 mW)	–70 to +3 dBm[*5] (0.1 nW to 2 mW)	–100 to +3 dBm[*5] (0.1 pW to 2 mW)
	Modulated light	–70 to +7 dBm[*6] (0.1 nW to 5 mW)	–80 to 0 dBm[*7] (10 pW to 1 mW)	–90 to 0 dBm[*7] (1 pW to 1 mW)
Measurement accuracy	Absolute accuracy (–23 dBm)	±5%[*8] (0.5 to 0.95 µm)	±5%[*9] (1.0 to 1.6 µm)	
	Linearity continuous light: 23°C, –23 dBm as reference	±0.15 dB[*10] (±0.45 dB for –70 to –60 dBm)	±0.15 dB[*10] (±0.45 dB for –70 to –60 dBm)	±0.15 dB[*10] (±0.45 dB for –90 to –80 dBm)
Resolution		W, W (REL) display: 0.1 to 1%, dBm display: 0.01 dB, dB (REL) display: 0.001 dB		
Power		100/115/120/200/220 Vac $^{+10}_{-15}$ %, 240 Vac $^{+4}_{-15}$ %, 50/60/400 Hz, ≤40 VA		
Operating temperature		0° to 50°C		
EMC[*11]		EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class D), EN61326: 1997/A1: 1998 (Annex A)		
LVD		EN610101-1: 1993/A2, 1995 (Installation Category Ⅱ, Pollution degree 2)		

Model		MA9711A/A1	MA9712A	MA9714B
Optical power measurement range	Continuous light	–40 to +10 dBm[*5] (0.1 µW to 10 mW)	–60 to +10 dBm[*5] (1 nW to 10 mW)	–47 to +23 dBm[*12] (20 nW to 200 mW)
	Modulated light	–60 to +7 dBm[*7] (1 nW to 5 mW)	–70 to +7 dBm[*7] (0.1 nW to 5 mW)	–57 to +20 dBm[*13] (2 nW to 100 mW)
Measurement accuracy	Absolute accuracy (–23 dBm)	±5%[*9] (0.95 to 1.5 µm)	±4.5% (1.3 µm) ±5%(0.95 to 1.6 µm)	±4.5% (1.55 µm)[*14] ±5%(0.95 to 1.6 µm)[*15]
	Linearity continuous light: 23°C, –23 dBm as reference	±0.15 dB[*10] (±0.45 dB for –40 to –30 dBm)	±0.15 dB[*10] (±0.45 dB for –60 to –50 dBm)	±0.15 dB[*16](–37 to +20 dBm, ±0.45 dBm for –47 to –37 dBm)
Resolution		W, W (REL) display: 0.1 to 1%, dBm display: 0.01 dB, dB (REL) display: 0.001 dB		
Power		100/115/120/200/220 Vac $^{+10}_{-15}$ %, 240 Vac $^{+4}_{-15}$ %, 50/60/400 Hz, ≤40 VA		
Operating temperature		0° to 50°C		
EMC[*11]		EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class D), EN61326: 1997/A1: 1998 (Annex A)		
LVD		EN610101-1: 1993/A2, 1995 (Installation Category Ⅱ, Pollution degree 2)		

[*1] Twelve modulation frequencies including 270 Hz and 1 kHz
[*2] FC-type connector standard
[*3] Only for PC type SM fiber (10/125 µm, NA 0.1)
[*4] At 0.85 µm
[*5] At 1.3 µm
[*6] At 0.85 µm, 270 Hz
[*7] At 1.3 µm, 270 Hz
[*8] For wavelengths other than 0.85 µm, specified at 23° ±5°C
[*9] For wavelengths other than 1.3 µm, specified at 23° ±5°C
[*10] At 23° ±5°C
[*11] Electromagnetic compatibility
[*12] At 1.55 µm
[*13] At 1.55 µm, 270 Hz
[*14] At 1.55 µm, 0 dBm
[*15] At 0 dBm
[*16] Reference = 0 dBm

Note:
When an optical fiber is used, performance is guaranteed for a fiber core diameter of up to 62.5 m and an NA of up to 0.29.
When any other fiber is used, a measurement error may occur.

• Optical connector options

Option No.	Optical connector
21	D4
22	RUNGE
23[*1]	Amphenol 906 type
34	DIAMOND (ø 3.5)
35[*1]	HP-SMA, Amphenol 905 type
38	ST
39	DIN
40	SC
41[*2]	TOCP172
43	HMS-10/A
45	FC

*1: If adapter mounted on 9612A, repeatability may be reduced.
*2: For MA9411A

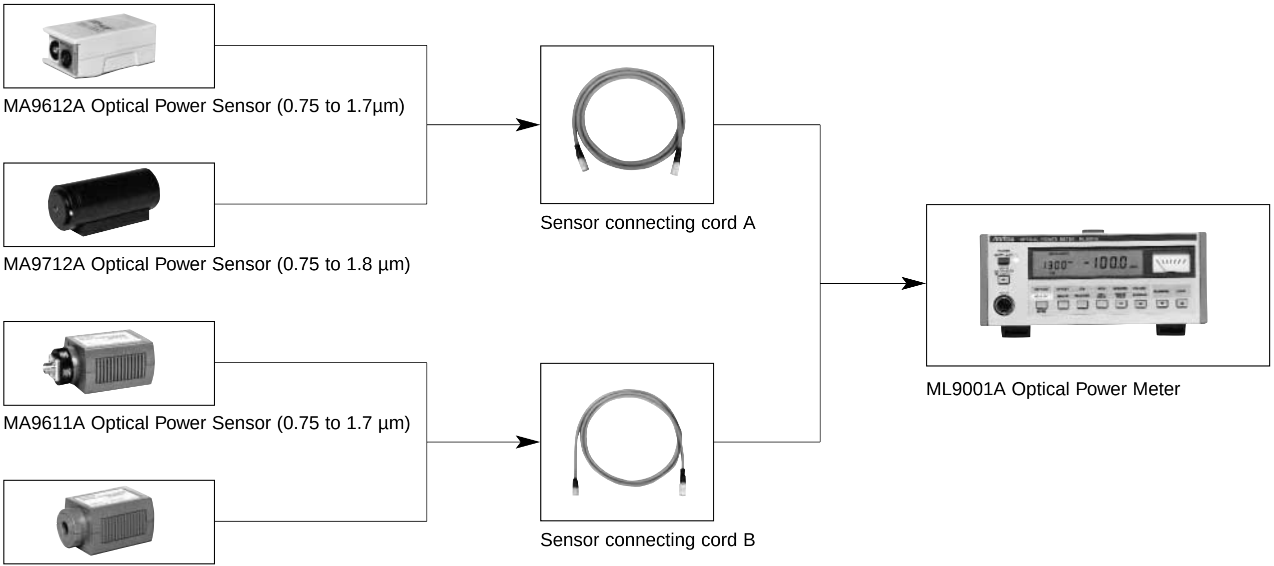
Ordering information

Please specify model/order number, name, and quantity when ordering.

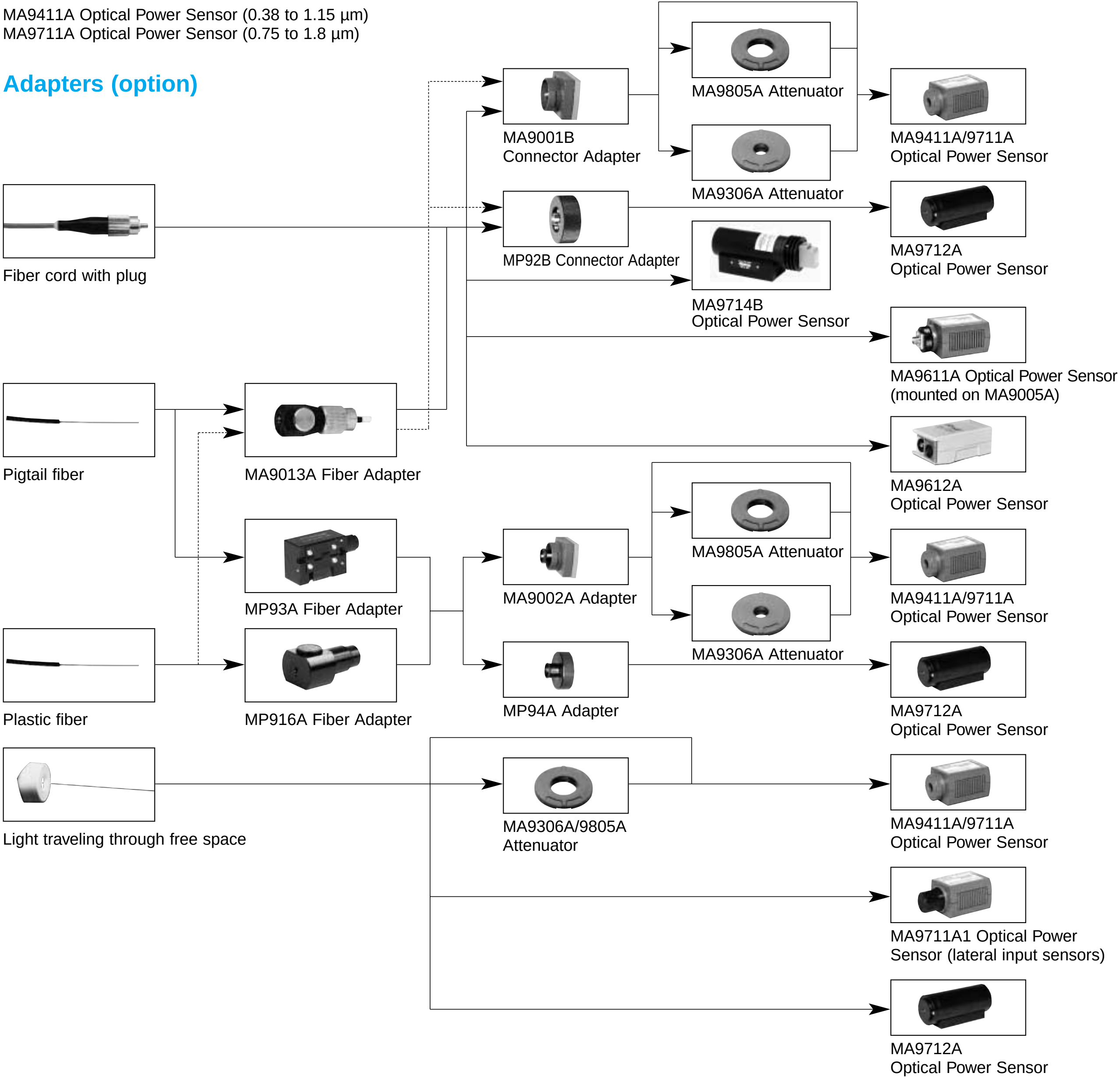
Model/order No.	Name
	Main frame
ML9001A	Optical Power Meter
	Standard accessories (for ML9001A)
J0313	Sensor connecting cord A, 2 m (for 9612A/9712A/9714B): 1 pc
J0314	Sensor connecting cord B, 2 m (for MA9411A/A1, MA9611A and MA9711A/A1): 1 pc
	Power cord, 2.5 m: 1 pc
F0004	Fuse, 0.4 A (T400MA250V): 2 pcs
F0007	Fuse, 0.8 A (T800MA250V): 2 pcs
W0420AE	ML9001A operation manual: 1 copy
W0420BE	ML9001A service manual: 1 copy
	Optical power sensors
MA9411A[*1]	Optical Power Sensor
MA9611A	Optical Power Sensor (with MA9005A connector adapter)
MA9612A	Optical Power Sensor (with J0480A connector adapter)
MA9711A/A1[*1]	Optical Power Sensor
MA9712A	Optical Power Sensor
MA9714B[*2]	Optical Power Sensor
	Optional accessories
MA9001B[*3]	Connector Adapter (FC type, for MA9411A/MA9711A)
J0480B[*3]	Connector adapter (FC type, for MA9612A)
MA9005A[*3]	Connector Adapter (FC type, for MA9611A)
MP92B[*3]	Connector Adapter (FC type, for MA9712A)
MA9013A[*3]	Fiber Adapter (with FC type plug, for fibers with 125 µm clad dia., 0.25 to 1.0 mm jacket dia.)
MP916A	Fiber Adapter (for MA9002A and MP94A, for plastic fiber with 1 mm dia.)
MP93A	Fiber Adapter (≤150 µm clad dia., 0.8 to 1.0 mm jacket dia.)
MP94A	Adapter (for MA9712A, used with MP93A)
MA9002A	Adapter (for MA9411A/MA9711A, used with MP93A)
MA9805A	Optical Attenuator (for MA9411A, 10 dB)
MA9306A	Optical Attenuator (for MA9711A, 10 dB)
MZ8010A	Optical Sensor Holder (securely mounts MA9411A or MA9711A/A1 for measuring light traveling through free space)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0186	Front cover
J0617B[*4]	Replaceable optical connector (FC)
J0618D[*4]	Replaceable optical connector (ST)
J0618E[*4]	Replaceable optical connector (DIN)
J0618F[*4]	Replaceable optical connector (HMS-10/A)
J0619B[*4]	Replaceable optical connector (SC)
J0741A	Replaceable ferrule (for MA9714B)
Z0282	Ferrule cleaner (Cletop A type, 1 pc)
Z0283	Tape for ferrule cleaner (6 pcs/set, for Z0282)
Z0284	Cleaner for optical adapter (stick-type, 200 pcs/set)

*1: MA9711A1 is lateral input sensors.
*2: Specify one of FC, ST, DIN, SC or HMS-10A (DIAMOND). When the connector type is not specified, FC is supplied.
*3: The optical connector of the standard product is FC. Please specify the option numbers along with model names shown in the tables, if you need a different optical connector.
*4: For MA9714B

ML9001A with sensor



Adapters (option)



OPTICAL HANDY POWER METER
ML9002A
0.38 to 1.8 µm

For Easy Optical Power Measurement

The ML9002A is a compact handy power meter with a measurement level as wide as other more expensive instruments. Six optical sensors are available for different wavelengths, measurement levels, and optical input types. Each can be calibrated for three common wavelengths so absolute optical power can be read directly. Each optical sensor can either be incorporated directly in the main frame or connected using a connecting cord. The ML9002A can be used to check optical disks, optical printers and optical communications systems and can back-up on-side operations as a powerful multifunctional measuring instrument for maintenance.

Features

- **Accurate optical power measurement**

The power of a narrow beam can be accurately measured even when an adapter is changed because anti-reflection optical sensor is used.

- **Long-distance measurement with wide measurement level range**

An unprecedented wide measurement level has been achieved in this handy optical power meter. Optical power of –70 to +3 dBm (MA9621A Optical Power Sensor) in the 1.3 µm band and –70 to +10 dBm (MA9423A Optical Power Sensor) in the 0.85 µm band can be measured.

- **Direct absolute power readings for three wavelengths**

Each optical sensor is calibrated at three wavelengths (0.633/0.78/0.85 µm or 0.66/0.78/0.85 µm for short wavelengths, and 0.85/1.3/1.55 µm for long wavelengths). The absolute power is indicated automatically just by switching to the measured wavelength.

- **Flexible measurements**

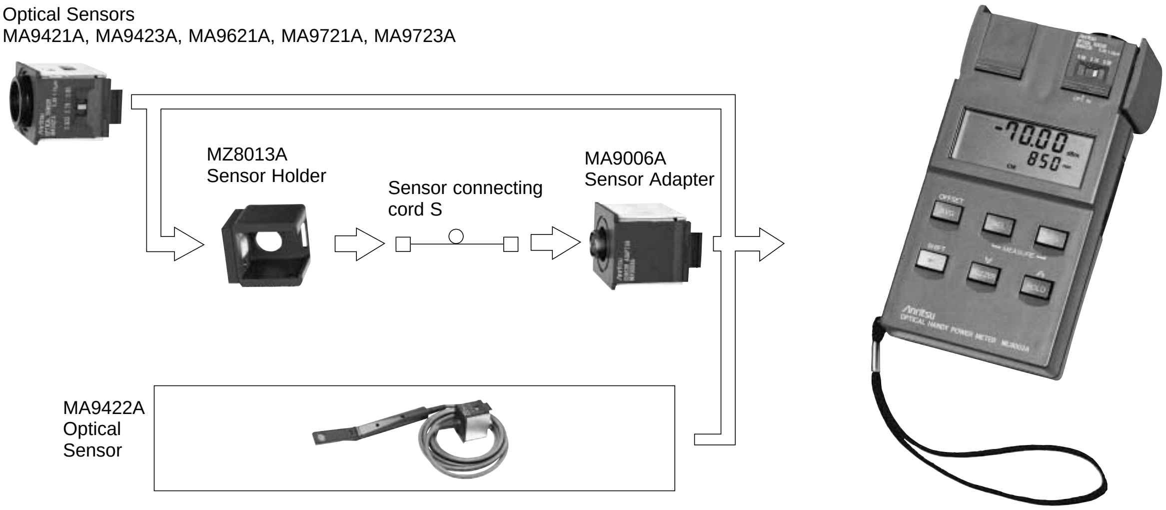
Two types of connections, a plug-in system (sensor incorporated into main frame) or a cord system (sensor connected using connecting cord), are possible so that measurement capabilities are flexible.

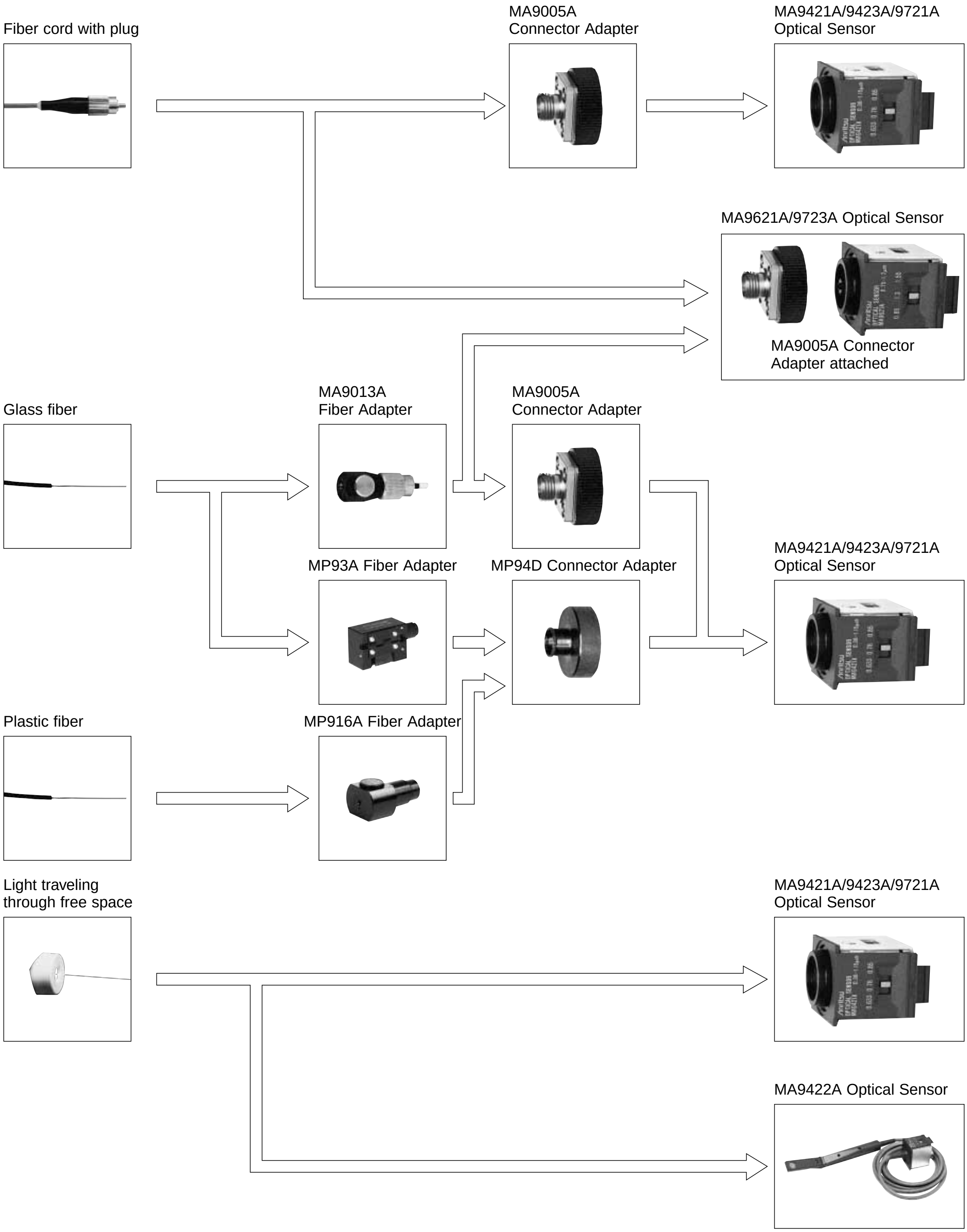
- **Monitoring without cutting optical fiber**

The optical power in an optical fiber cable (ø0.25 mm, UV-coated fiber) can be measured by using the Optical Power Sensor.

- **Compatible with various connectors**

The ML9002A can be quickly connected to FC, D4, RUNGE, ST, DIN, DIAMOND, and SC connectors just by replacing the connector adapter.




Fiber cord with plug
MA9005A
Connector Adapter
MA9421A/9423A/9721A
Optical Sensor
MA9621A/9723A Optical Sensor
MA9005A Connector
Adapter attached
Glass fiber
MA9013A
Fiber Adapter
MA9005A
Connector Adapter
MP93A Fiber Adapter
MP94D Connector Adapter
MA9421A/9423A/9721A
Optical Sensor
Plastic fiber
MP916A Fiber Adapter
Light traveling
through free space
MA9421A/9423A/9721A
Optical Sensor
MA9422A Optical Sensor

Specifications

Main frame	Unit display	W, W(REL), dBm, and dB(REL), selectable, 4 digits					
	Recorder output	1 V/full-scale, 0.316 V/–5 dB					
	Averaging	ON/OFF settings					
	Range hold	Range settings					
	Buzzer	1 dB sound threshold level setting					
	Auto power off	After 5 minutes non-use (with internal Ni-Cd battery)					
	Dimensions and mass	90 (W) x 196 (H) x 38 (D) mm, ≤700 g					
Sensors	Model	MA9421A	MA9422A	MA9423A	MA9621A	MA9721A	MA9723A
	Wavelength (µm)	0.38 to 1.15			0.75 to 1.7	0.75 to 1.8	
	Element	Si photodiode			InGaAs photodiode	Ge photodiode	
	Active area diameter	9.5 mm	9 mm	9.5 mm	1 mm	5 mm	1 mm
	Input	Direct			FC connector adapter[*1]	Direct	FC connector adapter[*1]
	Measurement range (dBm)	–60 to +20 (at 0.85 µm)	–50 to +20 (at 0.85 µm)	–70 to +10 (at 0.85 µm)	–70 to +3 (at 1.3 µm)	–40 to +10 (at 1.3 µm)	–60 to +3 (at 1.3 µm, 0° to 40°C)
	Dimensions and mass	30 (W) x 30 (H) x 37 (D) mm, ≤100 g	15 (W) x 16 (H) x 140 (D) mm, ≤200 g	30 (W) x 30 (H) x 37 (D) mm, ≤100 g			
Overall	Measurement accuracy	±5% (–10 dBm, CW mode)				±5% (–10 dBm, CW mode)[*3]	
	Calibration wavelength	0.633/0.78/0.85 µm		0.66/0.78/0.85 µm	0.85/1.3/1.55 µm		
	Measurement resolution	W/W(REL): 0.1 to 1%, dBm/dB(REL): 0.01 dB					
	Operating hours	20 hr or more, floating operation possible (on internal Ni-Cd battery)					
	Temperature range	Operating: 0° to +50°C, Storage: –30° to +50°C, Recharging: +10° to +45°C					
	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class D) EN61326: 1997/A1: 1998 (Annex A)					
	LVD	EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)					

∗1: Used for NA ≤0.29 core diameter fiber ≤62.5 µm
∗2: Used for 0.25 µm jacket diameter fiber
∗3: For 1.55 µm wavelength, it is specified at 23° ±5°C

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
ML9002A	Optical Handy Power Meter	
	Optical sensors	
MA9421A	Optical Sensor	
MA9422A	Optical Sensor (Thin sensor)	
MA9423A	Optical Sensor	
MA9621A	Optical Sensor (MA9005A Connector Adapter attached)	
MA9721A	Optical Sensor	
MA9723A	Optical Sensor (MA9005A Connector Adapter attached)	
	Standard accessories	
Z0178	AC adapter:	1 pc
	Power cord, 2.5 m:	1 pc
B0232	Blank panel:	1 pc
W0400CE	ML9002A instruction manual:	1 copy
J0477	Auto-power-off override plug:	1 pc
	Optional accessories	
MA9005A[*]	Connector Adapter (for optical sensor)	
MA9006A	Sensor Adapter (for sensor connecting cord S/T)	
MP93A	Fiber Adapter (≤150 µm clad dia., 0.8 to 1.0 mm jacket dia.)	
MP94D	Connector Adapter (for MP93A and MP916A)	
MA9013A	Fiber Adapter	
MZ8013A	Sensor Holder	
J0056B	FC-FC-2M-SM (FC optical fiber cord, 2 m, SM)	
J0200B	FC-FC-2M-GI (FC optical fiber cord, 2 m, GI)	
J0436	Sensor connecting cord S (for ML9002A sensors)	
J0438	Recorder output cord	
Z0179	Carrying case (with shoulder strap)	
Z0182	Soft case	
B0234	Battery box	

∗: Choose from the options listed in the following table when ordering non-FC optical connector.

Optical connector options table

Option No.	Optical connector
21	D4
22	RUNGE
23	Amphenol Type 906
24	OF-2
34	DIAMOND[*1]
35	HP-SMA, Amphenol Type 905
38	ST
39	DIN
40	SC
41	TOCP172[*2]

∗1: 3.5 mm diameter ferule, M9 screw
∗2: For MA9421A, MA9423A only

OPTICAL LOSS TEST SET
MS9020D

CE

For Measuring Optical Loss and Checking Optical Parts

The MS9020D is a handy optical measuring instrument that incorporates an LD or an LED light source and an optical power meter. It can also be used for return loss measurement. Every unit of the LD light source (4 types), LED source (5 types), the sensors (7 types) and the return loss measurement unit (1 type) is a plug-in type, for easy exchange and highest suitability for field use.
The MS9020D covers 0.66 µm, 0.85 µm, 1.3 µm, and 1.55 µm bands for optical loss measurement. In addition to the CW mode, it provides a modulated light mode with 270 Hz, 1 kHz, and 2 kHz modulation signals. Therefore, it is possible to measure optical loss over a wide dynamic range without stray light effect. This is the most suitable for single mode fiber measurement. For return loss, 1.3 µm band single mode fibers can be measured in the 0 to 40 dB range. As a power meter, every sensor has a wavelength calibration function of 5 nm steps at 3 wavelengths, so absolute values can be read directly.

Features

- Measures optical loss up to 67 dB
- Measures CW and modulated light
- Provides calibration function of 5 nm steps at 3 wavelengths
- Also measures optical return loss (0 to 40 dB)
- Operates in 3 modes; AC, rechargeable battery, and dry cells
- Various connectors

Applications

- **Optical fiber loss measurement**

When measuring optical fibers, it is convenient to provide one MS9020D each at both the near and far ends. By using switchable light source units (MS0904A, MS0909A), one-touch measurement of 0.85/1.3 µm and 1.3/1.55 µm can be done.
More accurate loss measurement is possible by using the modulated light function. When an LD light source is used, it is possible to measure optical loss up to 67 dB.

- **Optical parts performance check**

A light source and optical power meter are provided, and an optical parts performance check is possible at low cost.

- **Optical return loss measurement**

Return loss of connectors or optical devices can be measured easily using return loss measuring units.

Specifications

- **MS9020D (mainframe)**

Unit display	W, W $_{(REL)}$, dBm, dB $_{(REL)}$ selectable, 4 digits
Measurement resolution	W/W $_{(REL)}$ display: 0.1 to 1%, dBm/dB $_{(REL)}$ display: 0.01/0.1 dB, Blanking is possible.
Auto power off	Power turns off automatically after 5 minutes of no adjustment
Recorder output	1 V (on full-scale display), 0.316 V (on –5 dB from full-scale)
Battery alarm	Down-side part flickers when battery voltage goes down.
Auto offset	Sensor zero point is adjusted automatically.
Back light	Display section back light can be set on and off.
Averaging	On and off selectable
Range hold	Range can be specified and set to be on and off.
Reference value input	Used to input the loss point reference value
Buzzer	Sound when input level is higher than set reference level in 1 dB steps
Wavelength sensitivity characteristics compensation	Deviation of optical power sensor is compensated automatically in 5 nm steps.

Continued on next page

Resume function	At power on, the state when the power is just turned off is restored.
Backup	Setting condition is backed up for 30 minutes, when the line voltage is zero at exchanging batteries for example.
Modulation	CW, 270 Hz, 1 kHz, 2 kHz (2 kHz is for MA9621A only)
Power	Operation is possible using AC adapter, Ni-Cd battery [Operation hour: 4-hour for outputting light, No operation hour: 9-hour for light is turned off (when fully charged after new battery fully discharged), Charge time: 6-hour], UM-3 Alkali/Manganese battery[*1] (Require 4 pcs. Operation hour is equivalent with Ni-Cd battery at 25˚C.)
Temperature range	0˚ to 50˚C (use), 10˚ to 45˚C (at charging), –30˚ to +50˚C (storage)
Dimensions and mass	90 (W) x 190 (H) x 38 (D) mm, ≤700 g
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class D), EN61326: 1997/A1: 1998 (Annex A)
LVD	EN610101-1: 1993/A2, 1995 (Installation Category Ⅱ, Pollution degree 2)

∗1: Optional accessories

- **Light sources**

Model	MS0901A[*1]	MS0902A[*1]	MS0903A[*1]	MS0904A[*1]
Applicable fiber	GI	SM, GI		
Element	LED			
Wavelength (µm)	0.85 ±0.03	1.3 ±0.03	1.55 ±0.035	1.3 ±0.03 1.55 ±0.035
Spectral half-width (nm)	≤60	≤140	≤210	≤140 (1.3 µm) ≤210 (1.55 µm)
Optical output level: CW mode (dBm)[*2]	≥–20[*3]	≥–20[*3] ≥–40[*4]	≥–25[*3] ≥–45[*4]	≥–22 (1.3 µm)[*3] ≥–27 (1.55 µm)[*3] ≥–42 (1.3 µm)[*4] ≥–47 (1.55 µm)[*4]
Stability[*2,*5]	≤0.3 dB			
Short-term stability[*2,*6]	≤0.04 dB			
Internal modulation	Frequency: 270 Hz/1 kHz/2 kHz±1.5%, Square wave (duty factor: 45 to 55%)			
Optical connector[*7]	FC, ST, DIN, HMS-10/A, SC type connector adapter			
Temperature range	0˚ to 50˚C (use), –40˚ to +70˚C (storage)			
Dimensions and mass	30 (W) x 30 (H) x 37 (D) mm, ≤200 g			

Model	MS0906A[*8]	MS0902D[*9,*10]	MS0903D[*9,*10]	MS0908A[*11,*12]	MS0909A[*9,*11]
Applicable fiber	GI, SM	SM		SM (ITU-T G.652)	
Element	LED	FP-LD		FP-LD	
Wavelength (µm)	0.85 ±0.03 1.30 ±0.03	1.31 ±0.025[*13]	1.55 ±0.025[*13]	0.635 ±0.010[*13]	1.31 ±0.02[*13] 1.55 ±0.02[*13]
Spectral half-width (nm)	≤60 (0.85 µm) ≤140 (1.30 µm)	≤5[*13]	≤10[*13]	≤5[*13]	≤5 (1.31 µm)[*13] ≤10 (1.55 µm)[*13]
Optical output level: CW mode (dBm)[*2]	≥22 (0.85/1.3 µm)[*3] ≥–42 (1.3 µm)[*4]	–3±1[*4,*13]		–3±1[*13,*14]	≥–3[*13,*14]
Stability[*2,*5]	≤0.3 dB	±0.5 dB[*4]		±2 dB[*2,*14,*15]	±0.5 dB[*2,*5,*14]
Short-term stability[*2,*6]	≤0.04 dB	±0.05 dB[*4]		–	±0.05 dB[*2,*6,*14]
Internal modulation	Frequency: 270 Hz/1 kHz/2 kHz±1.5%, Square wave (duty factor: 45 to 55%)			Flickering light function (3 steps)	Frequency: 270 Hz/ 1 kHz/2 kHz ±1.5% Duty: 45 to 55%
Optical connector[*7]	FC, ST, DIN, HMS-10/A, SC type connector adapter	FC or SC type integrated with connector[*16]		Replaceable connector, PC polish (FC, ST, DIN, HMS-10A, SC)	
Temperature range	0˚ to 50˚C (use), –40˚ to +70˚C (storage)			0˚ to 40˚C (use), –40˚ to +70˚C (storage)	0˚ to 50˚C (use), –40˚ to +70˚C (storage)
Dimensions and mass	30 (W) x 30 (H) x 37 (D) mm, ≤200 g			90 (W) x 133 (H) x 38 (D) mm, ≤300 g	90 (W) x 133 (H) x 38 (D) mm, ≤500 g

∗1: Installed in MS9020A/B/C/D
∗2: Used with FC-type connectors
∗3: When connected with Anritsu GI fiber (50/125 µm, NA 0.2, 2 m)
∗4: When connected with Anritsu SM fiber (10/125 µm, NA 0.1, 2 m)
∗5: CW, 0˚ to 50˚C (5 hour)
∗6: CW, at ±1˚C (1 minute) within 0˚ to 50˚C
∗7: Specify one connector among those shown in the specification table. When no connector and manufacturer's name are specified, FC-type will be mounted and supplied.
Other than the connectors indicated in the table are dealt in special connectors of custom-made. The ordering method of optical connectors are indicated in the table on page 39.
∗8: Installed in MS9020B/C/D
∗9: Laser Product Safety Standards: Class-1 (IEC Pub. 825, FDA 21CFR)
∗10: Installed in MS9020C/D
∗11: Installed in MS9020D
∗12: Laser Product Safety Standards: Class-2 (IEC Pub. 825, FDA 21CFR)
∗13: CW, 25˚C
∗14: Connected with SM fiber (ITU-T G.652), 2 m
∗15: CW, at 0˚ to 40˚C ambient temperature, 5 hour
∗16: Use the conversion cord (see ordering information) for other optical connectors

• Optical sensors

Model		MA9421A[*1]	MA9422A[*1]	MA9423A[*1]	MA9621A[*1]
Wavelength range		0.38 to 1.15 µm			0.75 to 1.7 µm
Element		Si diode			InGaAs diode
Active area diameter		ø9.5 mm	ø9 mm	ø9.5 mm	ø1 mm
Input		Direct			FC, ST, DIN, HMS-10/A, SC type connector adapter[*2]
Measurement range	CW (dBm)	–60 to +20 (0.85 µm)	–50 to +20 (0.85 µm)	–70 to +10 (0.85 µm)	–70 to +3 (1.3 µm)
	MOD (dBm)	–65 to +17 (0.85 µm)	–50 to +17 (0.85 µm)	–75 to +7 (0.85 µm)	–75 to 0 (1.3 µm)
Measurement accuracy[*3]		±5%[*4]		±5%[*5]	±5%[*6]
Temperature range		0˚ to 50˚C (use), –40˚ to +70˚C (storage)			
Dimensions and mass		30 (W) x 30 (H) x 37 (D) mm, ≤100 g	15 (W) x 16 (H) x 140 (D) mm, ≤200 g	30 (W) x 30 (H) x 37 (D) mm, ≤100 g	

Model		MA9622A[*7,*8]	MA9721A[*1]	MA9723A[*1]
Wavelength range		1.2 to 1.7 µm	0.75 to 1.8 µm	
Element		InGaAs diode	Ge diode	
Active area diameter		–	ø5 mm	ø1 mm
Input		FC, SC, ST, DIN, HMS-10/A, replaceable connector, PC polishing	Direct	FC, ST, DIN, HMS-10/A, SC type connector adapter[*2]
Measurement range	CW (dBm)	–50 to +23 (1.3/1.55 µm)	–40 to +10 (1.3 µm)	–60 to +3[*9] (1.3 µm)
	MOD (dBm)	–55 to +20 (1.3/1.55 µm)	–50 to +7 (1.3 µm)	–65 to 0[*9] (1.3 µm)
Measurement accuracy[*3]		±5%[*10]	±5%[*6,*11]	
Temperature range		0˚ to +50˚C (use), –40˚ to +70˚C (storage)		
Dimensions and mass		30 (W) x 30 (H) x 37 (D) mm, ≤100 g		

∗1: Installed in MS9020A/B/C/D
∗2: Specify one connector among those shown in the specification table. When no connector and manufacturer's name are specified, FC-type will be mounted and supplied.
Other than the connectors indicated in the table are dealt in special connectors of custom-made. The ordering method of optical connectors are indicated in the table on page 39.
∗3: Used with FC-type connectors
∗4: At –10 dBm, 0.633/0.78/0.85 µm CW light mode
∗5: At –10 dBm, 0.66/0.78/0.85 µm CW light mode
∗6: At –10 dBm, 0.85/1.3/1.55 µm CW light mode
∗7: Installed in MS9020D, applicable connector: SM fiber (ITU-T G.652)
Return loss: ≥40 dB (1.55 ±0.2 µm, only when return loss of optical connector: ≥45 dB)
Polarization dependency: ≤0.1 dB (1.55 ±0.02 µm)
∗8: Installed in MS9020D
∗9: 0˚ to 40˚C
∗10: At –10 dBm, 1.3/1.55 µm CW light mode
∗11: At –10 dBm, 1.55 µm CW light mode, 18˚ to 28˚C

Safety measures for laser products

The MS0908A complies with the optical safety standards in Class 2 of the IEC pub. 825 and the FDA (21CFR 1040.10, USA); the following descriptive labels are affixed to the product (FDA label is only affixed to product for export to the USA).

IEC

FDA (CFR)

The maximum output is indicated under ∗1, and the wavelength under ∗2.
Caution: Do not look directly into the laser beam.

• MS0907A Return Loss Measurement Unit[*1]

Applicable fiber	SM (10/125 µm, NA 0.1)
Wavelength	1.31 ±0.03 µm (25˚C)
Measurement range	0 to 40 dB (relative to total internal reflection cord, including output connector reflection)
Measured data display range	0 to 60 dB (relative to total internal reflection cord, excluding output connector reflection)
Measurement accuracy	±1 dB (relative to the reflection, constant temperature)
Optical output connector[*2]	FC, ST, DIN, HMS-10/A, SC: PC-type
Temperature range	0˚ to 50˚C (use), –40˚ to +70˚C (storage)
Dimensions and mass	90 (W) x 93 (H) x 36 (D) mm, ≤300 g

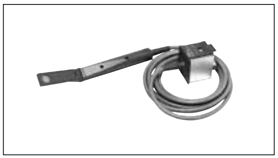
∗1: Installed in MS9020B/C/D; Laser Product Safety Standards: Class-1 (IEC Pub. 825, FDA 21CFR)
∗2: Specify one connector among those shown in the specification table. When no connector and manufacturer's name are specified, FC-type will be mounted and supplied.
Other than the connectors indicated in the table are dealt in special connectors of custom-made. The ordering method of optical connectors are indicated in the table on page 39.

Optical Sensor
(MA9421A/9423A/9621A/
9721A/9723A)

LED Source
(MS0901A/0902A/0903A/
0904A/0906A)
LD Source
(MS0902D/0903D)

MS9020D

Optical sensor
(MA9422A)



LD Source
(MS0908A/0909A)

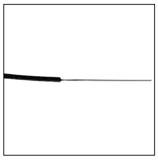
(A photograph
includes a sensor)

Fiber cord with plug

MA9004A Connector Adapter attached

LED Source
(MS0901A/0902A/0903A/0904A/0906A)

Bare fiber



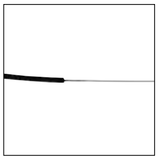
MA9014A
Bare Fiber Connector

Pigtail fiber

LD Source
(MS0902D/0903D)

FC/SC type (integrated with connector)

Bare fiber

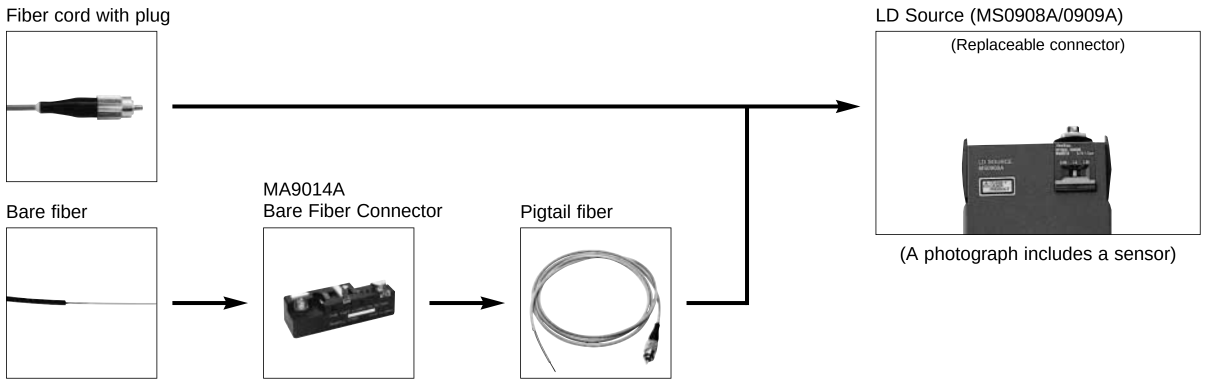


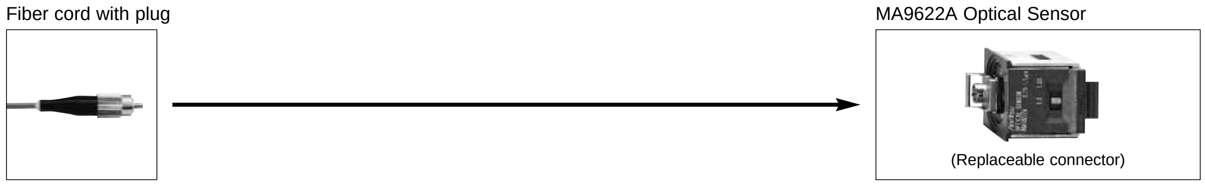
MA9013A Fiber Adapter

Optical Sensor
(MA9421A/9423A/9621A/9721A/9723A)

MA9005A Connector Adapter

Fiber cord with plug





Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Mainframe
MS9020D	Optical Loss Test Set (with Ni-Cd batteries)
	Standard accessories
Z0178	AC adapter: 1 pc
	Power cord, 2.5 m: 1 pc
J0599	AC operation adapter: 1 pc
J0477	Continuant adapter: 1 pc
J0597	Total internal reflection cord (for MS0907A only): 1 pc
W1306AE	MS9020D operation manual: 1 copy
	LED sources
MS0901A	LED Source (MA9004A Connector Adapter attached)
MS0902A	LED Source (MA9004A Connector Adapter attached)
MS0903A	LED Source (MA9004A Connector Adapter attached)
MS0904A	LED Source (MA9004A Connector Adapter attached)
MS0906A	LED Source (MA9004A Connector Adapter attached)
	LD sources
MS0902D	LD Source (integrated with connector)
MS0903D	LD Source (integrated with connector)
MS0908A	LD Source (replaceable connector attached)
MS0909A	LD Source (replaceable connector attached)
	Optical sensors
MA9421A	Optical Sensor
MA9422A	Optical Sensor (thin type)
MA9423A	Optical Sensor
MA9621A	Optical Sensor (MA9005A Connector Adapter attached)
MA9622A	Optical Sensor (for high power, replaceable optical connector attached)
MA9721A	Optical Sensor
MA9723A	Optical Sensor (MA9005A Connector Adapter attached)
	Optical return loss measuring unit
MS0907A	Optical Return Loss Measuring Unit

Model/Order No.	Name
	Optional accessories
MA9004A	Connector Adapter (for MS0902A/0903A/0904A)
MA9005A	Connector Adapter (for MA9421A/9423A/9621A/9721A/9723A)
MA9006A	Sensor Adapter (for optical sensors)
MA9013A	Fiber Adapter (Clad diam. 125 µm; Jacket diam. 0.25 to 1 mm)
MA9014A	Bare Fiber Connector
MP93A	Fiber Adapter (Clad diam. ≤150 µm)
MP94D	Connector Adapter (used with MP93A)
MZ8013A	Sensor Holder
J0436	Optical sensor cord S (for ML9002A, MS9020A/B/C/D)
J0438	Recorder output cord (mini-jack with clips)
J0598	Plastic fiber cord (ø1 mm, NA 0.5 , Amphenol 905, 2 m)
J0200B	FC-FC-2M-GI (FC optical fiber cord, 2 m, GI)
J0056B	FC-FC-2M-SM (FC optical fiber cord, 2 m, SM)
Z0179	Carrying case
Z0180	Battery pack (for Alkali/Manganese cell, up to 4 pcs)
Z0181	Ni-Cd battery pack
Z0182	Soft case (MS0908A/0909A can not house)
Z0426	Carrying case (for MS9020D + MS0908A/0909A)
J0206A	FC·PC-DIA·PC-1M-SM (FC·PC-DIAMOND·PC optical conversion cord, 1 m, SM)
J0208A	FC-BIC-1M-GI (FC-BICONIC optical conversion cord, 1 m, GI)
J0210A	FC-D4-1M-SM (FC-D4 optical conversion cord, 1 m, SM)
J0517A	FC-DIN-1M-SM (FC-DIN optical conversion cord, 1 m, SM)
J0519A	FC-ST-1M-SM (FC-ST optical conversion cord, 1 m, SM)
J0521A	FC-SC-1M-SM (FC-SC optical conversion cord, 1 m, SM)
J0617B	Replaceable connector (FC) *For MA9622A, MS0908A/0909A
J0618D	Replaceable connector (ST) *For MA9622A, MS0908A/0909A
J0618E	Replaceable connector (DIN) *For MA9622A, MS0908A/0909A
J0618F	Replaceable connector (HMS-10/A) *For MA9622A, MS0908A/0909A
J0619B	Replaceable connector (SC) *For MA9622A, MS0908A/0909A
Z0333A	Wavelength selector *For MS0904A/0906A/0909A
B0232	Blank panel

OPTICAL TEST SET

MT9810B

CE GPIB

Multipurpose Optical Measuring Instruments Supporting Reference Light Sources

Today, as we turn to photonic communications, a variety of optical communication networks, from core to access, are about to be realized. For this reason, there are a wide variety of performance requirements demanded of optical components and optical communications systems making up these rapidly developing optical communication networks.

And the performance and specifications of the sought after evaluation systems vary depending on the field (development, manufacturing, inspection, maintenance) in which these are developed, supplied and implemented.

The MT9810B Optical Test Set is the most fundamental optical measurement instrument with a complete line-up of light sources (DFB-LD, FP-LD, SLD) and optical sensors (high-speed, general-purpose, high-power).

The evaluation system can be configured to fit the users needs. In addition, by combining the optical test set with peripheral devices such as the optical directional coupler and the optical channel selector, the user can construct even more diverse evaluation systems. The MT9810B is a highly accurate and reliable evaluation system that will respond with flexibility to future diverse measurement needs.

- **Light source**

The DFB-LD complies with ITU-T recommended wavelengths and highly stable 1.31 µm band, 1.55 µm band FP-LD's are also offered. In addition, an SLD light source with a center wavelength of 1.55 µm and an approximately 40 nm wavelength band is provided.

- **Optical sensors**

There are three optical sensors: high-sensitivity, general-purpose and high-power. Each has sensor head and plug-in models.

- **Measurement conditions saving function**

Up to 10 sets of measurement conditions can be saved for each channel, permitting the repetition of measurements.

- **Clone function**

When the same types of units are mounted in Channels 1 and 2, the measurement conditions for one side can be copied onto the other side.

- **Measurement of max., min. and variation of optical power**

By mounting an optical sensor, the maximum and minimum values of optical power and the variations in its value can be always displayed, eliminating the need for saving the measured optical power various in the memory. Light source stability and PDL (polarization dependent loss) characteristics can be evaluated in real time.

- **Recording measured optical power values**

By mounting an optical sensor, a maximum of 1000 power measurement values can be saved per channel. The saved measurement values can be read by remote control, permitting various analyses and processings.

- **Variable optical power measurement interval**

By mounting an optical sensor, the optimum measurement interval can be set according to the applications (1 ms to 99 h 59 min 59 s); for example, a long interval for a long-duration measurement, and a short interval for high-speed measurement.

- **Variable optical power measurement bandwidth**

By mounting an optical sensor, the bandwidth can be set according to the measured item; for example, the average pulse optical power can be measured by widening the bandwidth, and the variations in optical power at an optical switch can be measured by narrowing the bandwidth. The setting range is between 0.1 Hz to 100 kHz (MU931311A) or 10 kHz (MU931421A/931422A).

- **Relative measurement**

By mounting an optical sensor, 0 dB is displayed as the measured value on the display when the relative key (Rel) is pressed. It allows the difference from the reference value to be read directly in the loss measurement of an optical fiber or device.

- **Reference measurement**

By mounting an optical sensor, a relative value based on a reference value (reference) entered using the keys can be displayed. When the light is incident at a distant location in the loss measurement of an optical fiber, the fiber loss can be read directly by entering the reference value of incident light as a reference.

- **Controlling optical channel selector**

The MN96xxA Optical Channel Selector can be controlled from the MT9810B Optical Test Set by connecting the two via a dedicated cable. It facilitates the measurement if the optical test set and the optical channel selector are at a distance from each other due to the configuration of the measurement system. The cable lengths are available in the range from 1 to 10 m.

- **GPIB and RS-232C I/F as standard**

GPIB and RS-232C interfaces are provided as standard, permitting remote control of the measurements via a PC. In addition, the LabVIEW® software driver for remote control is provided as standard, enhancing the construction of a remote measurement system.

∗ LabVIEW® is registered trademark of National Instruments Corporation.

Light source units

• DFB-LD light source unit

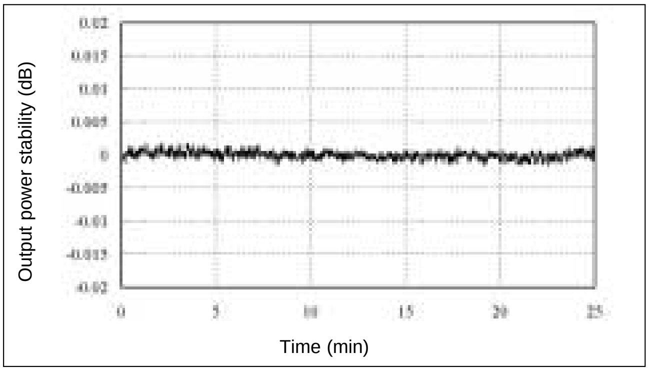
MU952500A/952600A series are 97 wavelengths supporting WDM. The unit is equipped with a high-output and high-stability DFB-LD light source.

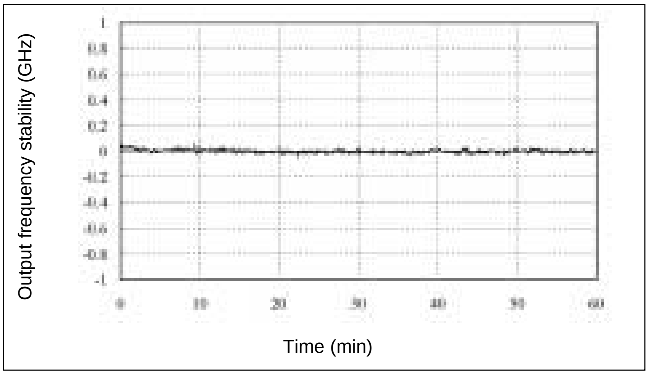
Conforms to wavelengths complying with ITU-T

The unit incorporates a DFB-LD light source that supports D-WDM and complies with ITU-T. Frequencies from 186.3 to 195.9 THz (1609.19 to 1530.33 nm) over a 100 GHz interval are available.

High-power, high-stability

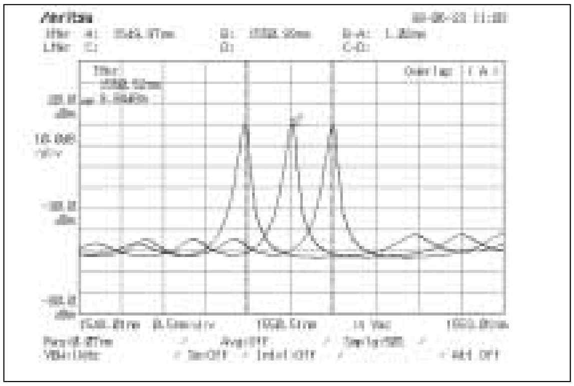
High Power of +10 dBm and high stability of better than or equal to ±0.005 dB are provided. In addition, high stability of better than or equal to ±2 GHz can be achieved for the center frequency (MU952501A/952502A/952503A/952504A/952505A).





Variable optical frequency

The center frequency of the light source can be varied in the maximum range of ±60 GHz (approx. ±0.5 nm). Moreover, the frequency can be displayed in either frequency or wavelength units. This function allows a required frequency to be set between reference grids.



• FP-LD light source units

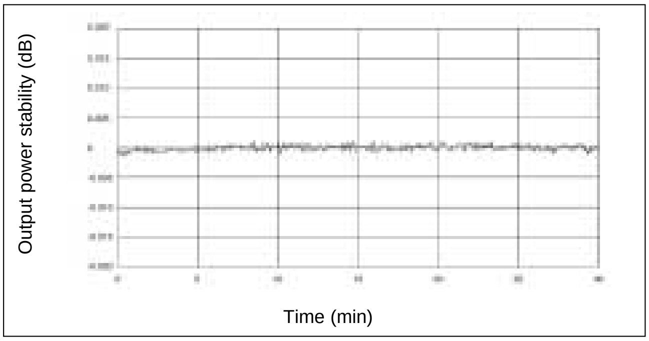
The MU951301A and MU951501A have a wavelength of 1.31 µm and 1.55 µm, respectively. The MU951001A allows the wavelength to be selected as either 1.31 or 1.55 µm.

High-power

The units are general-purpose light sources with a high output of +7 dBm, making them ideal for performing measurements over a high dynamic range.

High-stability

The units provide high output-power stability of better than or equal to ±0.002 dB. They are suitable as light sources for measurements in which high accuracy is required(MU951301A/951501A).



• SLD light source unit

This light source has a center wavelength of 1550 nm and an approximate wavelength band of 40 nm. Optical output power is –3 dBm. The output level is higher than LED light source. A measurement system of MS9710B/C Optical Spectrum Analyzer and SLD light source unit achieves more dynamic range.

On the other hand, when combined with the MN9604C/D Optical Directional Coupler, highly stable reflectance measurements can be performed because of low interference to use SLD light source.

Optical sensor units

High-sensitivity, general-purpose or high-power optical sensors are available. A remote sensor head model and a plug-in model are also provided. Furthermore, besides supporting all optical connectors, the optical input method (connection method) for optical sensors supports bare fiber connection and free-space optical input. The user can select the optical sensor that meets his use environment and purpose.

• General-purpose optical sensor (MU931421A/MU931422A/MA9332A)

MU931421A and MU931422A with measurement ranges of +10 to –80 dBm and MA9332A with a measurement range of +7 to –80 dBm, are highly accurate optical sensors that achieve a measurement accuracy of ±2% and linearity of ±0.01 dB.

MU931422A and MA9332A can be used in measuring fiber with an APC connector, GI fiber and bare fiber. MU931422A is a plug-in model and MA9332A, a sensor head model.

∗ When using MA9332A, MU931001A or MU931002A sensor adapter is necessary.

• High-power optical sensor (MA9331A/MU931431A)

High-power optical sensors MA9331A and MU931431A have maximum measurement optical inputs of +35 dBm and +33 dBm, respectively. These sensors have NPL (National Physical Laboratory) traceability in conducting calibration at +30 dBm, and are able to measure “high-power” with an even higher level of confidence than conventional high-power optical sensors. And of course all types of corresponding connectors also support fiber with an APC connector, GI fiber and bare fiber. MU931431A is a plug-in model and MA9331A, a sensor head model.

∗ When using MA9331A, MU931001A sensor adapter is necessary.

Optical input method of the sensor

Item	Model	Type	Various connector	Bare fiber	Space beam
General purpose	MU931421A	Unit	√*1		
	MU931422A	Unit	√	√	
	MA9332A	Sensor head	√	√	
High power	MU931431A	Unit	√	√	
	MA9331A	Sensor head	√	√	
High sensitivity	MU931311A	Unit	√*1		
Large diameter PD	MA9333A	Sensor head	√	√	√

*1: MU931421A/MU931311A does not correspond to MU connector, LC connector, and APC connector.

- **High-sensitivity optical sensor (MU931311A)**

The MU931311A has an optical power range of +10 to –110 dBm and measures high-level to extremely low-level light. It achieves measurement uncertainty of ±2% and linearity of ±0.01 dB. Optical power can be measured with a high degree of accuracy. And of course, this optical sensor is compatible with all connectors.

- **Large diameter PD sensor (MA9333A)**

This is a sensor head-model optical sensor that has low noise characteristics, and uses an internal photo acceptance unit with a ±5 mm-InGaAs-PD. In addition to SM, GI and POF (plastic fiber), a collimated spatial beam can also be measured directly. This optical sensor also supports bare fiber.

* When using MA9333A, MU931002A Sensor Adapter is necessary.

- **MA9901A/B Fiber Adapter**

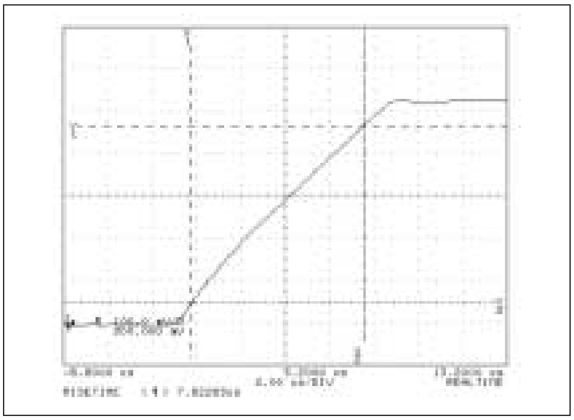
Setting can be accomplished without touching the cut fiber edge by using the clamping method, which catches and then fixes the fiber at both ends. Fiber can also be easily attached and removed by pinching the clamp, making this adapter perfect for extended work.

High-resolution optical power measurement

The MT9810B has a panel of high resolution of 1/1000 dB. In addition, the optical power can be measured at a high resolution of 1/10000 dB via GPIB or RS-232C interface.

High-speed analog output

The MU931311A Optical Sensor can send a signal to an analog output terminal with a response speed of approx. 10 µs (The response speed of other optical sensors is approx. 100 µs).



Specifications

- **MT9810B Optical Test Set**

Display resolution	dBm: 0.001, 0.01, 0.1 dB: 0.001, 0.01, 0.1 W: 5 digits
Display range	–199.999 to +199.999 dBm, ±0.0001 pW to ±10000 W
Display	Fluorescent character display tube, 7 segments (5-1/2 digits), 2 screens, dot matrix (138 x 20 dots), dedicated segments (AUTO, AVG, MOD, CAL, SYS, PRMTR, APPL, REMOTE)
System settings	Remote (GPIB, RS-232C) GPIB: Address RS-232C Data length: 7/8 bits, Stop bit: 1/2 bits Parity bit: None, odd, even Speed: 1200, 2400, 4800, 9600, 14400, 19200 bps Buzzer volume: 4 levels, Contrast: 9 levels Time setting: Year, month, day, hour, minute, second (24 hour display)
Functions	General Settings save: 10 max. (each channel) Settings copy: Between channels (only for same type of unit) Selectable controlled channel Using optical sensor Bar graph display: 60 dots Record measurement: 1000 max. data (each channel) Calculations: Channel subtraction, max./min./(max. – min.) displays, relative value display (measured value reference, numeric value input), calibration value correction
Remote control	GPIB, RS-232C
Laser safety mechanism	Remote inter-lock, optical output control (key control)
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation); Storage temperature: –25˚ to +71˚C
Plug-in units	2 max.
LabVIEW® driver	Bundled as standard
Dimensions and mass	213 (W) x 88 (H) x 351 (D) mm, ≤3.5 kg (without units)
Power	100 to 120/200 to 240 Vac (+10%/–15%), ≤70 VA, 47.5 to 63 Hz
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

- **Light sources**

DFB-LD light source

Model	MU952501A/952502A/952503A/952504A/952505A	MU952601A/952602A/952603A/952604A/952605A/952606A
Optical element	DFB-LD	
Applicable optical fiber	SM (ITU-T G.652)	
Specified wavelength range (fp)[*1]	191.7 to 195.9 THz (1563.86 to 1530.33 nm)	186.3 to 191.6 THz (1609.19 to 1564.68 nm)
Center optical frequency[*2]	fp ±0.01 THz (approx. ±0.08 nm)	
Spectrum half width[*2]	≤30 MHz	
Optical output power[*2]	+10 ±1 dBm	+7 ±1 dBm
Optical power stability	Time stability (short term)[*2, *3, *4]: ≤±0.005 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.25 dB	Time stability (short term)[*2, *3, *4]: ≤±0.01 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.25 dB
Center frequency stability	Time stability (short term)[*2, *4]: ≤±2 GHz (approx. ±0.02 nm) Time stability (long term)[*2, *5]: ≤±4 GHz (approx. ±0.04 nm)	
Optical frequency tuning	Tuning range: fp ±60 GHz (approx. ±0.48 nm), Step: 1 GHz (approx. 0.01 nm), Accuracy[*2]: ≤±10 GHz (setting to fp +60 GHz, or fp –60 GHz, 25˚C)	
Internal modulation	Frequency[*2]: 270 Hz, 1 kHz, 2 kHz ±0.1% Duty: 50% ±5%, Extinction ratio: ≥13 dB	
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)	
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb	
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC[*7] (all PC type)	
Warm-up time	1 h (after optical output on)	
Environmental conditions	Operating temperature/humidity: +15˚ to +35˚C/≤90% (no condensation), Storage temperature: –25˚ to +71˚C	
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	

Note: Wavelengths in vacuum

*1: Specify an optical frequency (wavelength) and model name from the ordering information.

*2: At CW, optical attenuation setting (0.00 dB), center optical frequency (fp) using SM fiber (ITU-T G.652) and FC-PC connector

*3: When return loss seen from light source side is 40 dB min.

*4: 5 min at constant temperature (at one point 20˚ to 30˚C)

*5: 1 h at constant temperature

*6: 8 h at +15˚ to +35˚C

*7: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

FP-LD light source

Model	MU951301A	MU951501A	MU951001A[*1]
Optical element	FP-LD		
Fiber	SM (ITU-T G.652)		
Wavelength[*2]	1310 ±20 nm	1550 ±20 nm	1310/1550 ±20 nm
Spectral half-width[*2]	≤5 nm	≤10 nm	≤5 nm (1310 nm), ≤10 nm (1550 nm)
Optical output power[*2]	+7 ±1 dBm		
Optical output power stability	Time stability (short term)[*2, *3, *4]: ≤±0.002 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.1 dB		Time stability (short term)[*2, *3, *4]: ≤±0.005 dB Time stability (long term)[*2, *3, *5]: ≤±0.05 dB Temperature stability[*2, *3, *6]: ≤±0.15 dB
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB		
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)		
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb		
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC[*7] (all PC type)		
Warm-up time	1 h (after optical output on)		
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation); Storage temperature: –40˚ to +71˚C (no condensation)		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g		

Note: Wavelengths in vacuum

*1: Only one MU951001A can be installed into MT9812B.

*2: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector

*3: When return loss seen from light source side is 40 dB min.

*4: 15 min at constant temperature (at one point from 20˚ to 30˚C)

*5: 6 h at constant temperature

*6: 8 h at 0˚ to 50˚C

*7: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

SLD light source

Model	MU954501A
Optical element	SLD
Fiber	SM fiber (ITU-T G.652)
Wavelength[*1]	1550 ±20 nm
Spectral half-width[*1]	≥40 nm
Optical output power[*1]	–3 ±1 dBm

Continued on next page

Optical output power stability	Time stability (short term)*1, *2, *3: ±0.01 dB Time stability (long term)*1, *2, *4: ±0.1 dB Temperature stability*1, *2, *5: ±0.5 dB
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB
Warm-up time	1 h (after optical output on)
Optical connector*6	FC, ST, DIN, HMS-10/A, SC (all PC type)
Laser safety mechanism	IEC60825-1: Class 1, 21CFR1040.10: Class I
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation) Storage Temperature: –40˚ to +71˚C
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g

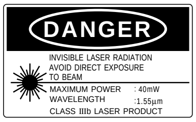
Note: Wavelengths in vacuum, please contact us for 1310 nm SLD light source.
*1: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector
*2: When return loss seen from light source side is 40 dB min.
*3: 15 min at constant temperature
*4: 6 h at constant temperature
*5: 8 h at 0˚ to 50˚C
*6: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

Laser product safety protection

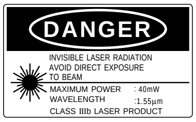
The MU952501A/952502A/952503A/952504A/952505A, MU952601A/952602A/952603A/952604A/952605A/952606A, MU951301A/951501A/951001A, and MU954501A are laser products and safety protection conforming to optical safety standards IEC 60825-1 and 21CFR1040.10 (USA) is incorporated; the following warning label is affixed to the product.

- **21CFR1040.10 warning label**

MU952501A/952502A/952503A/952504A/952505A



MU951501A



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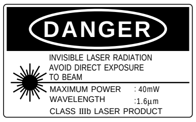
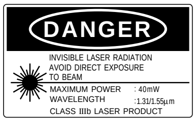
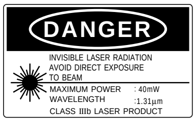


MU951001A

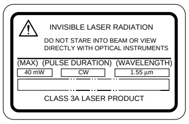


MU951301A

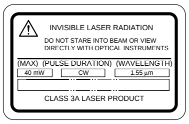


- **IEC 60825-1 warning label**

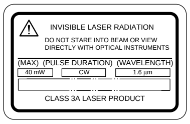
MU952501A/952502A/952503A/952504A/952505A



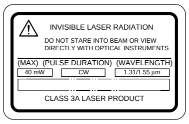
MU951501A



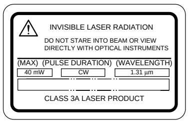
MU952601A/952602A/952603A/952604A/952605A/952606A



MU951001A



MU951301A



MU954501A

- **Optical sensors (unit)**

Model	MU931311A	MU931421A	MU931422A
Element	InGaAs-PD		
Input type	Fiber		
Applicable optical fiber	SM (ITU-T G.652)		9/125 to 62.5/125 µm (NA: ≤0.29) PC, APC polish conformity
Wavelength range	800 to 1600 nm	750 to 1700 nm	
Optical power measurement range*1	CW: +10 to –110 dBm MOD: +7 to –90 dBm	CW: +10 to –80 dBm MOD: +7 to –90 dBm	
Noise level*2	≤–93 dBm	≤–73 dBm	
Polarization dependency*3	≤±0.01 dB		≤±0.025 dB
Return loss*3	≥40 dB		—
Optical power measurement uncertainty	Reference conditions*4: ±2%, Operating conditions*5: ±3.5%		

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Model	MU931311A	MU931421A	MU931422A
Linearity[*6]	±0.05 dB (+10 to 0 dBm) ±0.01 dB ±0.3 pW (0 to –90 dBm)	±0.05 dB (+10 to 0 dBm) ±0.01 dB ±30 pW (0 to –70 dBm)	
Calibration factor input	–99.999 to +99.999 dB		
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units		
Zero set operation	Automatic zero calibration		
Range select	Auto, manual		
Modulated light reception	CW/MOD selectable, MOD: 270 Hz, 1 kHz, 2 kHz		
Measurement interval[*7]	1, 10, 20, 50, 100, 200, 500 ms, 1 s to 99 h 59 min 59 s		
Average setting	Off, 2, 5, 10, 20, 50, 100, 200, 500, 1000 times		
Analog output[*8]	Approx. +2 V		
Bandwidth select[*9]	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10, 100 kHz (CW mode only)	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10 kHz (CW mode only)	
Optical connector[*10]	FC-PC, ST, DIN, HMS-10/A, SC (all PC type)		FC, ST, DIN, HMS-10/A, SC, MU, LC
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation), Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	41 (W) x 78 (H) x 335 (D) mm, ≤550 g	

*1 Wavelength: 1300 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1300 nm
*3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
*4 Reference conditions
SM fiber (ITU-T G.652), master FC connector
Power level: 100 µW (–10 dBm), CW light, wavelength: 1300 nm, ambient temperature: 23˚ ±2˚C, at day of calibration,
Warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
*5 Operating conditions
SM Fiber (ITU-T G.652), master FC connector, CW light, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), power level: 100 µW (–10 dBm), ambient
temperature: 23˚ ±5˚C, within 1 year after calibration, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A), Uncertainty increase by 1% if either an APC connector or NA ≤0.29 fiber is used with the MU931422A.
*6 Measurement conditions: Constant temperature within 23˚ ±5˚C, bandwidth: auto/0.1/1/10 Hz, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), CW light, power level: 100 µW (–10 dBm) reference, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
*7 Only record measurements for measurement interval of ≤100 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth. Response time at bandwidth setting of 100 kHz varies according to analog output amplitude
*10 Specify connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

- **Optical sensor (sensor head)**

Model	MU931001A + MA9332A	MU931002A + MA9332A/MA9333A
Element	InGaAs-PD	
Input type	Fiber	
Applicable optical fiber	9/125 to 62.5/125 µm (NA: ≤0.29), PC, APC polish conformity	
Wavelength range	750 to 1700 nm	
Optical power measurement range[*1]	CW: +7 to –80 dBm, MOD: +4 to –70 dBm	CW: +7 to –80 dBm
Noise level[*2]	≤–73 dBm	
Polarization dependency[*3]	≤±0.017 dB (MA9332A), ≤±0.013 dB (MA9333A)	
Optical power measurement accuracy	Reference conditions[*4]: ±2%, Operating conditions[*5]: ±3.5%	
Linearity[*6]	±0.05 dB (+7 to 0 dBm), ±0.01 dB ±30 pW (0 to –70 dBm)	
Zero set operation	Automatic zero calibration	
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units	
Modulated light reception	CW/MOD selectable, MOD: 270 Hz, 1 kHz, 2 kHz	—
Measurement interval[*7]	1 ms to 99 h 59 min 59 s	
Average setting	2 to 1000 times	
Analog output[*8]	Approx. +2 V	
Bandwidth select[*9]	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 20 kHz (CW mode only)	Auto, manual Manual setting: 1, 10, 100 Hz, 1, 20 kHz (CW mode only)
Optical connector[*10]	FC, ST, DIN, HMS-10/A, SC, MU, LC	
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation) Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)	
Dimensions and mass	MU931001A/MU931002A: 41 (W) x 78 (H) x 335 (D) mm, ≤500 g MA9332A/MA9333A: 65 (W) x 80 (H) x 110 (D) mm, ≤750 g	

*1 Wavelength: 1550 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1550 nm
*3 SM fiber (ITU-T G.652), power level: 100 µW (–10 dBm), return loss: ≥45 dB, wavelength: 1550 nm

*4 Reference conditions
SM fiber (ITU-T G.652), master FC connector
Power level: 100 µW (–10 dBm), CW light, wavelength: 1550 nm, ambient temperature: 23˚ ±2˚C
At day of calibration, warm-up: 30 min, 1 h (when using MA9333A)
*5 Operating conditions
SM Fiber (ITU-T G.652), master FC connector, power level: 100 µW (–10 dBm)
CW light, wavelength: 1000 to 1650 nm, ambient temperature: 23˚ ±5˚C, within 1 year after calibration
warm-up: 30 min, 1 h (when using MA9333A)
Uncertainty increase by 1% if either an APC connector or NA ≤0.29 fiber is used.
*6 Measurement conditions
Constant temperature within 23˚ ±5˚C, any wavelength in 1000 to 1650 nm, CW light, power level: 100 µW (–10 dBm) reference
Bandwidth: auto/0.1/1/10 Hz (0.1 Hz: MU931001A only), warm-up: 30 min, 1 h (when using MA9333A)
*7 Only record measurements for measurement interval of ≤20 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth
*10 Specify connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

• Optical sensor (high-power)

Model	MU931001A + MA9331A	MU931431A
Element	InGaAs-PD	
Input type	Fiber	
Applicable optical fiber	9/125 to 62.5/125 µm (NA: ≤0.29), PC, APC polish conformity	
Wavelength range	940 to 1640 nm	
Optical power measurement range*1	CW: +35 to –50 dBm	CW: +33 to –50 dBm
Noise level*2	≤–43 dBm	
Polarization dependency*3	PC connector: ≤±0.005 dB, APC connector: ≤±0.025 dB	PC connector: ≤±0.025 dB, APC connector: ≤±0.05 dB
Optical power measurement accuracy	Reference conditions*4: ±3%, Operating conditions*5: ±4%	Reference conditions*4: ±4%, Operating conditions*5: ±5%
Linearity*6	±0.05 dB ±30 nW (+35 to –40 dBm)	±0.05 dB ±30 nW (+33 to –40 dBm)
Zero set operation	Automatic zero calibration	
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units	
Measurement interval*7	1 ms to 99 h 59 min 59 s	
Average setting	2 to 1000 times	
Analog output*8	Approx. +2 V	
Bandwidth select*9	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 20 kHz	
Optical connector*10	FC, ST, DIN, HMS-10/A, SC, MU, LC	
Environmental conditions	Operating temperature/humidity: 0˚ to +40˚C/≤90% (no condensation) Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)	
Dimensions and mass	MU931001A: 41 (W) x 78 (H) x 335 (D) mm, ≤500 g MA9331A: 65 (W) x 80 (H) x 110 (D) mm, ≤750 g	41 (W) x 78 (H) x 335 (D) mm, ≤880 g

*1 Wavelength: 1550 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1550 nm
*3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
*4 Reference conditions,
Connector adapter, SM fiber (ITU-T.G.652), APC connector
Power level 1 W (+30 dBm), CW light, and wavelength 1550 nm
Ambient temperature 23 ±2˚C, humidity 60 % ±10 %
Warm-up time 30 minutes, day of calibration.
*5 Operating conditions
Connector adapter, SM fiber (ITU-T G.652), APC connector, power level: 1 W (30 dBm)
CW light, wavelength: 980 ±1 nm, 1240 to 1340 nm, 1440 to 1640 nm
Ambient temperature: 23˚ ±5˚C, within 6 months after calibration
warm-up: 30 min
Uncertainty increase by 1% if either NA ≤0.29 fiber is used.
2 % added when wavelength besides above are used (However, humidity 60 % ±10 %)
*6 Measurement conditions
Constant temperature within 23˚ ±5˚C, any wavelength in 1000 to 1650 nm, CW light, power level: 1 W (+30 dBm) reference
Bandwidth: auto/0.1/1/10 Hz, warm-up: 30 min
*7 Only record measurements for measurement interval of ≤20 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth
*10 Specify connector for optical connector option supplied as standard accessory.
If connector not specified, FC (Option 37) supplied as standard.

• MA9901A Fiber Adapter

Fiber	ø250 µm strand (Clad diameter: ø125 mm)
Dimensions and mass	20 (W) x 22.5 (H) x 29.5 (D) mm, ≤30 g

Ordering information

Specify the model order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MT9810B	Optical Test Set	
	Standard accessories	
W1886AE	MT9810B operation manual:	1 copy
W1887AE	MT9810B remote control operation manual:	1 copy
J0895	RCA short pin (for remote inter-lock):	1 pc
J0896	RCA plug (for remote inter-lock):	1 pc
Z0391	Key (for laser output control):	2 pcs
F0011	Fuse, 2 A (for 100 to 120 Vac):	2 pcs
F0008	Fuse, 1 A (for 200 to 240 Vac):	2 pcs
	Power cord, 2.6 m:	1 pc
B0425	Blank panel:	1 pc
	Application parts	
J0006	GPIB cable, 0.5 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0009	GPIB cable, 4 m	
J0655A	RS-232C cable (9P-25P, cross)	
J0654A	RS-232C cable (9P-9P, cross)	
J0897B	8P modular cable, 1 m	
J0897C	8P modular cable, 2 m	
J0897D	8P modular cable, 5 m	
J0897E	8P modular cable, 10 m	
B0438B	Rack mount Kit	
B0438	Rack mount Kit	
B0425	Blank panel	
B0427	Protect cover	
	[Light sources]	
	Main frame	
MU952501A	DFB-LD Light Source*1	
MU952502A	DFB-LD Light Source*1	
MU952503A	DFB-LD Light Source*1	
MU952504A	DFB-LD Light Source*1	
MU952505A	DFB-LD Light Source*1	
MU952601A	DFB-LD Light Source*1	
MU952602A	DFB-LD Light Source*1	
MU952603A	DFB-LD Light Source*1	
MU952604A	DFB-LD Light Source*1	
MU952605A	DFB-LD Light Source*1	
MU952606A	DFB-LD Light Source*1	
MU951301A	FP-LD Light Source	
MU951501A	FP-LD Light Source	
MU951001A	Switchable FP-LD Light Source	
	Standard accessory	
	Optical connector adapter*2	
	Options	
MU952501A-01	Light source (fp: 193.10 THz, 1552.52 nm)	
MU952501A-02	Light source (fp: 193.20 THz, 1551.72 nm)	
MU952501A-03	Light source (fp: 193.30 THz, 1550.92 nm)	
MU952501A-04	Light source (fp: 193.40 THz, 1550.12 nm)	
MU952501A-05	Light source (fp: 193.50 THz, 1549.32 nm)	
MU952501A-06	Light source (fp: 193.60 THz, 1548.51 nm)	
MU952501A-07	Light source (fp: 193.70 THz, 1547.72 nm)	
MU952501A-08	Light source (fp: 193.80 THz, 1546.92 nm)	
MU952501A-09	Light source (fp: 193.90 THz, 1546.12 nm)	
MU952501A-10	Light source (fp: 194.00 THz, 1545.32 nm)	
MU952502A-01	Light source (fp: 192.10 THz, 1560.61 nm)	
MU952502A-02	Light source (fp: 192.20 THz, 1559.79 nm)	
MU952502A-03	Light source (fp: 192.30 THz, 1558.98 nm)	
MU952502A-04	Light source (fp: 192.40 THz, 1558.17 nm)	
MU952502A-05	Light source (fp: 192.50 THz, 1557.36 nm)	
MU952502A-06	Light source (fp: 192.60 THz, 1556.55 nm)	
MU952502A-07	Light source (fp: 192.70 THz, 1555.75 nm)	
MU952502A-08	Light source (fp: 192.80 THz, 1554.94 nm)	
MU952502A-09	Light source (fp: 192.90 THz, 1554.13 nm)	
MU952502A-10	Light source (fp: 193.00 THz, 1553.33 nm)	
MU952503A-07	Light source (fp: 191.70 THz, 1563.86 nm)	
MU952503A-08	Light source (fp: 191.80 THz, 1563.05 nm)	
MU952503A-09	Light source (fp: 191.90 THz, 1562.23 nm)	
MU952503A-10	Light source (fp: 192.00 THz, 1561.42 nm)	
MU952504A-01	Light source (fp: 194.10 THz, 1544.53 nm)	
MU952504A-02	Light source (fp: 194.20 THz, 1543.73 nm)	
MU952504A-03	Light source (fp: 194.30 THz, 1542.94 nm)	
MU952504A-04	Light source (fp: 194.40 THz, 1542.14 nm)	
MU952504A-05	Light source (fp: 194.50 THz, 1541.35 nm)	
MU952504A-06	Light source (fp: 194.60 THz, 1540.56 nm)	
MU952504A-07	Light source (fp: 194.70 THz, 1539.77 nm)	
MU952504A-08	Light source (fp: 194.80 THz, 1538.98 nm)	
MU952504A-09	Light source (fp: 194.90 THz, 1538.19 nm)	
MU952504A-10	Light source (fp: 195.00 THz, 1537.40 nm)	
MU952505A-01	Light source (fp: 195.10 THz, 1536.61 nm)	
MU952505A-02	Light source (fp: 195.20 THz, 1535.82 nm)	
MU952505A-03	Light source (fp: 195.30 THz, 1535.04 nm)	
MU952505A-04	Light source (fp: 195.40 THz, 1534.25 nm)	
MU952505A-05	Light source (fp: 195.50 THz, 1533.47 nm)	
MU952505A-06	Light source (fp: 195.60 THz, 1532.68 nm)	
MU952505A-07	Light source (fp: 195.70 THz, 1531.90 nm)	
MU952505A-08	Light source (fp: 195.80 THz, 1531.12 nm)	
MU952505A-09	Light source (fp: 195.90 THz, 1530.33 nm)	
MU952601A-01	Light source (fp: 191.10 THz, 1568.77 nm)	
MU952601A-02	Light source (fp: 191.20 THz, 1567.95 nm)	
MU952601A-03	Light source (fp: 191.30 THz, 1567.13 nm)	
MU952601A-04	Light source (fp: 191.40 THz, 1566.31 nm)	
MU952601A-05	Light source (fp: 191.50 THz, 1565.50 nm)	
MU952601A-06	Light source (fp: 191.60 THz, 1564.68 nm)	
MU952602A-01	Light source (fp: 190.10 THz, 1577.03 nm)	
MU952602A-02	Light source (fp: 190.20 THz, 1576.20 nm)	
MU952602A-03	Light source (fp: 190.30 THz, 1575.37 nm)	
MU952602A-04	Light source (fp: 190.40 THz, 1574.54 nm)	
MU952602A-05	Light source (fp: 190.50 THz, 1573.71 nm)	
MU952602A-06	Light source (fp: 190.60 THz, 1572.89 nm)	
MU952602A-07	Light source (fp: 190.70 THz, 1572.06 nm)	
MU952602A-08	Light source (fp: 190.80 THz, 1571.24 nm)	
MU952602A-09	Light source (fp: 190.90 THz, 1570.42 nm)	
MU952602A-10	Light source (fp: 191.00 THz, 1569.59 nm)	
MU952603A-01	Light source (fp: 189.10 THz, 1585.36 nm)	
MU952603A-02	Light source (fp: 189.20 THz, 1584.53 nm)	
MU952603A-03	Light source (fp: 189.30 THz, 1583.69 nm)	
MU952603A-04	Light source (fp: 189.40 THz, 1582.85 nm)	
MU952603A-05	Light source (fp: 189.50 THz, 1582.02 nm)	
MU952603A-06	Light source (fp: 189.60 THz, 1581.18 nm)	
MU952603A-07	Light source (fp: 189.70 THz, 1580.35 nm)	
MU952603A-08	Light source (fp: 189.80 THz, 1579.52 nm)	
MU952603A-09	Light source (fp: 189.90 THz, 1578.69 nm)	
MU952603A-10	Light source (fp: 190.00 THz, 1577.86 nm)	
MU952604A-01	Light source (fp: 188.10 THz, 1593.79 nm)	
MU952604A-02	Light source (fp: 188.20 THz, 1592.95 nm)	
MU952604A-03	Light source (fp: 188.30 THz, 1592.10 nm)	
MU952604A-04	Light source (fp: 188.40 THz, 1591.26 nm)	
MU952604A-05	Light source (fp: 188.50 THz, 1590.41 nm)	
MU952604A-06	Light source (fp: 188.60 THz, 1589.57 nm)	
MU952604A-07	Light source (fp: 188.70 THz, 1588.73 nm)	
MU952604A-08	Light source (fp: 188.80 THz, 1587.88 nm)	
MU952604A-09	Light source (fp: 188.90 THz, 1587.04 nm)	
MU952604A-10	Light source (fp: 189.00 THz, 1586.20 nm)	
MU952605A-01	Light source (fp: 187.10 THz, 1602.31 nm)	
MU952605A-02	Light source (fp: 187.20 THz, 1601.46 nm)	
MU952605A-03	Light source (fp: 187.30 THz, 1600.60 nm)	
MU952605A-04	Light source (fp: 187.40 THz, 1599.75 nm)	
MU952605A-05	Light source (fp: 187.50 THz, 1598.89 nm)	
MU952605A-06	Light source (fp: 187.60 THz, 1598.04 nm)	
MU952605A-07	Light source (fp: 187.70 THz, 1597.19 nm)	
MU952605A-08	Light source (fp: 187.80 THz, 1596.34 nm)	
MU952605A-09	Light source (fp: 187.90 THz, 1595.49 nm)	
MU952605A-10	Light source (fp: 188.00 THz, 1594.64 nm)	
MU952606A-03	Light source (fp: 186.30 THz, 1609.19 nm)	
MU952606A-04	Light source (fp: 186.40 THz, 1608.33 nm)	
MU952606A-05	Light source (fp: 186.50 THz, 1607.47 nm)	
MU952606A-06	Light source (fp: 186.60 THz, 1606.60 nm)	
MU952606A-07	Light source (fp: 186.70 THz, 1605.74 nm)	
MU952606A-08	Light source (fp: 186.80 THz, 1604.88 nm)	
MU952606A-09	Light source (fp: 186.90 THz, 1604.03 nm)	
MU952606A-10	Light source (fp: 187.00 THz, 1603.17 nm)	
	Applications parts	
J0617B	Replaceable optical connector (FC, user replaceable)	
J0618D	Replaceable optical connector (ST, user replaceable)	
J0618E	Replaceable optical connector (DIN, user replaceable)	
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)	
J0619B	Replaceable optical connector (SC, user replaceable)	
Z0282	Ferrule cleaner	
Z0283	Ferrule cleaning tape (6 pcs/set)	
Z0284	Adapter cleaner (stick type, 200 pcs/set)	
	Main frame	
MU954501A	SLD Light Source	
	Standard accessory	
	Optical connector adapter*2	
W2023AE	MU954501A instruction manual	

Continued on next page

Model/Order No.	Name
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
	[Optical sensor]
	Main frame
MU931311A	Optical Sensor
MU931421A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type with connector, RL >50 dB, SM), 2 m
MZ8012A	Connector Cleaning Set
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Main frame
MU931422A	Optical Sensor (MA9005A Connector Adapter attached)
	Standard accessory
	Optical connector adapter (for MU931311A/931421A)*2
W1624AE	MU931422A operation manual
	Applications parts
MA9005A-32	Connector adapter (MU, user replaceable)
MA9005A-33	Connector adapter (LC, user replaceable)
MA9005A-37	Connector adapter (FC, user replaceable)
MA9005A-38	Connector adapter (ST, user replaceable)
MA9005A-39	Connector adapter (DIN, user replaceable)
MA9005A-40	Connector adapter (SC, user replaceable)
MA9005A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
MA9901A	Fiber Adapter (for bare fiber)
MA9902A	Connector Adapter (for MA9901A)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type, with connector, RL >50 dB, SM), 2 m
MZ8012A	Connector Cleaning Set
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Main frame
MU931431A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
W1896AE	MU931431A operation manual
	Applications parts
MA9005B-32	Connector adapter (MU, user replaceable)
MA9005B-33	Connector adapter (LC, user replaceable)
MA9005B-37	Connector adapter (FC, user replaceable)
MA9005B-38	Connector adapter (ST, user replaceable)
MA9005B-39	Connector adapter (DIN, user replaceable)
MA9005B-40	Connector adapter (SC, user replaceable)
MA9005B-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
MA9901B	Fiber Adapter (for bare fiber)
MA9902B	Connector Adapter (for MA9901B)
J0178A	AG adapter
J0952A	Conversion cord (FC · PC-FC · APC), 1 m
J0954A	Conversion cord (SC · PC-SC · APC), 1 m

Model/Order No.	Name
	Main frame
MA9331A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
	Applications parts
MA9008A-32	Connector adapter (MU, user replaceable)
MA9008A-33	Connector adapter (LC, user replaceable)
MA9008A-37	Connector adapter (FC, user replaceable)
MA9008A-38	Connector adapter (ST, user replaceable)
MA9008A-39	Connector adapter (DIN, user replaceable)
MA9008A-40	Connector adapter (SC, user replaceable)
MA9008A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter
MA9901B	Fiber Adapter
MA9903A	Connector Adapter (for MA9901B)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
MZ8012A	Connector Cleaning Set
	Main frame
MA9332A	Optical Sensor
MA9333A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
	Applications parts
MA9005A-32	Connector adapter (MU, user replaceable)
MA9005A-33	Connector adapter (LC, user replaceable)
MA9005A-37	Connector adapter (FC, user replaceable)
MA9005A-38	Connector adapter (ST, user replaceable)
MA9005A-39	Connector adapter (DIN, user replaceable)
MA9005A-40	Connector adapter (SC, user replaceable)
MA9005A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
MA9901A	Fiber Adapter (for bare fiber)
MA9902A	Connector Adapter (for MA9901A)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
MZ8012A	Connector Cleaning set
	[Sensor adapter]
	Main frame
MU931001A	Sensor Adapter
	Standard accessory
J1073A	Optical sensor connect cable, 1.5 m
W1895AE	MU931001A/MA9331A/MA9332A operation manual
	Applications parts
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Main frame
MU931002A	Sensor Adapter
	Standard accessory
J1073A	Optical sensor connect cable, 1.5 m
	Applications parts
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Optical connector options (for light sources and optical sensors)
[Model]-32	MU connector (user replaceable)
[Model]-33	LC connector (user replaceable)
[Model]-37	FC connector (user replaceable)
[Model]-38	ST connector (user replaceable)
[Model]-39	DIN connector (user replaceable)
[Model]-40	SC connector (user replaceable)
[Model]-43	HMS-10/A connector (user replaceable)

*1: Specify an optical frequency (wavelength) and model name when ordering.

*2: When ordering, the option specified connector is supplied as standard. Specified the option number after the light source or optical sensor model number. If a connector is not specified, a FC (Option 37) connector is supplied as standard. These are applied to DFB-LD unit, FP-LD unit, SLD unit and optical sensor. However, MU and LC connecter option are only apply to MU931422A, MA9331A, MA9332A and MA9333A.

MULTI CHANNEL BOX
MT9812B

CE GPIB

For Adding Light Sources and Optical Sensors for Maximum of 9 Channels

The MT9812B is a mainframe supporting devices such as DFB-LD multiple light sources and multi-channel device evaluation systems. A maximum of 9 MT9810B compatible light sources (DFB-LD, FP-LD, SLD) and optical sensor units can be inserted. In addition to being able to set and verify setting conditions for each unit on the front panel, a remotely controlled measurement system can be supported as GPIB and RS-232C interfaces are standard equipment.

Comparison of the features of MT9810B and MT9812B

	Functions	MT9810B	MT9812B
Main frame	Number of channels	2	9
	Remote functions	√	√
	Date/time setting	√	
	Optical channel selector control	√	
	Laser safety protection mechanism	√	√
Optical sensor	Measuring power display	√	√
	Measuring range	√	Can be set remotely
	BW/interval	√	Can be set remotely
	Averaging	√	Can be set remotely
	Optical modulation mode	√	Can be set remotely
	Max/min value memory	√	
	Measurement condition/measuring value saving	√	
	Relative measurement	√	
	Reference measurement	√	
	Calibration measurement	√	
	Wavelength calibration	√	√
	Unit*	√	√
	Sensor head*	√	
DFB-LD	Attenuation	√	√
	Variable wavelength	√	√
	Modulation frequency	√	Can be set remotely
FP-LD	Attenuation	√	√
	Modulation frequency	√	Can be set remotely
	Changed wavelength (2 wavelength unit)	√	√
SLD	Modulation frequency	√	Can be set remotely

* Unit: MU931311B, MU931421B, MU931422B, MU931431A
Sensor head: MA9331A, MA9332A, MA9333A

Specifications

• MT9812B Multi Channel Box

Plug-in units[*1]	9 max.
Display	7 segments LED, 7 digits (sign: 1 digit, numerical value: 6 digits)
Remote control	GPIB, RS-232C
Laser safety mechanism	Remote inter-lock, optical output control (key control)
Environmental conditions	Operating temperature/humidity[*2]: 0° to 40°C/≤90% (no condensation) Storage temperature: –30° to +71°C
Power	85 to 132/170 to 250 Vac, 47.5 to 63 Hz, ≤250 VA
Dimensions and mass	426 (W) x 133 (H) x 451 (D) mm, ≤9 kg (without units)
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class D) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)

*1: Only one MU951001A can be installed into MT9812B
*2: Narrowest temperature range of the plug-in units or MT9812B

• DFB-LD light sources

Model	MU952501A/952502A/952503A/952504A/952505A	MU952601A/952602A/952603A/952604A/952605A/952606A
Optical element	DFB-LD	
Applicable optical fiber	SM (ITU-T G.652)	
Specified wavelength range (fp)[*1]	191.7 to 195.9 THz (1563.86 to 1530.33 nm)	186.3 to 191.6 THz (1609.19 to 1564.68 nm)
Center optical frequency[*2]	fp ±0.01 THz (approx. ±0.08 nm)	
Spectrum half width[*2]	≤30 MHz	
Optical output power[*2]	+10 ±1 dBm	+7 ±1 dBm
Optical power stability	Time stability (short term)[*2, *3, *4]: ≤±0.005 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.25 dB	Time stability (short term)[*2, *3, *4]: ≤±0.01 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.25 dB
Center frequency stability	Time stability (short term)[*2, *4]: ≤±2 GHz (approx. ±0.02 nm) Time stability (long term)[*2, *5]: ≤±4 GHz (approx. ±0.04 nm)	
Optical frequency tuning	Tuning range: fp ±60 GHz (approx. ±0.48 nm), Step: 1 GHz (approx. 0.01 nm) Accuracy[*2]: ≤±10 GHz (setting to fp + 60 GHz or fp – 60 GHz, 25°C)	
Internal modulation	Frequency[*2]: 270 Hz, 1 kHz, 2 kHz ±0.1% Duty: 50% ±5%, Extinction ratio: ≥13 dB	
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25°C when set to 6.00 dB)	
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb	
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC[*7]	
Warm-up time	1 h (after optical output on)	
Environmental conditions	Operating temperature/humidity: +15° to +35°C/≤90% (no condensation); Storage temperature: –25° to +71°C	
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	

Note: Wavelengths in vacuum
*1: Specify an optical frequency (wavelength) and model name from the ordering information.
*2: At CW, optical attenuation setting (0.00 dB), center optical frequency (fp) using SM fiber (ITU-T G.652) and FC-PC connector
*3: When return loss seen from light source side is 40 dB min.
*4: 5 min at constant temperature (at one point from 20 to 30°C)
*5: 1 h at constant temperature
*6: 8 h at 15° to 35°C
*7: Specified connector for optical connector option supplied as standard accessory.
If connector not specified, FC-PC (Option 37) supplied as standard.

• FP-LD light sources

Model	MU951301A	MU951501A	MU951001A[*1]
Optical element	FP-LD		
Fiber	SM fiber (ITU-T G.652)		
Wavelength[*2]	1310 ±20 nm	1550 ±20 nm	1310/1550 ±20 nm
Spectral half-width[*2]	≤5 nm	≤10 nm	≤5 nm (1310 nm), ≤10 nm (1550 nm)
Optical output power[*2]	+7 ±1 dBm		
Optical output power stability	Time stability (short term)[*2, *3, *4]: ≤±0.002 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.1 dB		Time stability (short term)[*2, *3, *4]: ≤±0.005 dB Time stability (long term)[*2, *3, *5]: ≤±0.05 dB Temperature stability[*2, *3, *6]: ≤±0.15 dB
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB		
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25°C when set to 6.00 dB)		
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb		
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC[*7]		

Continued on next page

Model	MU951301A	MU951501A	MU951001A[*1]
Warm-up time	1 h (after optical output on)		
Environmental conditions	Operating temperature/humidity: 0° to +50°C/≤90% (no condensation); Storage Temperature: –25° to +71°C		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g		

Note: Wavelengths in vacuum
*1: Only one MU951001A can be installed into MT9812B.
*2: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector
*3: When return loss seen from light source side is 40 dB min.
*4: 15 min at constant temperature (at one point from +20 to +30°C)
*5: 6 h at constant temperature
*6: 8 h at 0° to +50°C
*7: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

• MU954501A Light Source (SLD)

Optical element	SLD
Fiber	SM fiber (ITU-T G.652)
Wavelength[*1]	1550 ±20 nm
Spectral half-width[*1]	≥40 nm
Optical output power[*1]	–3 ±1 dBm
Optical output power stability	Time stability (short term)[*1, *2, *3]: ≤±0.01 dB Time stability (long term)[*1, *2, *4]: ≤±0.1 dB Temperature stability[*1, *2, *5]: ≤±0.5 dB
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25°C when set to 6.00 dB)
Laser safety mechanism	JIS, IEC60825-1: Class 1, 21CFR1040.10: Class I
Optical connector[*6]	FC, ST, DIN, HMS-10/A, SC (all PC type)
Warm-up time	1 h (after optical output on)
Environmental conditions	Operating temperature/humidity: 0° to +50°C/≤90% (no condensation) Storage Temperature: –40° to +71°C
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g

Note: Wavelengths in vacuum, please contact us for 1310 nm SLD light source.
*1: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector
*2: When return loss seen from light source side is 40 dB min.
*3: 15 min at constant temperature
*4: 6 h at constant temperature
*5: 8 h at 0° to 50°C
*6: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

• Optical sensors

Model	MU931311A	MU931421A	MU931422A
Element	InGaAs-PD		
Input type	Fiber		
Applicable optical fiber	SM (ITU-T G.652)		9/125 to 62.5/125 µm (NA: ≤0.29)
Wavelength range	800 to 1600 nm	750 to 1700 nm	
Optical power measurement range[*1]	CW: +10 to –110 dBm MOD: +7 to –90 dBm	CW: +10 to –80 dBm MOD: +7 to –90 dBm	
Noise level[*2]	≤–93 dBm	≤–73 dBm	
Polarization dependency[*3]	≤0.02 dB		≤0.05 dB
Return loss[*3]	≥40 dB		–
Optical power measurement uncertainty	Reference conditions[*4]: ±2%, Operating conditions[*5]: ±3.5%		
Linearity[*6]	±0.05 dB (+10 to 0 dBm), ±0.01 dB ±0.3 pW (–90 to 0 dBm)	±0.05 dB (+10 to 0 dBm), ±0.01 dB ±30 pW (–70 to 0 dBm)	
Calibration factor input	–99.999 to +99.999 dB		
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units		
Zero set operation	Automatic zero calibration		
Range select	Auto, manual		
Modulated light reception	CW/MOD selectable, MOD: 270 Hz, 1 kHz, 2 kHz		
Measurement interval[*7]	1, 10, 20, 50, 100, 200, 500 ms, 1 s to 99 h 59 min 59 s		
Average setting	Off, 2, 5, 10, 20, 50, 100, 200, 500, 1000 times		
Analog output[*8]	Approx. +2 V		
Bandwidth select[*9]	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10, 100 kHz (CW mode only)	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10 kHz (CW mode only)	
Optical connector[*10]	FC-PC, ST, DIN, HMS-10/A, SC		
Environmental conditions	Operating temperature/humidity: 0° to +50°C/≤90% (no condensation); storage: –40° to +71°C		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	41 (W) x 78 (H) x 335 (D) mm, ≤550 g	

∗1 Wavelength: 1300 nm
∗2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1300 nm
∗3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
∗4 Reference conditions
SM fiber (ITU-T G.652), master FC connector
Power level: 100 µW (–10 dBm), CW light, wavelength: 1300 nm, ambient temperature: 23˚ ±2˚C
At day of calibration, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
∗5 Operating conditions
SM Fiber (ITU-T G.652), master FC connector, CW light, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), power level: 100 µW (–10 dBm), ambient temperature: 23˚ ±5˚C, within 1 year after calibration, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A), Uncertainty increase by 1% if either a fiber other than a SM fiber (ITU-T G.652) or an APC connector is used with the MU931422A.
∗6 Measurement conditions: Constant temperature within 23˚ ±5˚C, bandwidth: auto/0.1/1/10 Hz, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), CW light, power level: 100 µW (–10 dBm) reference, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
∗7 Only record measurements for measurement interval of ≤100 ms
∗8 Full-scale value for each measurement range
∗9 Approx. 3 dB bandwidth. Response time at bandwidth setting of 100 kHz varies according to analog output amplitude
∗10 Specify connector for optical connector option supplied as standard accessory. If connector not specified, FC-PC (Option 37) supplied as standard.

• Optical sensor (high-power)

Model	MU931431A
Element	InGaAs-PD
Input type	Fiber
Applicable optical fiber	9/125 to 62.5/125 µm (NA: ≤0.29), PC, APC polish conformity
Wavelength range	940 to 1640 nm
Optical power measurement range∗1	CW: +33 to –50 dBm
Noise level∗2	≤–43 dBm
Polarization dependency∗3	PC connector: ≤±0.025 dB, APC connector: ≤±0.05 dB
Optical power measurement accuracy	Reference conditions∗4: ±4% Operating conditions∗5: ±5%
Linearity∗6	±0.05 dB ±30 nW (+33 to –40 dBm)
Zero set operation	Automatic zero calibration
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units
Measurement interval∗7	1 ms to 99 h 59 min 59 s
Average setting	2 to 1000 times
Analog output∗8	Approx. +2 V
Bandwidth select∗9	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 20 kHz
Optical connector∗10	FC, ST, DIN, HMS-10/A, SC, MU, LC
Environmental conditions	Operating temperature/humidity: 0˚ to +40˚C/≤90% (no condensation) Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤880 g

∗1 Wavelength: 1550 nm
∗2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1550 nm
∗3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
∗4 Reference conditions,
Connector adapter, SM fiber (ITU-T.G.652), APC connector
Power level 1 W (+30 dBm), CW light, and wavelength 1550 nm
Ambient temperature 23 ±2˚C, humidity 60 % ±10 %
Warm-up time 30 minutes, day of calibration.
∗5 Operating conditions
Connector adapter, SM fiber (ITU-T G.652), APC connector, power level: 1 W (30 dBm)
CW light, wavelength: 980 ±1 nm, 1240 to 1340 nm, 1440 to 1640 nm
Ambient temperature: 23˚ ±5˚C, within 6 months after calibration
warm-up: 30 min
Uncertainty increase by 1% if either NA ≤0.29 fiber is used.
2 % added when wavelength besides above are used (However, humidity 60 % ±10 %)
∗6 Measurement conditions
Constant temperature within 23˚ ±5˚C, any wavelength in 1000 to 1650 nm, CW light, power level: 1 W (+30 dBm) reference
Bandwidth: auto/0.1/1/10 Hz, warm-up: 30 min
∗7 Only record measurements for measurement interval of ≤20 ms
∗8 Full-scale value for each measurement range
∗9 Approx. 3 dB bandwidth
∗10 Specify connector for optical connector option supplied as standard accessory.
If connector not specified, FC (Option 37) supplied as standard.

Ordering information

Please specify the model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MT9812B	Multi Channel Box	
	Standard accessories	
J0895	RCA short pin (for remote inter-rock):	1 pc
J0896	RCA plug (for remote inter-rock):	1 pc
Z0391	Key (for laser output control):	2 pcs
F0013	Fuse, 5 A (for 100/200 Vac):	2 pcs
	Power cord, 2.6 m:	1 pc
B0425	Blank panel:	8 pcs
W1555AE	MT9812B operation manual:	1 copy
	Option	
MT9812B-01	High power sensor option (for MU931431A)	
	Application parts	
J0006	GPIB cable, 0.5 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0009	GPIB cable, 4 m	
J0655A	RS-232C cable (9P-25P, cross)	
J0654A	RS-232C cable (9P-9P, cross)	
	[Light sources]	
	Main frame	
MU952501A	DFB-LD Light Source*1	
MU952502A	DFB-LD Light Source*1	
MU952503A	DFB-LD Light Source*1	
MU952504A	DFB-LD Light Source*1	
MU952505A	DFB-LD Light Source*1	
MU952601A	DFB-LD Light Source*1	
MU952602A	DFB-LD Light Source*1	
MU952603A	DFB-LD Light Source*1	
MU952604A	DFB-LD Light Source*1	
MU952605A	DFB-LD Light Source*1	
MU952606A	DFB-LD Light Source*1	
MU951301A	FP-LD Light Source	
MU951501A	FP-LD Light Source	
MU951001A	Switchable FP-LD Light Source	
	Standard accessory	
	Optical connector adapter*2	
	Options	
MU952501A-01	Light source (fp: 193.10 THz, 1552.52 nm)	
MU952501A-02	Light source (fp: 193.20 THz, 1551.72 nm)	
MU952501A-03	Light source (fp: 193.30 THz, 1550.92 nm)	
MU952501A-04	Light source (fp: 193.40 THz, 1550.12 nm)	
MU952501A-05	Light source (fp: 193.50 THz, 1549.32 nm)	
MU952501A-06	Light source (fp: 193.60 THz, 1548.51 nm)	
MU952501A-07	Light source (fp: 193.70 THz, 1547.72 nm)	
MU952501A-08	Light source (fp: 193.80 THz, 1546.92 nm)	
MU952501A-09	Light source (fp: 193.90 THz, 1546.12 nm)	
MU952501A-10	Light source (fp: 194.00 THz, 1545.32 nm)	
MU952502A-01	Light source (fp: 192.10 THz, 1560.61 nm)	
MU952502A-02	Light source (fp: 192.20 THz, 1559.79 nm)	
MU952502A-03	Light source (fp: 192.30 THz, 1558.98 nm)	
MU952502A-04	Light source (fp: 192.40 THz, 1558.17 nm)	
MU952502A-05	Light source (fp: 192.50 THz, 1557.36 nm)	
MU952502A-06	Light source (fp: 192.60 THz, 1556.55 nm)	
MU952502A-07	Light source (fp: 192.70 THz, 1555.75 nm)	
MU952502A-08	Light source (fp: 192.80 THz, 1554.94 nm)	
MU952502A-09	Light source (fp: 192.90 THz, 1554.13 nm)	
MU952502A-10	Light source (fp: 193.00 THz, 1553.33 nm)	
MU952503A-07	Light source (fp: 191.70 THz, 1563.86 nm)	
MU952503A-08	Light source (fp: 191.80 THz, 1563.05 nm)	
MU952503A-09	Light source (fp: 191.90 THz, 1562.23 nm)	
MU952503A-10	Light source (fp: 192.00 THz, 1561.42 nm)	
MU952504A-01	Light source (fp: 194.10 THz, 1544.53 nm)	
MU952504A-02	Light source (fp: 194.20 THz, 1543.73 nm)	
MU952504A-03	Light source (fp: 194.30 THz, 1542.94 nm)	
MU952504A-04	Light source (fp: 194.40 THz, 1542.14 nm)	
MU952504A-05	Light source (fp: 194.50 THz, 1541.35 nm)	
MU952504A-06	Light source (fp: 194.60 THz, 1540.56 nm)	
MU952504A-07	Light source (fp: 194.70 THz, 1539.77 nm)	
MU952504A-08	Light source (fp: 194.80 THz, 1538.98 nm)	

Model/Order No.	Name
MU952504A-09	Light source (fp: 194.90 THz, 1538.19 nm)
MU952504A-10	Light source (fp: 195.00 THz, 1537.40 nm)
MU952505A-01	Light source (fp: 195.10 THz, 1536.61 nm)
MU952505A-02	Light source (fp: 195.20 THz, 1535.82 nm)
MU952505A-03	Light source (fp: 195.30 THz, 1535.04 nm)
MU952505A-04	Light source (fp: 195.40 THz, 1534.25 nm)
MU952505A-05	Light source (fp: 195.50 THz, 1533.47 nm)
MU952505A-06	Light source (fp: 195.60 THz, 1532.68 nm)
MU952505A-07	Light source (fp: 195.70 THz, 1531.90 nm)
MU952505A-08	Light source (fp: 195.80 THz, 1531.12 nm)
MU952505A-09	Light source (fp: 195.90 THz, 1530.33 nm)
MU952601A-01	Light source (fp: 191.10 THz, 1568.77 nm)
MU952601A-02	Light source (fp: 191.20 THz, 1567.95 nm)
MU952601A-03	Light source (fp: 191.30 THz, 1567.13 nm)
MU952601A-04	Light source (fp: 191.40 THz, 1566.31 nm)
MU952601A-05	Light source (fp: 191.50 THz, 1565.50 nm)
MU952601A-06	Light source (fp: 191.60 THz, 1564.68 nm)
MU952602A-01	Light source (fp: 190.10 THz, 1577.03 nm)
MU952602A-02	Light source (fp: 190.20 THz, 1576.20 nm)
MU952602A-03	Light source (fp: 190.30 THz, 1575.37 nm)
MU952602A-04	Light source (fp: 190.40 THz, 1574.54 nm)
MU952602A-05	Light source (fp: 190.50 THz, 1573.71 nm)
MU952602A-06	Light source (fp: 190.60 THz, 1572.89 nm)
MU952602A-07	Light source (fp: 190.70 THz, 1572.06 nm)
MU952602A-08	Light source (fp: 190.80 THz, 1571.24 nm)
MU952602A-09	Light source (fp: 190.90 THz, 1570.42 nm)
MU952602A-10	Light source (fp: 191.00 THz, 1569.59 nm)
MU952603A-01	Light source (fp: 189.10 THz, 1585.36 nm)
MU952603A-02	Light source (fp: 189.20 THz, 1584.53 nm)
MU952603A-03	Light source (fp: 189.30 THz, 1583.69 nm)
MU952603A-04	Light source (fp: 189.40 THz, 1582.85 nm)
MU952603A-05	Light source (fp: 189.50 THz, 1582.02 nm)
MU952603A-06	Light source (fp: 189.60 THz, 1581.18 nm)
MU952603A-07	Light source (fp: 189.70 THz, 1580.35 nm)
MU952603A-08	Light source (fp: 189.80 THz, 1579.52 nm)
MU952603A-09	Light source (fp: 189.90 THz, 1578.69 nm)
MU952603A-10	Light source (fp: 190.00 THz, 1577.86 nm)
MU952604A-01	Light source (fp: 188.10 THz, 1593.79 nm)
MU952604A-02	Light source (fp: 188.20 THz, 1592.95 nm)
MU952604A-03	Light source (fp: 188.30 THz, 1592.10 nm)
MU952604A-04	Light source (fp: 188.40 THz, 1591.26 nm)
MU952604A-05	Light source (fp: 188.50 THz, 1590.41 nm)
MU952604A-06	Light source (fp: 188.60 THz, 1589.57 nm)
MU952604A-07	Light source (fp: 188.70 THz, 1588.73 nm)
MU952604A-08	Light source (fp: 188.80 THz, 1587.88 nm)
MU952604A-09	Light source (fp: 188.90 THz, 1587.04 nm)
MU952604A-10	Light source (fp: 189.00 THz, 1586.20 nm)
MU952605A-01	Light source (fp: 187.10 THz, 1602.31 nm)
MU952605A-02	Light source (fp: 187.20 THz, 1601.46 nm)
MU952605A-03	Light source (fp: 187.30 THz, 1600.60 nm)
MU952605A-04	Light source (fp: 187.40 THz, 1599.75 nm)
MU952605A-05	Light source (fp: 187.50 THz, 1598.89 nm)
MU952605A-06	Light source (fp: 187.60 THz, 1598.04 nm)
MU952605A-07	Light source (fp: 187.70 THz, 1597.19 nm)
MU952605A-08	Light source (fp: 187.80 THz, 1596.34 nm)
MU952605A-09	Light source (fp: 187.90 THz, 1595.49 nm)
MU952605A-10	Light source (fp: 188.00 THz, 1594.64 nm)
MU952606A-03	Light source (fp: 186.30 THz, 1609.19 nm)
MU952606A-04	Light source (fp: 186.40 THz, 1608.33 nm)
MU952606A-05	Light source (fp: 186.50 THz, 1607.47 nm)
MU952606A-06	Light source (fp: 186.60 THz, 1606.60 nm)
MU952606A-07	Light source (fp: 186.70 THz, 1605.74 nm)
MU952606A-08	Light source (fp: 186.80 THz, 1604.88 nm)
MU952606A-09	Light source (fp: 186.90 THz, 1604.03 nm)
MU952606A-10	Light source (fp: 187.00 THz, 1603.17 nm)
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)

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Model/Order No.	Name
	[Light source]
	Main frame
MU954501A	Light Source (SLD)[*3]
	Standard accessories
J0617B	Optical connector adapter[*3]
W2023AE	MU954501A instruction manual: 1 copy
	Optical connector options
MU954501A-37	FC-PC connector
MU954501A-38	ST connector
MU954501A-39	DIN connector
MU954501A-40	SC connector
MU954501A-43	HMS-10/A connector
	Application parts
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A)
J0619B	Replaceable optical connector (SC)
	[Optical sensor]
	Main frame
MU931311A	Optical Sensor
MU931421A	Optical Sensor
	Standard accessory
	Optical connector adapter[*2]
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type with connector, RL >50 dB, SM), 2 m
MZ8012A	Connector Cleaning Set
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Main frame
MU931422A	Optical Sensor (MA9005A Connector Adapter attached)
	Standard accessory
	Optical connector adapter (for MU931311B/931421B)[*2]
W1624AE	MU931422B operation manual
	Applications parts
MA9005A-32	Connector adapter (MU, user replaceable)
MA9005A-33	Connector adapter (LC, user replaceable)
MA9005A-37	Connector adapter (FC, user replaceable)
MA9005A-38	Connector adapter (ST, user replaceable)
MA9005A-39	Connector adapter (DIN, user replaceable)
MA9005A-40	Connector adapter (SC, user replaceable)
MA9005A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type, with connector, RL >50 dB, SM), 2 m
MZ8012A	Connector Cleaning Set
B0444A	Cap R
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)

Model/Order No.	Name
	Main frame
MU931431A	Optical Sensor
	Standard accessory
	Optical connector adapter[*2]
W1896AE	MU931431A operation manual
	Applications parts
MA9005B-32	Connector adapter (MU, user replaceable)
MA9005B-33	Connector adapter (LC, user replaceable)
MA9005B-37	Connector adapter (FC, user replaceable)
MA9005B-38	Connector adapter (ST, user replaceable)
MA9005B-39	Connector adapter (DIN, user replaceable)
MA9005B-40	Connector adapter (SC, user replaceable)
MA9005B-43	Connector adapter (HMS-10/A, user replaceable)
J1078A	AG adapter
	Optical connector options (for light sources and optical sensors)
[Model]-32	MU connector (user replaceable)
[Model]-33	LC connector (user replaceable)
[Model]-37	FC connector (user replaceable)
[Model]-38	ST connector (user replaceable)
[Model]-39	DIN connector (user replaceable)
[Model]-40	SC connector (user replaceable)
[Model]-43	HMS-10/A connector (user replaceable)

[*1] Specify an optical frequency (wavelength) and model name when ordering.

[*2] When ordering, the option specified connector is supplied as standard. Specified the option number after the light source or optical sensor model number. If a connector is not specified, a FC (Option 37) connector is supplied as standard. These are applied to DFB-LD unit, FP-LD unit, SLD unit and optical sensor. However, MU and LC connecter option are only apply to MU931422B, MA9331A, MA9332A and MA9333A.

[*3] Connector for specified options at ordering supplied as standard. Specify by appending number after model. If connector not specified, FC-PANDA (Option 37) supplied as standard.

OPTICAL TIME DOMAIN REFLECTOMETER
MW9076 Series
1.31/1.45/1.55/1.625 µm (SM), 0.85/1.3 µm (GI)

CE

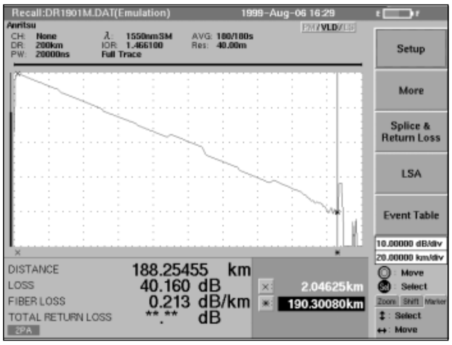
Simple Measurement of Chromatic Dispersion

Features
- 45 dB high dynamic range
- 8 m short dead zone
- Simple measurement of chromatic dispersion from one end of optical fiber
- Measurement in 10 s (Full-Auto mode), 0.15 s real-time sweep
- 5 cm high resolution, 50,000 sampling points
- 8.4 inch TFT-LCD color display

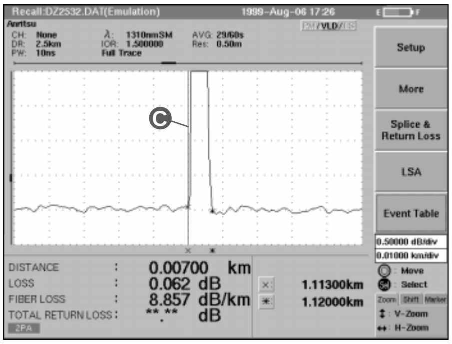
Model		MW9076B1	MW9076B	MW9076C	MW9076D1	MW9076J	MW9076K
Optical fiber		SM	SM	SM	SM	GI	GI
Wavelength		1.31/1.55 µm ± 25 nm	1.31/1.55 µm ± 25 nm	1.31/1.55/ 1.625 µm ± 25 nm	1.31/1.45/1.55/ 1.625 µm ± 3 nm	0.85 µm ± 30 nm	0.85/1.3 µm ± 30 nm
Dynamic range		40.5/38.5 dB (typical value)	45/43 dB (typical value)	41.5/39.5/37 dB	34.5/33.5/32.5/30.0 dB	21 dB	21/25 dB
Dead zone (Fresnel/ back-scattered)		1.6/8 m	1.6/8 m	1.6/8 m	3/25 m	2/7 m	2/7 m
Chromatic dispersion					√		
Light source function			√	√			
Options	Visible LD	√	√	√	√	√	√
	Optical power meter	√	√	√			
	High power optical power meter	√	√	√			
	Optical channel selector	√	√	√			
Features		• High cost performance • Short dead zone • Low cost	• Highest class model • Wide dynamic range • Short dead zone	• Three wavelengths • L-band measurement	• Chromatic dispersion measurement • Four wavelengths • Wavelength accuracy: ±3 nm	• For GI fiber • Short dead zone	• For GI fiber • Dual wavelengths • Short dead zone

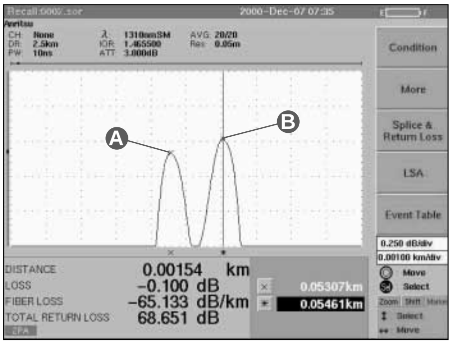
Performance and functions

• High dynamic range
When using a wavelength of 1.55 µm, a point about 190 km distant can be measured.


Recall:DR1901M.DAT(Emulation) 1999–Aug–06 16:29
CH: None DR: 200km PW: 20000ns
λ: 1550nmSM IOR: 1.466100 Full Trace
AVG: 180/180s Res: 40.00m
DISTANCE 188.25455 km
LOSS 40.160 dB
FIBER LOSS 0.213 dB/km
TOTAL RETURN LOSS **.** dB
×: 2.04625km
∗: 190.30080km
10.00000 dB/div
20.00000 km/div

• Short dead zone
Clearly measure up to near end by 8 m dead zone (back-scatter, SM unit)


Recall:DZ2532.DAT(Emulation) 1999–Aug–06 17:26
CH: None DR: 2.5km PW: 10ns
λ: 1310nmSM IOR: 1.500000 Full Trace
AVG: 29/60s Res: 0.50m
DISTANCE : 0.00700 km
LOSS : 0.062 dB
FIBER LOSS : 8.857 dB/km
TOTAL RETURN LOSS : **.** dB
×: 1.11300km
∗: 1.12000km
0.50000 dB/div
0.01000 km/div


Recall:0007.sor 2000–Dec–07 07:35
CH: None DR: 2.5km PW: 10ns
λ: 1310nmSM IOR: 1.465500 ATT: 3.000dB
AVG: 20/20 Res: 0.05m
DISTANCE 0.00154 km
LOSS –0.100 dB
FIBER LOSS –65.133 dB/km
TOTAL RETURN LOSS 68.651 dB
×: 0.05307km
∗: 0.05461km
0.250 dB/div
0.00100 km/div

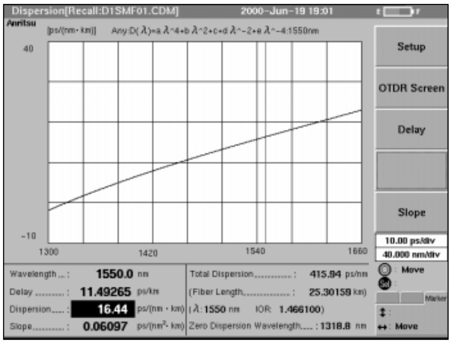
• Chromatic dispersion measurement
The MW9076D1 has a built-in function for measuring chromatic dispersion even outdoors. The chromatic dispersion can be measured automatically over a wide range from 1300 to 1660 nm from one end of the fiber. The dispersion reproducibility is ±0.05 ps/(nm · km)* and the dynamic range is 30 dB. The MW9076D1 can be operated from an external PC using remote commands to measure the chromatic dispersion. For detail of the chromatic dispersion measurement, refer to the document of "product introduction MW9076 series Optical Time Domain Reflectometer".

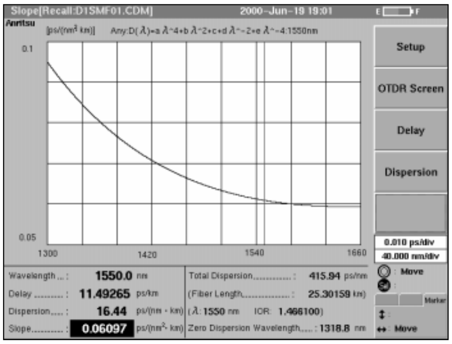
*: Measured with 25 km of 1.3 µm zero-dispersion fiber (ITU-T G.652) at 1550 nm.

• Fresnel reflection
The far-end Fresnel reflection can be measured for four wavelengths (1310/1450/1550/1625 nm).

• Group delay characteristics
The fitting formula supports cubic or quintic Sellmeier, and polynomials can be applied to various types of fibers.

• Chromatic dispersion characteristics
The zero and total dispersion can be displayed along with the delay, dispersion and dispersion slope at 0.1 nm steps.


Dispersion[Recall:D1SMF01.CDM] 2000–Jun–19 19:01
[ps/(nm· km)] Any:D(λ)=aλ^4+bλ^2+c+dλ^–2+eλ^–4:1550nm
Wavelength ... : 1550.0 nm
Delay .... : 11.49265 ps/km
Dispersion..... : 16.44 ps/(nm · km)
Slope........... : 0.06097 ps/(nm²· km)
Total Dispersion............. : 415.94 ps/nm
(Fiber Length................ : 25.30159 km)
(λ: 1550 nm IOR: 1.466100)
Zero Dispersion Wavelength.... : 1318.8 nm
10.00 ps/div
40.000 nm/div

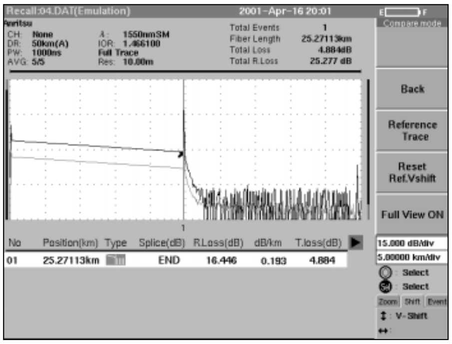

Slope[Recall:D1SMF01.CDM] 2000–Jun–19 19:01
[ps/(nm² km)] Any:D(λ)=aλ^4+bλ^2+c+dλ^–2+eλ^–4:1550nm
Wavelength ... : 1550.0 nm
Delay .... : 11.49265 ps/km
Dispersion..... : 16.44 ps/(nm · km)
Slope........... : 0.06097 ps/(nm²· km)
Total Dispersion............. : 415.94 ps/nm
(Fiber Length................ : 25.30159 km)
(λ: 1550 nm IOR: 1.466100)
Zero Dispersion Wavelength.... : 1318.8 nm
0.010 ps/div
40.000 nm/div

• High-speed measurement
It takes only 10 seconds to measure and display the waveform and connection loss on one screen. Just one press of the Start key is all that is needed to make measurement.

• Full automatic mode
Measurement results are displayed by simply pressing the Start key. All complicated settings of distance range, pulse width, attenuator, and maker can be automatically executed. Measurement speed in this mode was significantly increased. When the wavelengths are set to ALL, wavelengths are automatically changed.

• Repeated measurement
A series of operations, such as measurement, wavelength switching, data saving, optical channel switching, and next optical fiber measurement, can be executed automatically under preset measurement conditions. This mode is ideal for measuring a multi-core optical fiber.

• Waveform comparison function
Measured and saved data can be compared on the same screen. In addition, differences can be displayed as a waveform for simple observation of distance and level differences. This is useful for checking aging changes or comparing several fibers.

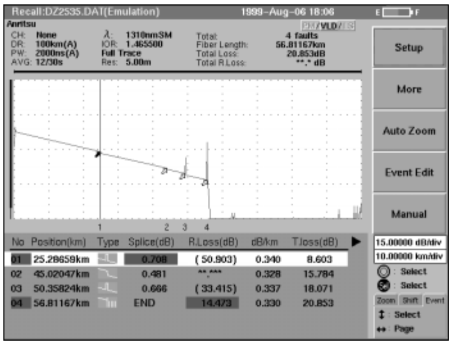

Recall:04.DAT(Emulation) 2001–Apr–16 20:01
CH: None DR: 50km(A) PW: 1000ns AVG: 5/5
λ: 1550nmSM IOR: 1.466100 Full Trace Res: 10.00m
Total Events 1
Fiber Length 25.27113km
Total Loss 4.884dB
Total R.Loss 25.277 dB

No	Position(km)	Type	Splice(dB)	R.Loss(dB)	dB/km	T.loss(dB)
01	25.27113km		END	16.446	0.193	4.884

15.000 dB/div
5.00000 km/div

- **Warning level setup function**

In automatic measurement mode, an event warning value can also be set in addition to a detection threshold value. For example, the threshold value can be set to the acceptance level, and warning value to a pass/rejection decision level. In this case, all events will be detected, and those exceeding the warning value are displayed in another color, therefore, enabling the operator to easily identify possible "borderline" events.



Recall:DZ2535.DAT(Emulation) 1999–Aug–06 18:06

CH: None
DR: 100km(A)
PW: 2000ns(A)
AVG: 12/30s
λ: 1310nmSM
IOR: 1.465500
Full Trace
Res: 5.00m
Total: 4 faults
Fiber Length: 56.81167km
Total Loss: 20.853dB
Total R.Loss: **.* dB

No	Position(km)	Type	Splice(dB)	R.Loss(dB)	dB/km	T.loss(dB)
01	25.28659km		0.708	(50.903)	0.340	8.603
02	45.02047km		0.481	**.***	0.328	15.784
03	50.35824km		0.666	(33.415)	0.337	18.071
04	56.81167km		END	14.473	0.330	20.853

- **Communication light check function**

When measuring a fiber in service, there is a possibility of mis-measurement by an OTDR. To guard against the risk of mis-measurement, this check function checks for the presence of light other than the OTDR optical measurement pulse.

- **Optical channel selector control function**

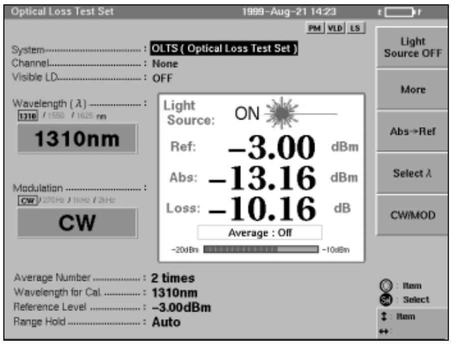
In addition to using the built-in optical channel selector, external MN9662A/9664A Optical Channel Selector can be controlled via the RS-232C interface from an OTDR. By using these selectors, an optical fibercable consisting of up to 32 cores can be measured automatically.

- **Visible LD**

A 635 nm visible LD option is available for the detection of breaks and loss points along the fiber to be measured.

- **Light source, power meter**

Optical fiber loss can be measured using the optical power meter function and light source function. Two types of optical power meters are supported: One is measurement range of –70 to +3 dBm (MW9076B/B1/C-02 option), the other is measurement range of –50 to +23 dBm (MW9076B/B1/C-03 option).



Optical Loss Test Set 1999–Aug–21 14:23

System: OLTS (Optical Loss Test Set)
Channel: None
Visible LD: OFF
Wavelength (λ): 1310nm
Modulation: CW

Light Source: ON
Ref: –3.00 dBm
Abs: –13.16 dBm
Loss: –10.16 dB
Average : Off

Average Number: 2 times
Wavelength for Cal.: 1310nm
Reference Level: –3.00dBm
Range Hold: Auto

- **VGA output terminal**

The VGA connector outputs the screen interface to a CRT monitor, which is very useful for production-line applications.

- **Large internal memory**

About 18 MB internal memory is provided as standard. The following table shows the number of waveforms which can be saved in each media.

Media	GR196	Analysis
FDD (1.4 MB)	123	67
PC-ATA card (32 MB)	2700	1520
PC-ATA card (256 MB)	16000	10600
Internal memory (18 MB)	1560	860
Hard disk (1 GB)*	32700	32700

Number of data points: 5,000

*: The hard disk is for the PC card slot (IBM Microdrive DSCM-11000 + PC card adapter)

MX907600A OTDR Emulation Software

- **Emulation function**

Measured waveform data can be analyzed using a PC.

- **Data transmission function**

Data files recorded by the MW9076 series can be transferred to a PC via the RS-232C port.

- **Both-end measurement function**

A new waveform can be composed by averaging data measured at both ends of an optical fiber.

Specifications

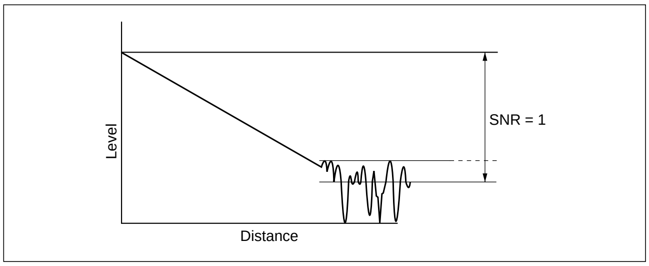
• Optical Time Domain Reflectometer (main frame)

Model	MW9076B	MW9076C	MW9076B1	MW9076J	MW9076K	MW9076D1
Wavelength	1310/1550 nm ±25 nm[*1]	1310/1550/1625 nm ±25 nm[*1]	1310/1550 nm ±25 nm[*1]	850 nm ±30 nm	850/1300 nm ±30 nm	1310/1450/1550/ 1625 nm ±3 nm[*1]
Measurable optical fiber	10/125 µm single-mode optical fiber (ITU-T G.652)			62.5/125 µm GI fiber[*2]		10/125 µm single-mode optical fiber (ITU-T G.652)
Optical connector	FC, SC, DIN, HMS-10/A, ST (replaceable, PC type)			FC, SC, DIN, ST (replaceable, PC type)		FC, SC, DIN, HMS-10/A, ST (replaceable, PC type)
Distance range	1, 2.5, 5, 10, 25, 50, 100, 200, 250, 400 km			1, 2.5, 5, 10, 25, 50, 100 km		1, 2.5, 5, 10, 25, 50, 100, 200, 250, 400 km
Pulse width	10, 20, 50, 100, 500, 1000, 2000, 4000, 10000, 20000 ns			10, 20, 50, 100 ns	10, 20, 50, 100 ns (0.85 µm) 10, 20, 50, 100, 500, 1000 ns (1.3 µm)	10, 20, 50, 100, 500, 1000, 2000, 4000, 10000, 20000 ns
Dynamic range[*3, *4] (S/N = 1)	42.5 dB (1.31 µm) 40.5 dB (1.55 µm) ∗Typical value: 45 dB (1.31 µm) 43 dB (1.55 µm)	41.5 dB (1.31 µm) 39.5 dB (1.55 µm) 37 dB (1.625 µm)	38 dB (1.31 µm) 36 dB (1.55 µm) ∗Typical value: 40.5 dB (1.31 µm) 38.5 dB (1.55 µm)	21 dB	21 dB (0.85 µm) 25 dB (1.3 µm)	34.5 dB (1.31 µm) 33.5 dB (1.45 µm) 32.5 dB (1.55 µm) 30.0 dB (1.625 µm)
Dead zone (back-scattered light)[*5]	≤8 m (1.31 µm) ≤9 m (1.55 µm)	≤8 m (1.31 µm) ≤9 m (1.55 µm) ≤12 m (1.625 µm)	≤8 m (1.31 µm) ≤9 m (1.55 µm)	≤7 m (deviation: ±0.5 dB) ≤50 m (deviation: ±0.1 dB)	≤7 m (0.85 µm, deviation: ±0.5 dB) ≤10 m (1.3 µm, deviation: ±0.5 dB) ≤50 m (deviation: ±0.1 dB)	≤25 m
Dead zone (Fresnel reflection)[*6]	≤1.6 m			≤2 m		≤3 m
Marker resolution	0.05 to 800 m			0.05 to 200 m		0.05 to 800 m
Sampling resolution	0.05 to 80 m			0.05 to 20 m		0.05 to 80 m
Sampling points[*7]	Quick mode: 5001, 6251 Normal mode: 20001, 25001 High mode: 40001, 50001					
Y-axis scale	0.25, 0.5, 1, 2.5, 5, 10, 15 dB/div (15 dB/div is indicated only at Auto and Full Auto measurement.)					
IOR settings	1.400000 to 1.699999 (0.000001 steps)					
Distance measurement accuracy	±1 m ±3 x measurement distance x 10^{-5} ±marker resolution (excluding uncertainty caused by fiber IOR)					0.1 m ±3 x measurement distance x 10^{-5} ±marker resolution (excluding uncertainty caused by fiber IOR)
Loss measurement accuracy (linearity)	±0.05 dB/dB or ±0.1 dB (whichever is greater)					
Return loss measurement accuracy	±2 dB			±4 dB		±2 dB
Automatic measurement[*8]	Measurement items: Total loss, total return loss. Each event distance, connection loss, return loss, or reflection amount (displays in table format) Threshold values Connection loss: 0.01 to 9.99 dB (in 0.01 dB steps), Return loss: 20 to 60 dB (in 0.1 dB steps), Fiber-end: 1 to 99 dB (in 1 dB steps) Warning values Splice connection loss: 0.1 to 10 dB (in 0.01 dB steps), Connector connection loss: 0.1 to 10 dB (in 0.01 dB steps), Return loss: 10 to 50 dB (in 0.1 dB steps), Fiber loss: 0.01 to 10 dB (in 0.01 dB steps), Total loss: 0.1 to 60 dB (in 0.1 dB steps), Total return loss: 10 to 50 dB (in 0.1 dB steps), Average loss: 0.01 to 10 dB (in 0.01 dB steps) Number of detected events: Up to 99 Automatic setting: Distance range, pulse width, averaging count (time) Measurement time: ≤60 s (in full automatic measurement mode) Connection check: Automatic check of front panel connector connection quality Communication light check: Check for presence of communication light in optical fiber to be measured					
Manual measurement	Measurement items: Transmission loss and distance between 2 points, loss per unit length between 2 points, connection loss, return loss/reflection amount, total return loss, average loss Real-time sweep: 0.1 to 0.2 second or less[*9]					

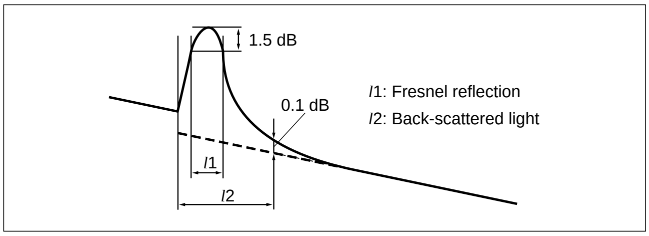
Continued on next page

Model	MW9076B	MW9076C	MW9076B1	MW9076J	MW9076K	MW9076D1
Optical loss measurement light source function	Applicable optical fibers: SM optical fiber (ITU-T G.652) Optical connectors: Shared with OTDR (same port) Light-emitting elements: FP-LD Center wavelength: 1310/1550 ±25 nm (MW9076B, CW, 25°C) 1310/1550/1625 ±25 nm (MW9076C, CW, 25°C) Spectrum width: ≤5/10 nm (MW9076B, CW, 25°C) ≤5/10/10 nm (MW9076C, CW, 25°C) Output level accuracy: –3 ±1.5 dBm (CW, 25°C, SM optical fiber: 2 m) Optical output short term stability: ≤0.1 dB [CW, at one point from –10° to +40°C (±1°C), Difference between maximum and minimum values in one min, SM optical fiber cable: 2 m] Output waveform CW, 270 Hz, 1 kHz, 2 kHz (Modulated waves are square waves.) Modulation frequency: 270 Hz/1 kHz/2 kHz ±1.5% Laser safety specification: 21CFR Class 1, IEC 60825-1 Class 1		—			
Chromatic dispersion measurement	—					Wavelength range: 1300 to 1660 nm, Wavelength accuracy: ±0.5 nm[*10] (typical), Zero-dispersion repeatability: ±0.6 nm (typical)[*11], Dispersion repeatability: ±0.05 ps/(nm·km)[*11] * Typical Dynamic range: 30 dB (4% Fresnel, typical)
Other functions	Waveform storage [Bellcore. SOR (GR-196-CORE, SR-4731) or Anritsu. Dat format, user selectable], waveform comparing function, print output (Centronics), repeated measurement function (A series of operations such as wavelength switching, waveform storage, and printing can be executed by pressing a single key.), relative distance set (zero cursor set), calendar clock, distance unit set (km, m, kf, f, mi), title input (up to 32 characters), remaining battery power display					
Laser safety specification	21CFR Class 1, IEC Pub. 60825-1 Class 1					
Power	≤35 W max. (at charging), 4 W (in standard state, MU250000A power consumption included.)					
Battery	Continuous operation: 6 h (typical value)[*12]					
Dimensions and mass	290 (W) × 194 (H) × 30 (D) mm (MW9076B/B1/C/J/K main frame) 290 (W) × 194 (H) × 75 (D) mm (MU250000A Display Unit included) ≤1.4 kg ≤3.7 kg (MU250000A display unit and battery pack included)					290 (W) × 194 (H) × 77 (D) mm (MW9076D1 main frame) 290 (W) × 194 (H) × 122 (D) mm (with MU250000A Display Unit) ≤3.1 kg (MW9076D1 main frame only), ≤5.4 kg (with MU250000A Display Unit and battery pack included)
Environmental condition	Operating temperature and humidity: –10° to 40°C, ≤ 85% (no condensation) Storage temperature and humidity: –20° to 60°C, ≤ 85% Vibration: Conforming to MIL-T-28800E Class 3 Shock: 76 cm height, 6 surfaces, 8 corners[*13] Dust-proofing: MIL-T-28800E Drip-proofing: MIL-T-28800E					
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class D) EN61326: 1997/A1: 1998 (Annex A)					
LVD	EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)					

*1 At 25°C, pulse width: 1 µs
*2 For GI fiber (core diameter: 62.5 µm ±3.0 nm, NA: 0.275 ±0.015, transmission loss: ≤3.2/0.9 dB/km (wavelength: 0.85/1.3 µm). At measurement of 50/125 µm GI fiber, the dynamic range drops by about 3.0 dB.
*3 At 25°C, pulse width: SM 20 µs, GI 100 ns (0.85 µm), 1 µs (1.3 µm)
*4 Dynamic range (one-way back-scattered light)
SNR=1: The level difference between the RMS noise level and the level where near end back-scattering occurs.



*5 Pulse width: 10 ns, return loss: SM 40 dB, GI 30 dB, deviation: ±0.1 dB (Refer to the figure right.)
*6 Pulse width: 10 ns (Refer to the figure below.)
*7 Either value is automatically selected in each mode, depending on the distance range.
*8 Automatic measurement is a supporting function which enables to operate easier, it doesn't assure results. As there is a case of miss detection, please check a waveform data, either.
*9 At quick mode
*10 Compared value with internal wavelength data at chromatic dispersion measurement
*11 Measured with 25 km of 1.3 µm zero-dispersion fiber (ITU-T G.652) at 1550 nm.
Not an error from absolute value but repeatability of measured results. Contact Anritsu Corporation in case of measuring ITU-T G.655 fiber.
*12 At back light low brightness, measurement not executed.
*13 Dropped on the floor of plywood thickness 5 cm fixed by concrete. Not applicable to the MW9076D1.



• MU250000A/A4 Display Unit

Display	MU250000A Unit: 8.4 inch color, TFT-LCD (640 x 480 pixels, transparent type, with back light) MU250000A4 Unit: 7.8 inch color, STN-LCD (640 x 480 pixels, reflective type, with front light on/off)
Interface	Serial interface: RS-232C-1 (115.2 kbps max.), with D-sub 9-pin connector RS-232C-2 (57.6 kbps max.), with mini-DIN 8-pin connector Printer interface: 8-bit parallel interface (Centronics), with D-sub, 25-pin connector Keyboard interface: IBM US ENGLISH (101 keys) 106 keys compatible, with mini-DIN 6-pin connector VGA output connector: Mini-DIN 10-pin connector
FDD	Built-in 3.5 inch (1.44 MB/720 kB)
Power supply	10 to 26.4 Vdc 100 to 250 Vac (rated), 50/60 Hz, ≤50 VA max. (Specific AC adapter is used.) Battery: CGR-B/802 Lithium ion battery pack can be used. (mounted in main frame)
Power	≤35 W
Dimensions and mass	290 (W) x 194 (H) x 45 (D) mm, ≤1.9 kg
Environmental conditions	Restricted by memory card specifications when a memory card is mounted. AC adapter: Depend on the conditions of AC adapter Operation temperature and humidity: –10° to +40°C, ≤85% (no condensation), +5° to 40°C, ≤80% (FDD is used.) Storage temperature and humidity: –20° to 60°C, ≤85% Vibration: Conform to MIL-T-28800E Class 3 Shock: 76 cm height, 6 surfaces, 8 corners* Dust proofing: Conform to MIL-T-28800E Drip proofing: Conform to MIL-T-28800E
EMC	Same as MW9076 series
LVD	Same as MW9076 series

*: Dropped on the floor of plywood (thickness 5 cm) fixed by concrete

• Battery pack: CGR-B/802D

Battery	Lithium ion secondary battery
Voltage, capacity	14.4 V, 3440 mAh (49.53 Wh)
Continuous drive time	See the MW9076 series specifications
Charging time	≤3 h
Dimensions and mass	134.5 (W) x 89.5 (H) x 20.5 (D) mm, ≤420 g

• AC adapter: ADP60WB24.0

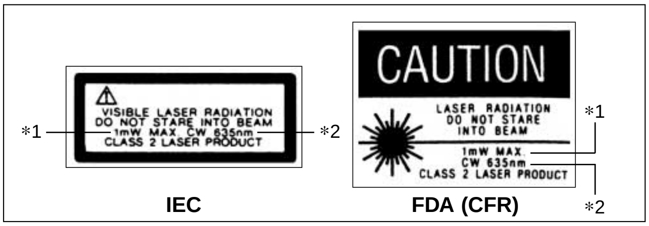
Rated AC input	100 to 240 Vac, 50/60 Hz
Rated DC output	24 Vdc, 2.5 A
Dimensions and mass	109.5 x 62.5 x 31 mm, ≤350 g
Safety specifications	UL, CSA, TUV, CE, AS
Environmental conditions	Operating temperature and humidity: 0° to +40°C, 80% Storage temperature and humidity: –20° to +80°C, 90%

• Visible light source: MW9076B/B1/C/D1/J/K-01

Central wavelength	635 ±15 nm (at 25°C)
Optical output	–3.0 ±1.5 dBm
Output optical fiber	10/125 µm, SM (ITU-T G.652)
Optical connector	FC, SC, ST, DIN, HMS-10/A (DIAMOND) *Replaceable
Optical safety	IEC Pub 60825-1 Class 2, 21CFR Class 2
Environmental conditions	Same as MW9076 series
EMC	Same as MW9076 series
LVD	Same as MW9076 series

Safety measures for laser products

This option complies with optical safety standards in Class 2 of the IEC pub. 60825-1 and the FDA (21CFR1040.10, USA); the following descriptive labels are affixed to the product (FDA labels is only affixed to product for export to the USA).



The maximum output is indicated under *1, and the wavelength under *2.

Caution: Do not look directly into the laser beam.

• Optical power meter: MW9076B/B1/C-02, MW0976B/B1/C-03

Applicable optical fiber	10/125 µm, SM (ITU-T G.652)
Optical connector	FC, SC, ST, DIN, HMS-10/A (DIAMOND) *Replaceable
Wavelength range	1.2 to 1.7 µm
Measurement range	Option 02: +3 to –70 dBm (continuous light) 0 to –73 dBm (modulated light) Option 03: +23 to –50 dBm (continuous light) +20 to –53 dBm (modulated light)
Measurement accuracy	Option 02: ±5% (–10 dBm, 1.31/1.55 µm, continuous light) Option 03: ±5% (–10 dBm, 1.31/1.55 µm, continuous light)
Environmental conditions	Same as MW9076 series
EMC	Same as MW9076 series
LVD	Same as MW9076 series

• MU960001A/960002A Optical Channel Selector Unit

Model	MU960001A	MU960002A
Configuration	1 x 4	1 x 8
Wavelength range	1.2 to 1.65 µm (The special wavelength are 1.31/1.55 µm.)	
Optical fiber	10/125 µm, SM (ITU-T G.652)	
Optical connector	FC, SC, ST, DIN, HMS-10/A (DIAMOND) *Replaceable	
Insertion loss	≤2.5 dB	≤4.5 dB
Environmental conditions	Same as MW9076 series (not applicable to the shock)	
Dimensions	290 (W) x 194 (H) x 47 (D) mm	
Mass	≤1.5 kg	≤2.0 kg
EMC	Same as MW9076 series	
LVD	Same as MW9076 series	

*MU960001A/MU960002A can not be attached to MW9076D1.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Optical Time Domain Reflectometer (main frame, requires display unit)
MW9076B	SMF 1.31/1.55 µm OTDR
MW9076B1	SMF 1.31/1.55 µm OTDR
MW9076C	SMF 1.31/1.55/1.625 µm OTDR
MW9076D1	SMF 1.31/1.45/1.55/1.625 µm OTDR
MW9076J	GIF 0.85 µm OTDR
MW9076K	GIF 0.85/1.3 µm OTDR
	Standard accessories (main frame)
W1659AE	MW9076 series operation manual: 1 copy
W1660AE	MW9076 series serial interface manual: 1 copy
	Connector adapter[*1]: 1 pc
Z0619A	Lithium ion battery pack: 1 pc
	Units
MU250000A	Display Unit (8.4 inch TFT-LCD)
MU250000A4	Display Unit (7.8 inch STN-LCD)
	Standard accessories (display unit)
ADP60WB24.0	AC adapter
Z0402	Front cover
0979	A-2 power cord[*2] (for Japan)
J0980	A-2 power cord[*2] (for USA, Canada, Taiwan)
J0981	B4 power cord[*2] (for UK, Malaysia, South Africa, Hong Kong)
J0982	C7 power cord[*2] (for Europe)
J0983	S3 power cord[*2] (for Oceania, China)
J1027	P4 power cord[*2] (for India)
J1028	D1 power cord[*2] (for Switzerland)
Z0403A	Belt with hook
MU960001A	Optical Channel Selector Unit (1 x 4 channels, with connector adapter[*1])
MU960002A	Optical Channel Selector Unit (1 x 8 channels, with connector adapter[*1])
	Battery pack
Z0619A	Lithium ion battery pack
	Software
MX907600A	OTDR Emulation Software
	Options
MW9076B/B1/C/D1-01	Visible light source (factory option)
MW9076B/B1/C-02	Optical power meter (factory option)[*3, *4]
MW9076B/B1/C-03	High power optical power meter (factory option)[*3, *4]
MW9076B/C-25	FC-APC connector (factory option)
MW9076B/C-26	SC-APC connector (factory option)
MW9076B/B1/C/D1-37	FC-PC connector
MW9076B/B1/C/D1-38	ST connector
MW9076B/B1/C/D1-39	DIN connector
MW9076B/B1/C/D1-40	SC connector
MW9076B/B1/C/D1-43	HMS-10/A (DIAMOND) connector
MW9076B/C-47	HRL-10 connector (factory option)
MU960001A-37	FC-PC connector
MU960002A-37	FC-PC connector
MU960001A-38	ST connector
MU960002A-38	ST connector
MU960001A-39	DIN connector
MU960002A-39	DIN connector
MU960001A-40	SC connector
MU960002A-40	SC connector
MU960001A-43	HMS-10/A (DIAMOND) connector
MU960002A-43	HMS-10/A (DIAMOND) connector
	Application parts
Z0434A	Keyboard (requires mini-DIN conversion adapter)
JT8MA3-NT1	PC-ATA card (8 MB)
JT16MA3-NT1	PC-ATA card (16 MB)
JT32MA3-NT1	PC-ATA card (32 MB)
JT64MA3-NT1	PC-ATA card (64 MB)
JT128MA3-NT1	PC-ATA card (128 MB)
JT256MA3-NT1	PC-ATA card (256 MB)
JT512MA3-NT1	PC-ATA card (512 MB)
J0057	Optical adapter FC type
J0635□[*5]	Optical fiber cord [with FC-PC at both ends (SM)]
B0442	Soft carrying case [440 (W) x 310 (H) x 110 (D) mm]
Z0435	Soft carrying case [430 (W) x 300 (H) x 170 (D) mm]
Z0436	Hard carrying case (holds main frame and thermal printer)

Continued on next page

Model/Order No.	Name
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A, HFS-13/A)
J0619B	Replaceable optical connector (SC)
J0441	Total internal reflection cord (SM)
J1039	Total internal reflection cord (SC-PC)
J0654A	Serial interface cord (for remote control with IBM-PC/AT or J-310, 9 pin-9 pin)
J0655A	Serial interface cord (for PC-98 remote control, 9 pin-25 pin)
J0977	Serial interface cord (for connection with external optical channel selector)
J0978	VGA conversion cable (for external monitor)
J0952A	FC · PC-FC · APC(SG)-1M-SM (FC · APC closed width: 2 mm, conforms to seiko-giken)
J0953A	FC · PC-FC · APC(SI)-1M-SM (FC · APC closed width: 2.14 mm, conforms to SSI)
J0954A	SC · PC-SC · APC-1M-SM [return loss: >50 dB (SC · PC), >65 dB (SC · APC)]
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J1041A	1.31/1.55 LWPF filter cord (SC · PC), 1 m
	Peripherals
BL-80R2	High speed thermal printer*6
BL-100W	AC adapter (for BL-80R2, AC 100 to 240 V)
DPU-414-31B	Thermal printer*7
PW-4007-U1	AC adapter*7
DPU-414-31B	Thermal printer*8
PW-4007-E1	AC adapter*8
J0614	Printer connection cable (for DPU-414)
	Supplies
BL-80-30	Printer paper (for BL-80R2 thermal printer, 10 rolls/set)
TP411-28CL	Printer paper (for DPU-414 Thermal printer, 10 rolls/set)

*1: Specify one of FC, ST, DIN, SC or HMS-10/A. When the connector type is not specified, FC-PC is supplied.
*2: Specify one of A-2, B4, C7, S3, P4 or D1.
*3: The optical power meter (Option 02) and high-level-input optical power meter (Option 03) cannot be mounted at the same time.
*4: The optional optical power meter and high-level-input optical power meter cannot be set for MW9076D1.
*5: Specify the optical fiber length as A, B or C (A: 1 m, B: 2 m, C: 3 m)
*6: Operates only with AC adapter, printing width: 72 mm, printing speed: approximately 13 s (manual measure-ment result with header), 0° to +40°C, dimensions: 119 (W) x 77 (H) x 174 (D) mm, Sanei products (AC adapter and printer cable are sold separately.)
*7: 120 VAC ±10 %, 60 Hz, 0° to +40°C, Seiko products (printer cable: sold separately)
*8: 230 VAC ±10 %, 50 Hz, 0° to +40°C, Seiko products (printer cable: sold separately)

OPTICAL TIME DOMAIN REFLECTOMETER
MW9060A
1.31/1.55 µm (SM), 0.85/1.3 µm (GI)

CE GPIB

For High-Accuracy Measurement of Optical Fiber Cables

Custom-made product

The MW9060A is an upgraded version of the high-performance MW9040A/B OTDR. Anritsu's unique procedure and event-registration functions combine to reduce measurement time. The new unit also incorporates a 3.5 inch FDD and printer.

This is a universal type OTDR to be used for single mode or multimode fiber in a wide dynamic range for long distance or in a high-resolution for short distance.

There are 2 types of wide dynamic range plug-in units in the single mode (1.31 µm, 1.31/1.55 µm) whose dynamic ranges are 34 dB, 32 dB, and 34/32 dB, respectively. The long-distance optical fibers can be measured with high efficiency. There are also 2 types of high-resolution plug-in unit, one is in single mode (1.31/1.55 µm) and the other is in multimode (0.85/1.30 µm). A single mode unit realizes near-end dead zone of 8 m (MW0944B high-resolution unit), and a multimode fiber unit realizes the zone of 3 m, thus making possible for fault detection from the near end.

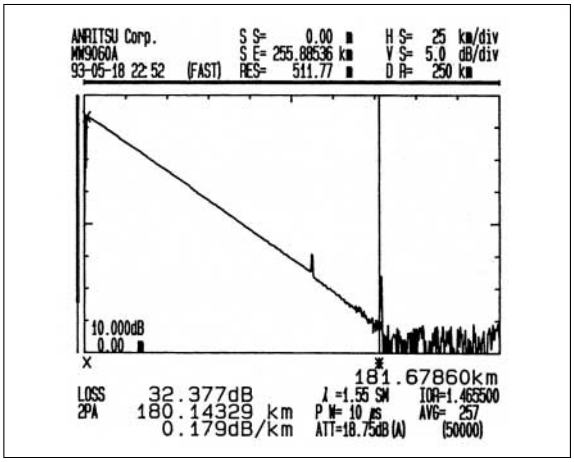
Features

- For long- and short-haul, and single-mode and multimode fiber
- Fast 0.3-s sweep speed (FAST mode, 2PA mode)
- Procedure and event registration functions shorten measurement time
- Printer and 3.5 inch FD/PMC drives as standard equipment
- Return loss measurement

Functions and Performance

- **Measurement of long optical fibers**

The MW0945B/0947B plug-in units have a dynamic range of 34/32 dB or better (1.31/1.55 µm), for measuring long optical fibers of 180 km or more. A measurement example for a long optical fiber with a transmission loss of 0.18 dB/km (1.55 µm) is shown below.



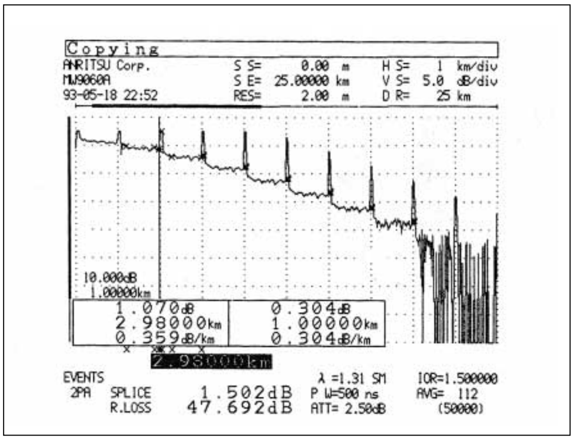
```
ANRITSU Corp.              S S=      0.00 m     H S=  25  km/div
MW9060A                    S E= 255.88536 km    V S=  5.0 dB/div
93-05-18 22:52   (FAST)    RES=    511.77 m     D R=  250 km

10.000dB
 0.00 m
X                                    *
                                      181.67860km
LOSS      32.377dB          λ =1.55 SM   IOR=1.465500
2PA      180.14329 km       P W= 10 µs   AVG=  257
           0.179dB/km       ATT=18.75dB (A)   (50000)
```

- **High-resolution measurements**

The MW0944B plug-in unit has a spatial resolution of less than 2 m and a near-end dead zone of less than 8 m, making it useful for detecting faults in short optical fibers used in buildings, etc.

- **Built-in high-speed printer**

The image displayed on the screen can be printed in about 7 seconds at 73.1 x 57.1 mm. Averaging continues even during printing and the unit also responds to key input during printing, so there is no need to wait for printing to finish.



```
Copying
ANRITSU Corp.          S S=     0.00  m     H S=    1  km/div
MW9060A                S E= 25.00000 km     V S=  5.0  dB/div
93-05-18 22:52         RES=     2.00  m     D R=   25  km

10.000dB
 1.00000km
  1.070dB          0.304dB
  2.98000km        1.00000km
  0.359dB/km       0.304dB/km
        2.98000km
EVENTS                               λ =1.31 SM     IOR=1.500000
 2PA   SPLICE     1.502dB    P W=500 ns     AVG=  112
       R.LOSS    47.692dB    ATT= 2.50dB        (50000)
```

Copy example using event function

- **PMC and FD drives**

With a 512 KB PMC, 248 measured waveform screens can be recorded. The FDD uses the MS-DOS* format, so recorded data can be read on a PC. Up to 700 measured waveform screens can be recorded on one 2HD floppy disk. PMCs offer better durability than floppy disks and are very reliable even in dusty and hot environments.

*: MS-DOS is a registered trademark of Microsoft Corporation.

- **Direct-plot function**

Direct printing to an external printer or plotter is possible using the GPIB interface.

- **Unique procedure and event registration functions**

The procedure function can be used to assign operation procedures to function keys. The same operation can then be repeated just by pressing the assigned function key. In addition, event markers can be set at any point to be measured; when the LASER-ON key is pressed, the measured results are displayed in an event table according to the marker settings.

Specifications

- **MW9060A (main frame)**

Sweep speed		Min. 0.3 s/sweep (used in fast sweep mode and 2PA mode)
Automatic search		No. of search points: Max. 5 points (at event mode off), max. 100 points (at event mode on) Threshold (dB): 0.05, 0.1, 0.3, 1.0, 3.0, 5.0
Optical return loss measurement		Provided
Waveform comparison		Displays 2 waveforms simultaneously
Smoothing function		Improves the S/N ratio of the waveform by 6 levels from level 1 through level 6
Full-trace display function		Display the full measurement trace, measured by switching each attenuator in turn
Relative distance measurement function		Display distance relative to cursor setting
Event function		Fiber length, total loss, transmission loss, return loss for fiber on either side of splice point
Procedure function		Key command sequence is recorded and assigned to a single key for automatic execution.
Built-in memory		32 waveforms (store the setting conditions at the same time)
Memory card		Plug-in memory card, 32/64/128/256/512 KB (option)
Floppy disk*1		Micro Floppy disk, storage capacity (MS-DOS*2 formatted), 2 MB/1 MB (1.44 MB/720 KB) or 1.6 MB/1 MB (1.2 MB/720 KB)
Printer		Hard copy of screen display is available by line thermal printer.
Title display		20 characters x 2 lines
Index of refraction (IOR)		1.400000 to 1.699999 (in 0.000001 steps)
Distance display units		Meters, feet, miles
CRT		6-inch, green
Interface	GPIB	Conforms to IEE-488.1 and IEEE-448.2 Device mode: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Controller mode: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C4, C7, E2
	Direct plot	Hard copy of the measurement screen to an external plotter/printer is available through GPIB.
Power supply		85 to 132 (170 to 250) Vac, 50/60 Hz ±5%, ≤160 VA
Temperature and humidity*3		–10° to +55°C (operate), –20° to +60°C (storage), ≤80%
Dimensions and mass		284 (W) x 177 (H) x 450 (D) mm, ≤12.5 kg (without plug-in units)
EMC		EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class D) EN61326: 1997/A1: 1998 (Annex A)
LVD		EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)

*1: 1 MB/1.6 MB (720 KB/1.2 MB) capability available as option
720 KB/1.44 MB: When formatting the IBM-PC series (IBM is a registered trademark of International Business Machines Corporation)
720 KB/1.2 MB: When formatting the PC-9800 series (PC-9800 series is a product of NEC.)

*2: MS-DOS is a registered trademark of Microsoft Corporation.

*3: When plug-in memory cards (PMC) are used, the operating temperature is:
PMC left inserted: –10° to +55°C
Inserting/removing PMC: 0° to +55°C
Operating temperature when floppy disk and printer are used: +5° to +35°C

• MW0944B high-resolution unit

Wavelength[*1]		1310/1550 nm ±15 nm				
Fiber under measurement		10/125 µm single-mode fiber (ITU-T G.652)				
Optical connector[*2]		FC-PC, DIAMOND-PC, ST-PC, DIN-PC, SC-PC				
Pulse width		10 ns	20 ns	100 ns	500 ns	2 µs
Dynamic range (one-way back-scattered light level)[*3,*4]	Effective	6.5/4.0 dB	8.0/5.5 dB	11.5/9.0 dB	15.0/12.5 dB	18.0/15.5 dB
	SNR=1	9.5/7.0 dB	11.0/8.5 dB	14.5/12.0 dB	18.0/15.5 dB	21.0/18.5 dB
Dynamic range (4% Fresnel reflection)[*4]	Effective	34.5/33.0 dB				
	SNR=1	37.5/36.0 dB				
Near-end dead zone[*5,*6]	Fresnel reflection	3 m	5 m	13 m	55 m	220 m
	Back-scattered light	8 m	10 m	20 m	65 m	240 m
Spatial resolution[*5,*7]	Fresnel reflection	2 m	4 m	13 m	55 m	220 m
	Back-scattered light	2 m	4 m	15 m	60 m	220 m
Mask function[*5,*8]	No. of masks	5 max. (optical)				
	Mask width	13 m	13 m	18 m	65 m	240 m
Variable near-end mask width		Provided				
Variable optical output power function[*8]		Provided				
Distance range (km)[*5]		10, 25, 50, 100				
Horizontal axis[*5]	Scale (m/div)	2.5, 5, 10, 25, 50, 100, 250, 500, 1 km (10 km range) 2.5, 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km (25 km range) 2.5, 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km, 5 km (50 km range) 2.5, 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km, 5 km, 10 km (100 km range)				
	Resolution	Sampling resolution: 5 cm to 20 m Read-out resolution: 5 cm to 200m				
	Accuracy	±1 m ±measured value (m) x 2 x 10^{-5} (does not include uncertainty in fiber index of refraction)				
Vertical axis	Scale (dB/div)	0.1, 0.25, 0.5, 1, 2.5, 5				
	Read-out resolution	0.001 dB				
	Linearity	±0.05 dB/dB				
Ambient temperature		0° to +35°C (spec. meet), –10° to +60°C(storage)				
Mass		≤2.5 kg				

• MW0945B/0947B wide dynamic range unit

Wavelength[*1]		1310 nm ±15 nm											
Fiber under measurement		10/125 µm single-mode fiber (ITU-T G.652)											
Optical connector[*9]		FC, DIAMOND, ST, DIN, SC											
Pulse width		20 ns	100 ns	500 ns	1 µs	4 µs	10 µs	20 ns	100 ns	500 ns	1 µs	4 µs	10 µs
Dynamic range (one-way back-scattered light level)[*3,*4]	Effective	15 dB	20 dB	23 dB	26 dB	31 dB	34 dB	13 dB	18 dB	21 dB	24 dB	29 dB	32 dB
	SNR=1	18 dB	23 dB	26 dB	29 dB	34 dB	37 dB	16 dB	21 dB	24 dB	27 dB	32 dB	35 dB
Dynamic range (4% Fresnel reflection)[*4]	Effective	35 dB	39 dB	41 dB	42 dB	44 dB	45 dB	34 dB	38 dB	40 dB	41 dB	43 dB	44 dB
	SNR=1	38 dB	42 dB	44 dB	45 dB	47 dB	48 dB	37 dB	41 dB	43 dB	44 dB	46 dB	47 dB
Near-end dead zone[*5,*6]	Fresnel reflection	35 m	50 m	95 m	200 m	700 m	1500 m	35 m	50 m	95 m	200 m	700 m	1500 m
	Back-scattered light	35 m	50 m	95 m	200 m	700 m	1500 m	35 m	50 m	95 m	200 m	700 m	1500 m
Spatial resolution[*5,*7]	Fresnel reflection	15 m	30 m	75 m	150 m	500 m	1500 m	15 m	30 m	75 m	150 m	500 m	1500 m
	Back-scattered light	30 m	50 m	90 m	200 m	700 m	1500 m	30 m	50 m	90 m	200 m	700 m	1500 m
Mask function[*5,*8]	No. of masks	5 max. (optical)											
	Mask width	75 m	75 m	150 m	200 m	700 m	1500 m	75 m	75 m	150 m	200 m	700 m	1500 m
Variable optical output power function[*8]		Provided											
Distance range (km)[*5]		10, 25, 50, 100, 250											
Horizontal axis[*5]	Scale (m/div)	5, 10, 25, 50, 100, 250, 500, 1 km (10 km range) 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km (25 km range) 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km, 5 km (50 km range) 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km, 5 km, 10 km (100 km range) 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km, 5 km, 10 km, 25 km (250 km range)											
	Resolution	Sampling resolution: 10 cm to 50 m, Read-out resolution: 10 cm to 500 m											
	Accuracy	±1 m ±measured value (m) x 2 x 10^{-5} (does not include uncertainty in fiber index of refraction)											
Vertical axis	Scale (dB/div)	0.1, 0.25, 0.5, 1, 2.5, 5											
	Read-out resolution	0.001 dB											
	Linearity	±0.03 dB/dB											
Ambient temperature		–10° to +55°C (spec. meet), –40° to +75°C (storage)											
Mass		≤2.5 kg											

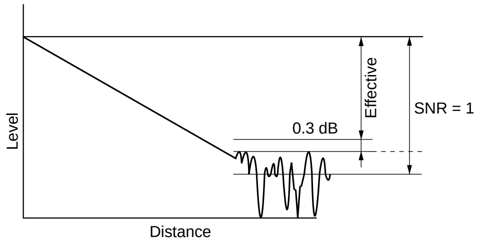
• MW0967B high-resolution unit

Wavelength[*1]		850/1300 nm ±15 nm				
Fiber under measurement[*10]		50/125 µm GI multimode fiber (NA0.2) ∗ITU-T G.651				
Optical connector[*11]		FC, DIAMOND, ST, DIN, SC				
Pulse width		5 ns	20 ns	100 ns	500 ns	2 µs
Dynamic range one-way back-scattered light level[*3,*4]	Effective	9.0/7.0 dB	12.0/10.0 dB	15.5/13.5 dB	19.0/17.0 dB	21.5/20.0 dB
	SNR = 1	12.0/10.0 dB	15.0/13.0 dB	18.5/16.5 dB	22.0/20.0 dB	24.5/23.0 dB
Dynamic range (4% Fresnel reflection)[*4]	Effective	27/29 dB	29/31 dB			
	SNR = 1	30/32 dB	32/34 dB			
Near-end dead zone[*5,*6]	Fresnel reflection	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m
	Back-scattered light	3 m	4.5 m	15 m	60 m	220 m
Spatial resolution[*5,*7]	Fresnel reflection	2 m	4 m	15 m	60 m	220 m
	Back-scattered light	2 m	4 m	15 m	60 m	220 m
Mask function		Not provided				
Variable optical output power function		Provided				
Distance range (km)[*5]		10, 25, 50, 100				
Horizontal axis[*5]	Scale (m/div)	2.5, 5, 10, 25, 50, 100, 250, 500, 1 km (10 km range) 2.5, 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km (25 km range) 2.5, 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km, 5 km (50 km range) 2.5, 5, 10, 25, 50, 100, 250, 500, 1 km, 2.5 km, 5 km, 10 km (100 km range)				
	Resolution	Sampling resolution: 5 cm to 20 m Read-out resolution: 5 cm to 200 m				
	Accuracy	±1m ±measured value (m) x 2 x 10^{-5} (does not include uncertainty fiber index of refraction)				
Vertical axis	Scale (dB/div)	0.1, 0.25, 0.5, 1, 2.5, 5				
	Readout resolution	0.001 dB				
	Linearity	±0.05 dB/dB				
Ambient temperature		–10° to +55°C (spec. meet), –40° to +75°C (storage)				
Mass		≤2.5 kg				

∗1: Not applicable in the variable optical output power mode

∗2: Please specify one of these types when ordering. Please contact us for other connectors. (However, the dynamic range is degraded by 0.5 dB for DIAMOND and D4 connectors.)

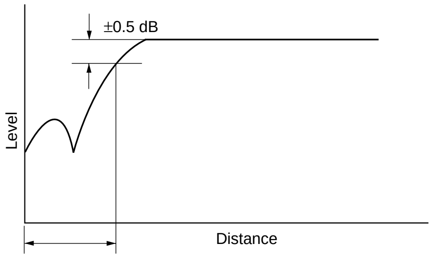
∗3: Dynamic range (one-way back-scattered light)
Effective: The difference between the level of the point which is 0.3 dB higher than the peak noise level and the level of the point where near-end back-scattering occurs.
SNR=1: The level difference between the RMS noise level and the level where near end back-scattering occurs.



∗4: Values are obtained using smoothing (level 6). With no smoothing, all values are reduced by 2 dB.

∗5: When the index of refraction is set to 1.500000.

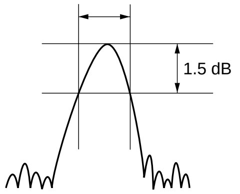
∗6: Near-end dead zone
Fresnel reflection: The minimum distance at which the 4% Fresnel reflection generated by the fault can be detected. (MW0944B with built-in variable optical output power function used.)
Back-scattered light: The near-end dead zone (for back-scattered light) is the distance at which the near-end back-scattered light level approaches ±0.5 dB of its final value. — For the MW0944B: This specification represents the values for the FC-PC connector (when return loss ≥25 dB). When a fiber with an FC connector (flat polished) is measured, the dead zone may be larger than the specified value. The variable near-end mask width function can be used to suppress dead zone widening to 2 to 3 m.

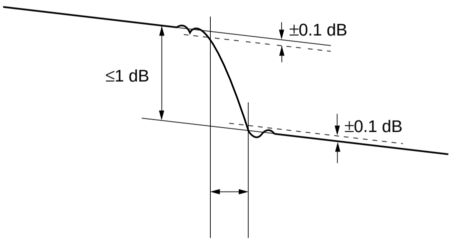


Dead zone (back-scattered light)

∗7: Spatial resolution
Fresnel reflection: The width of an unsaturated Fresnel reflection pulse at the point that is 1.5 dB less than the peak value.
Back-scattered light: The distance between the points where the beginning and ending levels at a splice etc. (≤1 dB) are within ±0.1 dB of their initial and final values, respectively.

Spatial resolution (Fresnel reflection)





Spatial resolution (back-scattered light)

∗8: All masks including the near-end mask (except MW0945B and MW0947B) are OFF in the variable optical output mode.

∗9: Please specify one of these types when ordering. Please contact us for other connectors. (However, the dynamic range is degraded by 0.5 dB for DIAMOND, D4, and AT&T Biconic connectors.)

∗10: The dynamic range is increased by about 1.5 dB when measuring 62.5/125 µm (NA 0.29) fibers. The transmission loss measurement result may differ from that obtained with NA 0.29 by as much as 0.1 dB/km.

∗11: Please specify one of these types when ordering. Please contact us for other connectors.

Ordering information

Please specify model/order number, name, and quantity when ordering.

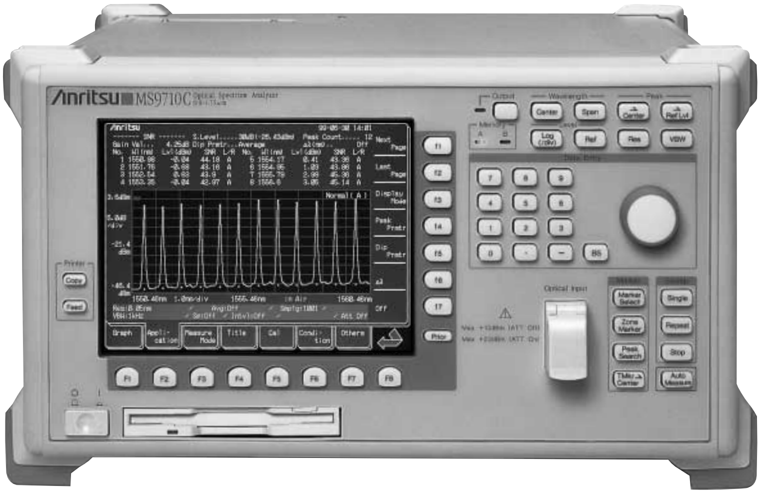
Model/order No.	Name
	Main frame
MW9060A	Optical Time Domain Reflectometer
	Plug-in units
MW0944B	SMF 1.31/1.55 µm Unit (short distance, high resolution)
MW0945B	SMF 1.31 µm Unit (long distance, wide-dynamic range measurement)
MW0947B	SMF 1.31/1.55 µm Unit (long distance, wide-dynamic range measurement)
MW0967B	GIF 0.85/1.30 µm Unit (short distance, high resolution)
	Standard accessories (main frame)
	Power cord, 2.5 m: 1 pc
F0013	Fuse, 5 A: 2 pcs
Z0240	Thermal roll paper (2 rolls/set): 2 sets
W0667AE	MW9060A operation manual: 1 copy
	Standard accessory (plug-in unit)
B0346	Unit adapter (for unit installation): 1 pc/1 unit
	Options (main frame)
MW9060A-01	GPIB interface
MW9060A-02	1.2 MB FDD (conforming to NEC PC-9800 series format)
	Options (plug-in unit)
MW09[ ][ ]-21	D4 connector
MW09[ ][ ]-22	AT&T Biconic connector (unavailable for the MW0944B)
MW0967B-23	Amphenol 906
MW09[ ][ ]-37	FC-PC connector (unavailable for the MW0944B/0967B)
	Optional accessories
B0346	Unit adapter
B0293	CRT hood
P0005	Memory card (RAM: 32 KB)
P0006	Memory card (RAM: 64 KB)
P0007	Memory card (RAM: 128 KB)
P0008	Memory card (RAM: 256 KB)
P0009	Memory card (RAM: 512 KB)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0126B	BCN cable, 2 m
FC-AP	Optical adapter FC type
J0200[*]	FC-FC-[*]M-GI (FC optical fiber cord, [*] m, GI)
J0056[*]	FC-FC-[*]M-SM (FC optical fiber cord, [*] m, SM)
J0087[*]	FC-D4-[*]M-GI (FC-D4 optical conversion cord, [*] m, GI)
J0210[*]	FC-D4-[*]M-SM (FC-D4 optical conversion cord, [*] m, SM)
J0209[*]	FC-BIC-[*]M-GI (FC-BICONIC optical conversion cord, [*] m, GI)
J0208[*]	FC-BIC-[*]M-GI (FC-BICONIC optical conversion cord, [*] m, GI)
J0207[*]	FC-DIA-[*]M-GI (FC-DIAMOND optical conversion cord, [*] m, GI)
J0206[*]	FC·PC-DIA·PC-[*]M-SM (FC·PC-DIAMOND·PC optical conversion cord, [*]m, SM)
J0516[*]	FC-DIN-[*]M-GI (FC-DIN optical conversion cord, [*] m, GI)
J0517[*]	FC-DIN-[*]M-SM (FC-DIN optical conversion cord, [*] m, SM)
J0518[*]	FC-ST-[*]M-GI (FC-ST optical conversion cord, [*] m, GI)
J0519[*]	FC-ST-[*]M-SM (FC-ST optical conversion cord, [*] m, SM)
J0520[*]	FC-SC-[*]M-GI (FC-SC optical conversion cord, [*] m, GI)
J0521[*]	FC-SC-[*]M-SM (FC-SC optical conversion cord, [*] m, SM)
B0329K	Protective cover (for front panel)
B0350	Carrying case (hard type)
Z0245	Carrying case for plug-in unit (hard type)
Z0246	Carrying case for plug-in unit (soft type)
	Peripherals
MA9014A	Bare Fiber Connector (common use for SM and GI fiber)
MA9013A	Fiber Adapter
FP-850	Printer (EPSON product)
VP-870	Printer (EPSON product)
HP7550A	Plotter (HP product)
	Supplies
Z0168	3.5 inch mini floppy disk (2HD): 10 pcs/set
Z0054	3.5 inch mini floppy disk (2DD): 10 pcs/set

[*]: These lengths are expressed by symbols A, B and C in the order number, for example; J0200A, B or C, where A = 1 m, B = 2 m, C = 3 m.

OPTICAL SPECTRUM ANALYZER
MS9710C
600 to 1750 nm

CE GPIB

High Performance for DWDM Optical Communications



The MS9710C is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 600 to 1750 nm wavelength band. In addition to uses such as measurement of LD and LED spectra, it has functions for measuring the transmission characteristics of passive elements such as optical isolators, as well as NF/Gain of optical fiber amplifier systems.
In addition to its basic features, the superior stability and reliability of the diffraction grating (patent pending) offer the severe level and wavelength specifications particularly in the WDM band.
This analyzer has the dynamic range, reception sensitivity, and sweep speed requested by users, backed by Anritsu's high-level technology. The high sensitivity meets the exacting demands placed on today's measuring instruments. In particular, the excellent wavelength and level specifications fully meet the dense WDM requirements (1520 to 1620 nm).
The MS9710C Optical Spectrum Analyzer is the successor to the popular MS9710B but with improved functions and higher performance. The specifications have been upgraded for the important 1.55 µm band for WDM communications and have also been optimised to include the new requirements for L-band (1570 to 1620 nm) use. In addition to the high reliability and excellent basic performance, this analyzer has a full range of application functions to support accurate measurement in the fastest possible time.

Features

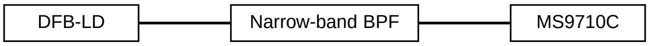
- Wavelength accuracy of ±20 pm (C-band) and ±50 pm (L-band)
- Dynamic range of 42 dB (0.2 nm from peak wavelength), 70 dB (1 nm from peak wavelength)
- WDM measurement of wavelength, level, and SNR for up to 128 channels

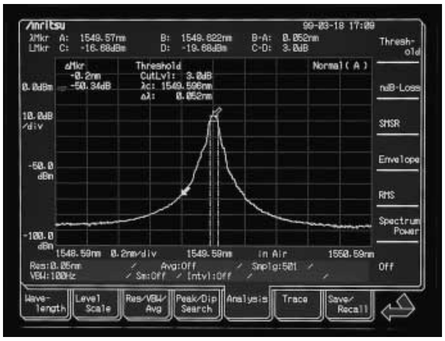
Performance and applications

• 70 dB dynamic range
The dynamic range at 0.2 nm from the peak wavelength is better than 42 dB and is a high 58 dB min. at 0.4 nm from the peak, permitting high-accuracy measurement of DWDM systems with a 50 GHz (0.4 nm) channel spacing. The analyzer demonstrates its excellence in SNR measurement of WDM light sources, as well as in evaluation of narrow-band optical band pass filters.

Distance from peak wavelength	0.2 nm	0.4 nm	1 nm
Normal dynamic range mode	42 dB (45 dB typical)	58 dB	62 dB
High dynamic range mode	42 dB (45 dB typical)	60 dB	70 dB

High-dynamic range measurement example with DFB-LD spectrum passed via narrow-band Band-Pass Filter (BPF).





• Relying on WDM transmission
As a result of the need for increased transmission capacity, R&D into large-capacity transmission techniques is becoming more active, and Wavelength Division Multiplexing (WDM) is now in use. This WDM transmission technology requires quantitative measurement of the signal quality and wavelength transmission characteristics of each channel.
Measuring instruments for this purpose require highly-accurate wavelength and level measurements. Furthermore, accurate measurement of fiber-amplifier NF requires extremely good polarization dependant loss characteristics and level linearity specifications.
The MS9710C design achieves excellent wavelength and level specifications for this purpose in the 1520 to 1620 nm wavelength band and also in the extended band (L-band) to 1620 nm. In particular, the wavelength accuracy can be calibrated automatically using an optional internal reference wavelength light source; the post-calibration accuracy is better than ±20 pm.

Specifications for WDM application

Mainframe, option	MS9710C	With Option 15*2
Wavelength accuracy*1	±20 pm (1530 to 1570 nm) ±50 pm (1520 to 1600 nm)	±20 pm (1520 to 1620 nm)
Wavelength resolution	50 pm (FWHM of internal optical BPF)	
Resolution accuracy	≤±3% (1530 to 1570 nm, resolution: 0.2 nm)	≤±3% (1520 to 1620 nm, resolution: 0.2 nm)
Level flatness to wavelength	±0.1 dB (1530 to 1570 nm) ±0.3 dB (1520 to 1620 nm)	±0.1 dB (1520 to 1620 nm)
	Resolution: 0.5 nm, ATT: off	
Polarization dependency	±0.05 dB (1550/1600 nm)	
Level linearity	±0.05 dB (1550 nm)	±0.05 dB (1550/1600 nm)
	–50 to 0 dBm (ATT: off), –30 to +20 dBm (ATT: on)	

*1: After calibration with optical reference wavelength light source
*2: L-band enhancement

Full function lineup

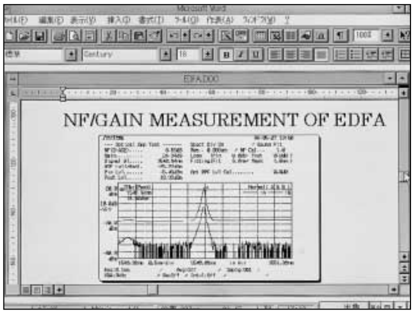
In addition to its excellent basic functions, the MS9710C comes with a full lineup of other useful functions summarized in the following table.

Device analysis	For analyzing and evaluating waveforms of optical devices (DFB-LDs, FP-LDs, LEDs)
Waveform analysis	For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis
Application measurement	EDFA NF and gain measurement, polarization mode dispersion measurement
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz
Markers	Multimarkers: Marker function for max. 300 points Zone markers: For waveform analysis within zone Peak/dip search: Searches for a peak or dip
Power monitor	Also functions an optical power meter
Vacuum wavelength display	Converts displayed wavelength to value in vacuum
External interfaces	GPIB, RS-232C, VGA monitor output

• 3.5 inch internal FDD

In addition to saving and recalling measurement data, etc., waveforms saved to floppy disk can be easily and directly read by a personal computer.

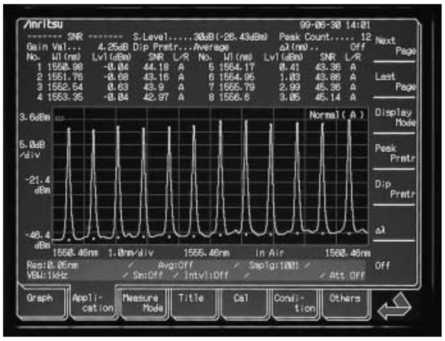
The PC screen shown on the right is displaying an image of the MS9710C screen saved to floppy disk. Screen images can be saved to FD media and output as Windows® bitmap-format files. In addition, since the data can be output in text-file format, it can be manipulated easily using spreadsheet software.


NF/GAIN MEASUREMENT OF EDFA

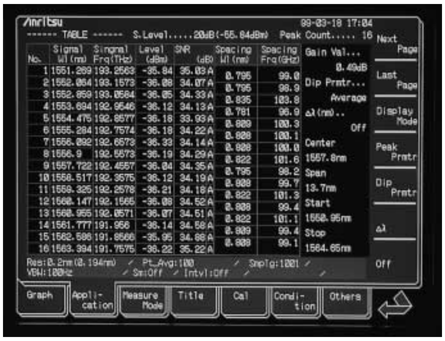
• Spectrum analysis for WDM communication systems

The wavelength, level, and SNR of up to 300 WDM channels can be analyzed.

A new noise level left/right average function (shown below) has been added to SNR measurement. In addition, the noise level is normalized to a per nm figure. Accurate SNR measurement can be achieved due to the high-resolution accuracy of the MS9710C.


```
Anritsu                                                        99-06-30 14:01
------- SNR -------  S.Level.....30dB(-26.43dBm)  Peak Count..... 12
Gain Val...    4.25dB Dip Prmtr...Average         Δλ(nm)..       Off
No.   Wl(nm)   Lvl(dBm)   SNR   L/R  No.   Wl(nm)   Lvl(dBm)   SNR   L/R
  1 1550.98    -0.04    44.18   A     5 1554.17    0.41     43.36   A
  2 1551.76    -0.68    43.16   A     6 1554.95    1.03     43.86   A
  3 1552.54     0.63    43.9    A     7 1555.79    2.99     45.36   A
  4 1553.35    -0.04    42.97   A     8 1556.6     3.05     45.14   A
Res:0.05nm        /     Avg:Off       /  Smplg:1001 /
VBW:1kHz          / Sm:Off  / Intvl:Off   /            / Att Off
```

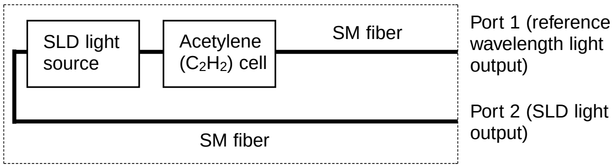
The measurement results described above can be switched to a table display that can be saved and recalled in text format. Both the wavelength and frequency are shown in the table.


```
Anritsu                                                        99-03-18 17:04
------ TABLE ------  S.Level.....20dB(-55.84dBm)  Peak Count..... 16
     Signal    Singnal   Level   SNR     Spacing  Spacing   Gain Val...
No.  Wl(nm)    Frq(THz)  (dBm)    (dB)   Wl(nm)   Frq(GHz)          0.49dB
  1 1551.269 193.2563  -35.84  35.03 A   0.795      99.0   Dip Prmtr...
  2 1552.064 193.1573  -36.08  34.07 A   0.795      98.9        Average
  3 1552.859 193.0584  -36.05  34.33 A   0.835     103.8   Δλ(nm)..
  4 1553.694 192.9546  -36.12  34.13 A   0.781      96.9             Off
  5 1554.475 192.8577  -36.18  33.93 A   0.809     100.3   Center
  6 1555.284 192.7574  -36.18  34.22 A   0.808     100.1   1557.8nm
  7 1556.092 192.6573  -36.33  34.14 A   0.808     100.0   Span
  8 1556.9   192.5573  -36.19  34.29 A   0.822     101.6   13.7nm
  9 1557.722 192.4557  -36.04  34.35 A   0.795      98.2   Start
 10 1558.517 192.3575  -36.12  34.19 A   0.808      99.7   1550.95nm
 11 1559.325 192.2578  -36.21  34.18 A   0.822     101.3   Stop
 12 1560.147 192.1565  -36.08  34.52 A   0.808      99.4   1564.65nm
 13 1560.955 192.0571  -36.07  34.51 A   0.822     101.1
 14 1561.777 191.956   -36.14  34.58 A   0.809      99.4
 15 1562.586 191.8566  -35.95  34.88 A   0.808      99.1
 16 1563.394 191.7575  -36.22  35.22 A
Res:0.2nm(0.194nm)  / Pt_Avg:100        /  SmpIg:1001 /
VBW:100Hz           / Sm:Off  / Intvl:Off   /            /
```

- **Convenient light source option, including reference wavelength light source for better accuracy**

Any one of the wavelength reference & SLD light source (Option 13), SLD light source (Option 14), wavelength reference light source (Option 05), and White light source (Option 02) can be installed in the MS9710C.

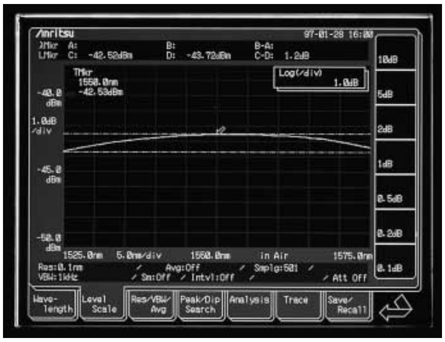
The block diagram of the SLD light source & Reference wavelength light source option is shown below. This option has two separate output ports: Port 1 for wavelength calibration, and the Port 2 for measuring transmission characteristics. When the MS9710C is calibrated automatically by inputting the reference wavelength light source, post-calibration wavelength accuracy in the 1520 to 1620 nm range is better than ±20 pm (Option 15). This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.



Block diagram of SLD light source & Reference wavelength light

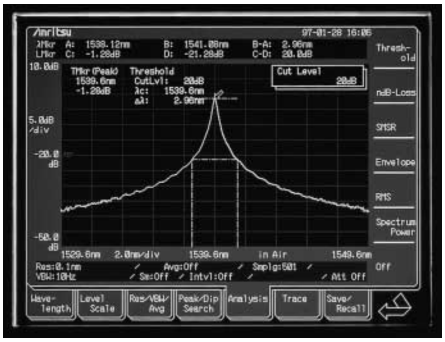
The following diagram shows the spectrum of the SLD light source output from Port 2.

When this light source is used instead of the earlier white light source for measurement of the wavelength transmission characteristics of optical receiver elements, it is possible to achieve a 20 dB wider dynamic range.



Spectrum of SLD light

The following figure is a measurement example of the transmission characteristics of an optical band pass filter using the SLD light source.



Measurement of optical bandpass filter

If this dynamic range is not required, a lower-cost white light source can be installed instead.

Specifications

	Main frame, option	MS9710C	With Option 15 (L-band enhancement)
	Applicable optical fiber	10/125 µm SM fiber (ITU-T G.652)	
	Optical connector[*1]	User replaceable (FC, SC, ST, DIN, HMS-10/A), factory option (E2000, FC-APC, SC-APC, HRL-10)	
Wavelength	Measurement range	600 to 1750 nm	
	Accuracy	±20 pm (1530 to 1570 nm)[*2], ±50 pm (1520 to 1600 nm)[*2]	±20 pm (1520 to 1620 nm)[*2]
		±200 pm (1530 to 1570 nm)[*3] , ±300 pm (600 to 1750 nm)[*3]	
	Stability	±5 pm	
	Linearity	±20 pm (1530 to 1570 nm)	
	Resolution	0.05, 0.07, 0.1, 0.2, 0.5, 1.0 nm (RBW: 3 dB optical filter; transmission bandwidth)	
	Read resolution	5 pm	
	Resolution[*4]	≤±2.2% (1530 to 1570 nm, resolution: 0.5 nm) ≤±3% (1530 to 1570 nm, resolution: 0.2 nm) ≤±7% (1530 to 1570 nm, resolution: 0.1 nm) ≤±4% (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.5 nm) ≤±5% (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.2 nm) ≤±10% (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.1 nm)	≤±2.2% (1520 to 1620 nm, resolution: 0.5 nm) ≤±3% (1520 to 1620 nm, resolution: 0.2 nm) ≤±7% (1520 to 1620 nm, resolution: 0.1 nm)
		≤±7% (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.5 nm) ≤±15% (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.2 nm) ≤±30% (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.1 nm)	

Continued on next page

Main frame, option		MS9710C	With Option 15 (L-band enhancement)
Level	Measurement range	–65 to +10 dBm (600 to 1000 nm, 0 to +30˚C, optical ATT: off) –85 to +10 dBm (1000 to 1250 nm, 0 to +30˚C, optical ATT: off) –90 to +10 dBm (1250 to 1600 nm, 0 to +30˚C, optical ATT: off) –75 to +10 dBm (1600 to 1700 nm, 0 to +30˚C, optical ATT: off) –55 to +10 dBm (1700 to 1750 nm, 0 to +30˚C, optical ATT: off) –60 to +10 dBm (600 to 1000 nm, +30 to +50˚C, optical ATT: off) –80 to +10 dBm (1000 to 1250 nm, +30 to +50˚C, optical ATT: off) –85 to +10 dBm (1250 to 1600 nm, +30 to +50˚C, optical ATT: off) –70 to +10 dBm (1600 to 1700 nm, +30 to +50˚C, optical ATT: off) –50 to +10 dBm (1700 to 1750 nm, +30 to +50˚C, optical ATT: off) –70 to +23 dBm (1100 to 1600 nm, 0 to +30˚C, optical ATT: on) –65 to +23 dBm (1100 to 1600 nm, +30 to +50˚C, optical ATT: on) [Resolution: ≥0.07 nm, VBW: 10 Hz, sweep average: 10 times]	
	Accuracy	±0.4 dB (1300/1550 nm, input: –23 dBm, resolution: ≥0.1 nm)	
	Stability	±0.02 dB (1 min, resolution: ≥0.1 nm, input: –23 dBm, no polarization fluctuation)	
	Flatness	±0.1 dB (1530 to 1570 nm, resolution: 0.5 nm, optical ATT: off) ±0.3 dB (1520 to 1620 nm, resolution: 0.5 nm, optical ATT: off)	±0.1 dB (1520 to 1620 nm, resolution: 0.5 nm, optical ATT: off)
	Linearity	±0.05 dB (1550 nm, –50 to 0 dBm, optical ATT: off) ±0.05 dB (1550 nm, –30 to +20 dBm, optical ATT: on)	±0.05 dB (1550/1600 nm, –50 to 0 dBm, optical ATT: off) ±0.05 dB (1550/1600 nm, –30 to +20 dBm, optical ATT: on)
Polarization dependency		±0.05 dB (1550/1600 nm), ±0.1 dB (1300 nm) ∗Setting resolution: ≥0.5 nm	
Dynamic range∗5		High-dynamic range mode (20˚ to 30˚C): 70 dB (1 nm from peak wavelength), 60 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength) Normal mode (20˚ to 30˚C): 62 dB (1 nm from peak wavelength), 58 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength)	
Optical return loss		≥35 dB (1300/1550 nm)	
Sweep		Sweep width: 0, 0.2 to 1200 nm Sweep speed (typical)∗6 : 0.5 s (normal dynamic mode, sweep width: 500 nm, VBW: 10 kHz, center wavelength: 1200 nm, sweep start to stop, no optical input, sampling point: 501)	
Display		6.4 inch, color TFT-LCD	
Memory		A/B (2 trace), 3.5 inch FDD (for MS-DOS® format)	
Printer		Internal (thermal type)	
Interface		GPIB, RS-232C, VGA output	
Operating conditions		Operating temperature: 0˚ to +50˚C (FDD: +5˚ to +50˚C), storage temperature: –20˚ to +60˚C, Relative humidity: ≤90% (no condensation, FDD: 20 to 80%) Shock: 30 G, 11 ms pulse, half sine	
Power		85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)	
Dimensions and mass		320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg	
EMC		EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)	
LVD		EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)	

∗1: One of these connector is attached. Please specify when ordering.
∗2: After Wl cal (ref) at wavelength reference optical light source (Option 05/13), resolution: 0.05 to 0.2 nm
∗3: After Wl cal (Ext) at DFB-LD and soon external optical light source
∗4: Actual screen resolution, 0˚ to 30˚C
∗5: Setting resolution: 0.05 nm, wavelength: 1550 nm, optical attenuator: off
∗6: Typical value for reference; not guaranteed specification

VBW, sweep speed, minimum light reception sensitivity∗1

VBW	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Sweep speed (typ)	30 s	5 s	0.5 s	0.5 s	0.5 s	0.5 s
Minimum light reception sensitivity∗2	–90 dBm	–80 dBm	–70 dBm	–60 dBm	–50 dBm	–40 dBm

∗1: Data for reference (501 points no averaging; not guaranteed specifications)
∗2: RMS noise level (1250 to 1600 nm)

Note: Warm-up the MS9710C for about 5 min. to ensure stable operation. The above specifications were obtained 2 hours after power-on.

White light source (Option 02)

Optical output	≥–59 dBm/nm (multimode fiber input)∗1
Wavelength range	900 to 1600 nm
Operating temperature	18˚ to 28˚C

∗1: –65 dBm (typ) measured with MS9710C (at 1 nm wavelength resolution) which has single-mode fiber at the input.

Wavelength reference light source (Option 05)

Wavelength reference	1530 nm band Acetylene

Wavelength Reference & SLD light source (Option 13)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability[*1]	±0.04 dB (MS9710C setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0° to 40°C
Wavelength reference	1530 nm band Acetylene

*1: Measured after one hour warm-up

SLD light source (Option 14)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability[*1]	±0.04 dB (MS9710C setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0° to 40°C

*1: Measured after one hour warm-up

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS9710C	Optical Spectrum Analyzer	
	Standard accessories	
	Optical connector adapter[*1]:	1 pc
	Power cord, 2.5 m:	1 pc
Z0312	Printer paper:	2 rolls
W1579AE	MS9710C operation manual:	1 copy
W1580AE	Remote control operation manual:	1 copy
MX971003S	LabVIEW® driver (RS-232C):	1 pc
MX971003G	LabVIEW® driver (GPIB):	1 pc
B0329G	Front cover:	1 pc
	Options	
MS9710C-02	White light source[*2]	
MS9710C-05	Wavelength reference light source[*2]	
MS9710C-13	Wavelength reference & SLD light source[*2]	
MS9710C-14	SLD light source[*2]	
MS9710C-15	L-band enhancement	
MS9710C-25	FC-APC connector[*3]	
MS9710C-26	SC-APC connector[*3]	
MS9710C-27	E2000 (Diamond) connector[*3]	
MS9710C-31	EC (Radial) connector[*3]	
MS9710C-37	FC connector[*4]	
MS9710C-38	ST connector[*4]	
MS9710C-39	DIN connector[*4]	
MS9710C-40	SC connector[*4]	
MS9710C-43	HMS-10/A (Diamond) connector[*4]	
MS9710C-47	HRL-10 connector[*3]	
	Application parts	
J0654A	RS-232C cable (9P-9P)	
J0655A	RS-232C cable (9P-25P)	
J0007	GPIB cable, 1 m	
J0617B	Replaceable optical connector (FC)	
J0618D	Replaceable optical connector (ST)	
J0618E	Replaceable optical connector (DIN)	
J0618F	Replaceable optical connector (HMS-10/A)	
J0619B	Replaceable optical connector (SC)	
J0635B	FC-PC · FC-PC 2M-SM (FC-PC optical fiber cord, 2 m, SM)	
Z0282	Ferrule cleaner	
Z0283	Replacement reel for ferrule cleaner (for Z0282)	
Z0284	Cleaner for optical adapter (stick type)	
G0084A	Polarization rotation module (for PMD measurement)	
B0330C	Tilt stand	

*1: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified, the FC connector (MS9710C-37) is supplied as standard.
*2: Factory options; Two units cannot be installed simultaneously. Exchangeable-type optical connectors (FC, SC, ST, DIN, HMS-10/A) are supplied when specified at ordering. One conversion cord is supplied for connecting other optical connectors to the FC connector.
*3: Factory option
*4: User replaceable

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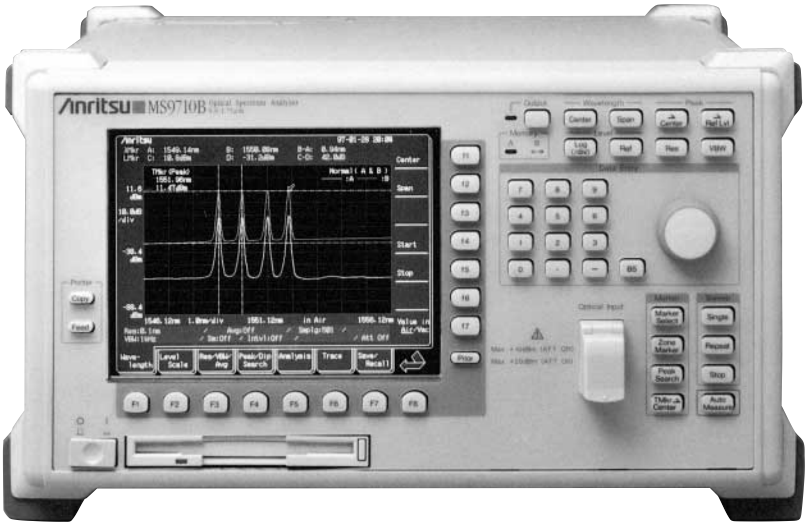
OPTICAL SPECTRUM ANALYZER

MS9710B

600 to 1750 nm

CE GPIB

For Evaluating LED/LD Spectra and Transmission Characteristics of Passive Elements



The MS9710B is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 600 to 1750 nm wavelength band. In addition to uses such as measurement of LD and LED spectra, it has functions for measuring the transmission characteristics of passive elements such as optical isolators, as well as the NF/Gain of optical fiber systems.

In addition to its basic features, the superior stability and reliability of the diffraction grating (patent pending) easily pass the severe specifications required for precise measurement of WDM communications methods, particularly in the 1.55 µm band. This analyzer has the dynamic range, reception sensitivity, and sweep speed requested by users, backed by Anritsu's high-level technology. The high sensitivity meets the exacting demands placed on today's measuring instruments. In particular, the excellent wavelength and level specifications fully meet the dense WDM requirements in the 1.55 µm band.

In addition to having a much wider dynamic range, its compact portability (approx. 50% lighter) eliminates the large cumbersome image of earlier analyzers by perfectly combining portability with high performance. In addition to the high reliability and excellent basic performance, this analyzer has a full range of application functions to support accurate measurement in the fastest possible time.

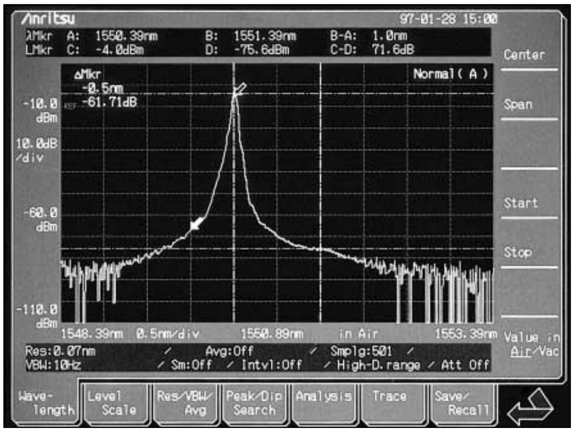
Features

- 70 dB dynamic range
- –90 dBm guaranteed optical reception sensitivity
- Internal 3.5 inch FDD (Windows®)
- Tracking with tunable laser source
- Optical pulse measurement
- Full range of WDM application functions

Performance and functions

• 70 dB dynamic range

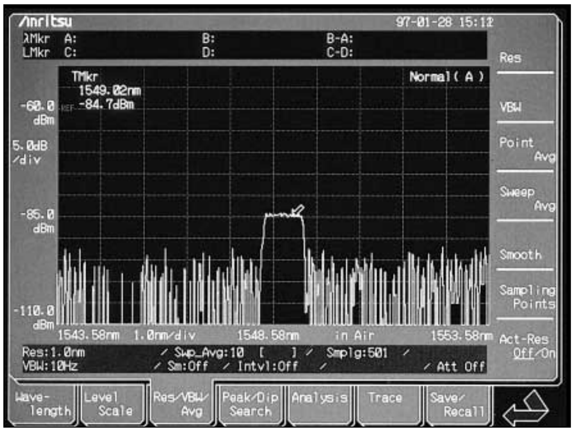
The measurement dynamic range of the MS9710B in the normal measurement mode at a wavelength 1 nm from the peak wavelength is 62 dB. In the high dynamic range measurement mode, better than 70 dB can be achieved. The analyzer demonstrates its excellence in SMSR measurement of DFB-LDs, as well as in evaluation of narrow-band optical band pass filters. (See top screen in adjoining column.)



```
λMkr  A:  1550.39nm     B:  1551.39nm     B-A:  1.0nm
LMkr  C:  -4.0dBm       D:  -75.6dBm      C-D:  71.6dB
ΔMkr
 -0.5nm
 -61.71dB
Res:0.07nm         /    Avg:Off        /  Smplg:501    /
VBW:10Hz          / Sm:Off  / Intvl:Off  / High-D.range / Att Off
```

• –90 dBm guaranteed optical reception sensitivity

The MS9710B has achieved an improved S/N over a wide range by taking thorough countermeasures to noise and stray light. The RMS noise level at wavelengths from 1250 to 1600 nm is –90 dBm max. The screen display below is the waveform obtained when measuring a 1.55 µm DFB-LD optical source of –85 dBm; only 25 seconds are required for the measurement. In addition, the S/N can be improved using sweep averaging.



```
λMkr  A:                B:                B-A:
LMkr  C:                D:                C-D:
TMkr
 1549.02nm
 -84.7dBm
Res:1.0nm          / Swp_Avg:10  [    ] /  Smplg:501    /
VBW:10Hz          / Sm:Off  / Intvl:Off  /              / Att Off
```

• Full function lineup

In addition to its excellent basic functions, the MS9710B comes with a full lineup of other useful functions summarized in the following table.

Device analysis	For analyzing and evaluating waveforms of optical elements (DFB-LDs, FP-LDs, LEDs)
Waveform analysis	For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis
Application measurement	EDFA NF and gain measurement, PMD measurement (See applications.)
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz
Markers	Multimarkers: Marker function for max. 128 points (See applications.) Zone markers: For waveform analysis in zone Peak/dip search: Searches for a peak or dip
Power monitor	Also functions as optical power meter
Vacuum wavelength display	Converts displayed wavelength to value in vacuum
External interfaces	GPIB, RS-232C

• Relying on 1.55 µm transmission band

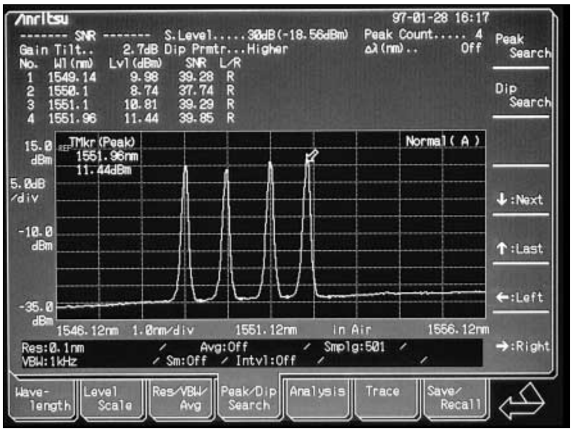
As a result of the need for increased transmission capacity, R&D into large-capacity transmission techniques is becoming more active and wavelength division multiplexing (WDM) is ready to use. This WDM transmission technology requires quantitative measurement of the wavelength transmission characteristics between each channel.

Measuring instruments for this purpose require more accurate wavelength and level measurement. Furthermore, accurate measurement of fiber-amplifier NF requires extremely good polarized light dependency and level linearity specifications. The MS9710B design has achieved excellent wavelength and level specifications for this purpose in the 1.53 to 1.57 µm wavelength band. In particular, the wavelength accuracy can be calibrated automatically using an optical internal reference wavelength light source — the post-calibration accuracy is better than ±0.05 nm. Evaluation of WDM systems requires measurement without repeated calibration at each measurement and the MS9710B achieves high-accuracy measurement with high repeatability.

Applications

• Spectrum analysis for WDM communication system

The wavelength characteristics for the gain, and signal to noise ratio (SNR) between each channel are difficult problems in WDM transmission technology. In evaluation, it is very important to measure this quantitatively. The MS9710B permits extremely quick and simple waveform analysis of up to 300 spectra. The waveform and level (SNR) of each peak exceeding the set threshold is displayed. The screen display below shows an example of the tilt gain.



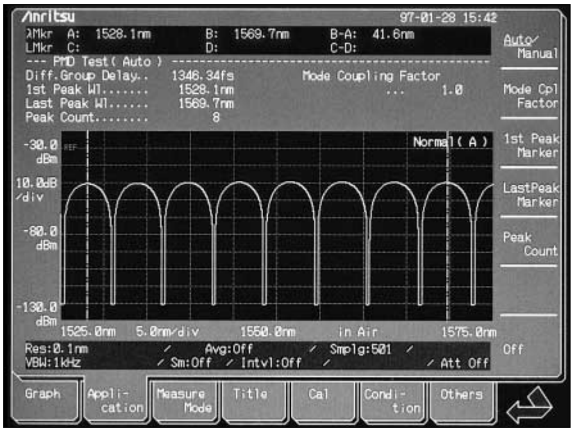
```
97-01-28 16:17
-------- SNR --------  S.Level.....30dB(-18.56dBm)  Peak Count..... 4
Gain Tilt..   2.7dB Dip Prmtr...Higher              Δλ(nm)..      Off
No.  Wl(nm)   Lvl(dBm)   SNR   L/R
 1  1549.14     9.98    39.28   R
 2  1550.1      8.74    37.74   R
 3  1551.1     10.81    39.29   R
 4  1551.96    11.44    39.85   R
TMkr(Peak)
1551.96nm
11.44dBm
Normal( A )
Res:0.1nm          /      Avg:Off       /  Smplg:501  /
VBW:1kHz          / Sm:Off  / Intvl:Off  /              /
```

• Polarization mode dispersion

An important factor determining the upper limit of the transmission bit rate is the polarization mode dispersion (PMD). PMD is measured in the time and wavelength domains (see below). The MS9710B can be used as a fixed analyzer to perform simple and automated measurement in the wavelength domain and immediately computes the PMD by data processing from the measured waveform. The wavelength difference ($\lambda_2 - \lambda_1$) between the peak wavelength (λ_1) and the wavelength at the Nth peak (λ_2) are read directly, and the PMD is calculated from the following equation:

$$PMD = K \frac{N-1}{C} \times \frac{\lambda_1 \cdot \lambda_2}{\Delta\lambda}$$

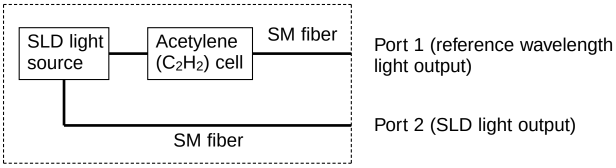
where: K is the mode coupling factor and C is the speed of light (m/s).



```
97-01-28 15:42
λMkr  A:  1528.1nm        B:  1569.7nm       B-A:  41.6nm
LMkr  C:                  D:                 C-D:
--- PMD Test( Auto ) ----------------------------------------
Diff.Group Delay..   1346.34fs      Mode Coupling Factor
1st Peak Wl.......    1528.1nm              ...       1.0
Last Peak Wl......    1569.7nm
Peak Count........        8
Normal( A )
Res:0.1nm          /      Avg:Off       /  Smplg:501  /
VBW:1kHz          / Sm:Off  / Intvl:Off  /              / Att Off
```

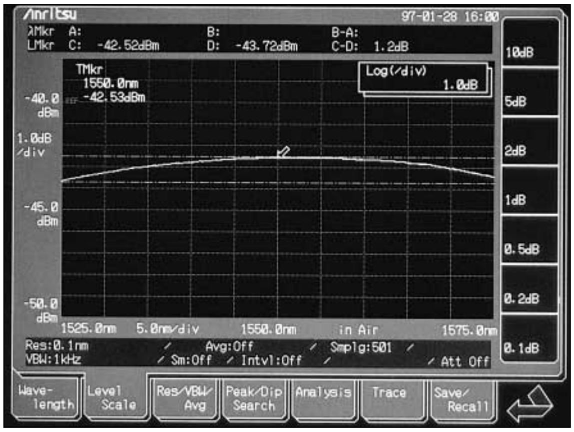
- **Convenient light source option (reference wavelength or white light) for better accuracy**

The wavelength reference & SLD light source (Option 13), SLD light source (Option 14), wavelength reference light source (Option 05), and white light source (Option 02) can each be installed in the MS9710B. The block diagram of the SLD light source and reference wavelength light source option is shown below. This option has two separate output ports: Port 1 for wavelength calibration and Port 2 for measuring transmission characteristics. When the MS9710B is calibrated automatically by inputting the reference light for the wavelength, post-calibration wavelength accuracy in the 1.52 to 1.57 µm range is better than ±0.05 nm. This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.



Block diagram of SLD light source & reference wavelength light

The following diagram shows the spectrum of the SLD light output from Port 2. When this light source is used instead of the earlier white light source for measurement of the wavelength transmission characteristics of optical receiver elements, it is possible to achieve a 20 dB wider dynamic range.


97-01-28 16:00

λMkr A: B: B-A:
LMkr C: -42.52dBm D: -43.72dBm C-D: 1.2dB

TMkr 1550.0nm -42.53dBm

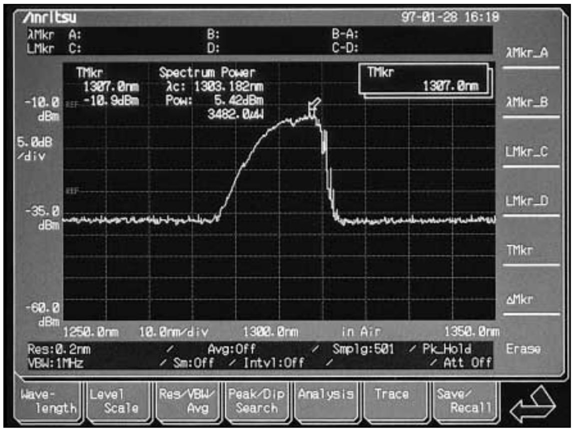
Log(/div) 1.0dB

Res:0.1nm Avg:Off Smplg:501
VBW:1kHz Sm:Off Intvl:Off Att Off

Spectrum of SLD light source

- **Measurement of modulated and pulsed light**

The synchronization signal for the measured modulated/pulsed light is input to the external input trigger on the rear panel. With this analyzer, the data can be held by this sync signal. As a result, the spectrum of the modulated or pulsed light can be measured accurately without data loss. In addition, an optical source that does not have a sync signal can be measured in the same manner by setting an appropriate gate time. The waveform in the diagram on the right shows measurement of an optical pulse (OTDR's light source) with a pulse width of 1 µs and a duty cycle of 1%. However, for accurate spectrum measurement, the VBW must be set to a wider bandwidth than the modulation frequency of the measured light (see below). The maximum settable VBW in the MS9710B is 1 MHz. (Refer to the specifications page for the relationship between VBW, received light sensitivity and sweep time.)


97-01-28 16:18

λMkr A: B: B-A:
LMkr C: D: C-D:

TMkr 1307.0nm -10.9dBm

Spectrum Power λc: 1303.182nm Pow: 5.42dBm 3482.0µW

TMkr 1307.0nm

Res:0.2nm Avg:Off Smplg:501 Pk_Hold
VBW:1MHz Sm:Off Intvl:Off Att Off

Specifications

- **MS9710B**

Fiber	10/125 µm SM fiber (ITU-T G.652)
Optical connector*1	User replaceable: FC, SC, ST, DIN, HMS-10/A Factory option (not user replaceable): E-2000 (Diamond), EC (Radial), FC-APC, SC-APC, HRL-10
Wavelength	Range: 600 to 1750 nm Accuracy: ±0.2 nm (1530 to 1570 nm, after wavelength calibration) ±0.3 nm (600 to 1750 nm, after wavelength calibration) ±0.05 nm (1530 to 1570 nm, resolution: 0.07 to 0.2 nm, after calibration with wavelength reference light source option) ±0.1 nm (1530 to 1570 nm, resolution: 0.5 to 1 nm, after calibration with wavelength reference light source option) Stability: ±5 pm (smoothing: 11 points, 1 minute, at half-width center wavelength) Linearity: ±20 pm (1530 to 1570 nm) Resolution: 0.07, 0.1, 0.2, 0.5, 1 nm Resolution accuracy*2: ±≤2.2% (resolution: 0.5 nm, 1550 ±20 nm), ±≤7% (resolution: 0.5 nm, at other wavelength), ±≤3% (resolution: 0.2 nm, 1550 ±20 nm), ±≤15% (resolution: 0.2 nm, at other wavelength), ±≤7% (resolution: 0.1 nm, 1550 ±20 nm), ±≤30% (resolution: 0.1 nm, at other wavelength)
Level	Measurement range: –65 to +10 dBm (600 to 1000 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –85 to +10 dBm (1000 to 1250 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –90 to +10 dBm (1250 to 1600 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –75 to +10 dBm (1600 to 1700 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –55 to +10 dBm (1700 to 1750 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –65 to +20 dBm (1100 to 1600 nm, attenuator: on) Accuracy: ±0.4 dB (1300/1550 nm, –23 dBm, resolution: ≥0.1 nm) Stability: ±0.02 dB (1550 nm, –23 dBm, resolution: ≥0.1 nm, 1 minute, constant temperature, no polarization shift) Linearity: ±0.05 dB (1550 nm, 0 to –50 dBm) Flatness: ±0.1 dB (1530 to 1570 nm)

Continued on next page

Polarization dependency	±0.05 dB (1.55 µm band, resolution: ≥0.5 nm), ±0.1 dB (1.3 µm band, resolution: ≥0.5 nm)
Dynamic range	70 dB (±1 nm, resolution: 0.07 nm, 1.55 µm band, high-dynamic range mode measurement, 20° to 30°C) 60 dB (±0.5 nm, resolution: 0.07 nm, 1.55 µm band, high-dynamic range mode measurement, 20° to 30°C) 62 dB (±1 nm, resolution: 0.07 nm, 1.55 µm band, normal mode measurement) 58 dB (±0.5 nm, resolution: 0.07 nm, 1.55 µm band, normal mode measurement)
Optical return loss	≥35 dB (1.3/1.55 µm band)
Sweep	Sweep width: 0, 0.2 to 1200 nm Sweep speed[*3](typical): 0.5 s (sweep width: 500 nm, normal mode measurement, VBW: 10 kHz)
Display	6.4 inch color TFT-LCD
Memory	A, B (2 traces), 3.5 inch FDD (for Windows®)
Printer	Internal (thermal type)
Interface	GPIB, RS-232C
Main functions	Optical pulse measurement, power monitor, wavelength auto-calibration
Operating conditions	Operating temperature: 0° to +50°C (FDD: 5° to 50°C), storage temperature: –20° to +60°C, Relative humidity: ≤90% (no condensation)
Power	85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

∗1: One of these connector is attached. Please specify when ordering.
∗2: Actual screen resolution
∗3: Typical value for reference; not guaranteed specification

• White light source (Option 02)

Optical output	≥–59 dBm/1 nm (multimode/fiber input)[*1]
Wavelength range	900 to 1600 nm
Operating temperature	18° to 28°C

∗1: –65 dBm (typ.) measured with MS9710B (at 1 nm wavelength resolution) which has single mode fiber at the input

• Reference wavelength light source (Option 05)

Wavelength reference	1.53 µm band Acetylene

• Wavelength Reference & SLD light source (Option 13)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability[*1]	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0° to 40°C
Wavelength reference	1530 nm band Acetylene

∗1: Measured after one hour warm-up

• SLD light source (Option 14)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability[*1]	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0° to 40°C

∗1: Measured after one hour warm-up

• VBW, sweep speed, minimum light reception sensitivity[*1]

VBW	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Sweep speed (typ.)	30 s	5 s	0.5 s	0.5 s	0.5 s	0.5 s
Minimum light reception sensitivity[*2]	–90 dBm	–80 dBm	–70 dBm	–60 dBm	–50 dBm	–40 dBm

∗1: Data for reference; not guaranteed specifications
∗2: RMS noise level (1.25 to 1.6 µm)

Note: Warm-up to the MS9710B for about 5 minutes to ensure stable operation. The above specifications were obtained 2 hours after power-on.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MS9710B	Optical Spectrum Analyzer
	Standard accessories
	Optical connector adapter[*1]: 1 pc
	Power cord, 2.5 m: 1 pc
F0012	Fuse, 3.15 A (for 100/200 Vac system): 2 pcs
Z0312	Printer paper: 2 rolls
W1283AE	MS9710B operation manual: 1 copy
W1284AE	Remote control operation manual: 1 copy
MX971002S	LabVIEW® driver (RS-232C): 1
MX971002G	LabVIEW® driver (GPIB): 1
B0329G	Front cover: 1 pc
	Options
MS9710B-02	White light source[*2]
MS9710B-05	Wavelength reference light source[*2]
MS9710B-06	Monitor output
MS9710B-10	Functional addition (Frequency display, table display)
MS9710B-13	Wavelength reference & SLD light source[*2]
MS9710B-14	SLD light source[*2]
MS9710B-25	FC-APC connector[*3]
MS9710B-26	SC-APC connector[*3]
MS9710B-27	E2000 (Diamond) connector[*3]
MS9710B-31	EC (Radial) connector[*3]
MS9710B-37	FC connector[*4]
MS9710B-38	ST connector[*4]
MS9710B-39	DIN connector[*4]
MS9710B-40	SC connector[*4]
MS9710B-43	HMS-10/A (Diamond) connector[*4]
MS9710B-47	HRL-10 connector[*3]
	Application parts
J0654A	RS-232C cable, 9P-9P
J0655A	RS-232C cable, 9P-25P
J0007	GPIB cable, 1 m
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A)
J0619B	Replaceable optical connector (SC)
J0635B	FC·PC-FC·PC-2M-SM (FC·PC optical fiber cord, 2 m, SM)
Z0282	Ferrule cleaner
Z0283	Replacement reel for ferrule cleaner (for Z0282)
Z0284	Cleaner for optical adapter (stick type)
G0084A	Polarization rotation module (for PMD measurement)
B0330C	Tilt stand

*1: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified, the FC connector (MS9710B-37) is supplied as standard.

*2: Factory options; Two units cannot be installed simultaneously. Exchangeable-type optical connectors (FC, SC, ST, DIN, HMS-10/A) are supplied when specified at ordering. One conversion cord is supplied for connecting other optical connectors to the FC connector.

*3: Factory option

*4: User replaceable

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OPTICAL SPECTRUM ANALYZER
MS9780A
600 to 1750 nm

CE GPIB

For Fibers with Core Diameters of 10, 50, and 62.5 µm

The MS9780A is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 600 to 1750 nm wavelength band. Its input section has been redesigned to support fibers with core diameters of 50/62.5 µm; the input section of the MS9780A can be used to measure the spectra of LDs and LEDs, etc. In addition to uses such as measurement of LD and LED spectra, it has functions for measuring the transmission characteristics of passive elements such as optical isolators, as well as the NF/Gain of optical fiber amplifier systems. In addition to its basic features, the superior stability and reliability of the diffraction-grating (patent pending) capability easily passes the severe specifications required for the precise measurement of WDM communications methods, particularly in the 1.55 µm band.
This analyzer, which is backed by Anritsu's high-level technology, has the dynamic range, reception sensitivity and sweep speed requested by users. Its high sensitivity meets the exacting demands placed on today's measuring instruments. In particular, the excellent wavelength and level specifications fully meet the dense WDM requirements in the 1.55 µm band. In addition to the high reliability and excellent basic performance, this analyzer has a full range of application functions to support accurate measurement in the fastest possible time.

Features

- **70 dB dynamic range**
- **–90 dBm guaranteed optical reception sensitivity**
- **Optical pulse measurement**
- **Full range of WDM application functions**
- **Tracking with tunable laser source**

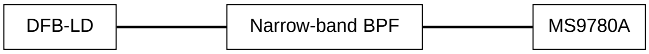
Applications

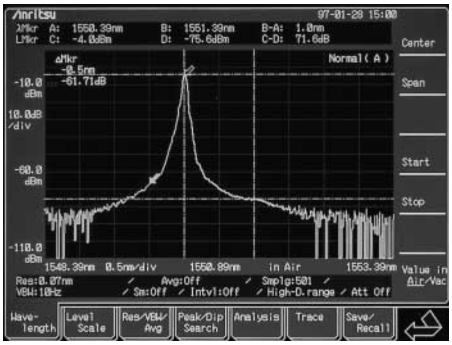
- **70 dB dynamic range**

The measurement dynamic range of the MS9780A in the normal measurement mode at a wavelength 1 nm from the peak wavelength is 62 dB. In the high-dynamic range measurement mode, better than 70 dB can be achieved. The analyzer demonstrates its excellence in SMSR measurement of DFB-LDs, as well as in evaluation of narrow-band optical band pass filters.

Measurement mode	Dynamic range (at SM fiber)	
	1 nm from peak	0.5 nm from peak
High dynamic range	70 dB	60 dB
Normal	62 dB	58 dB

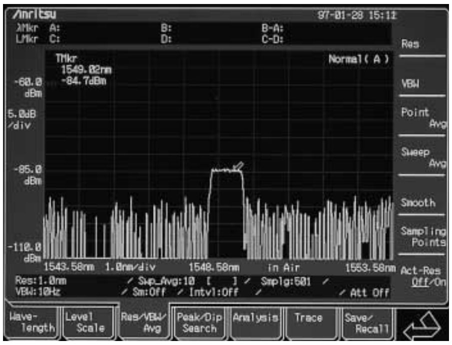
Wide-dynamic range measurement example with DFB-LD spectrum passed via narrow-band BPF.





- **–90 dBm guaranteed optical reception sensitivity**

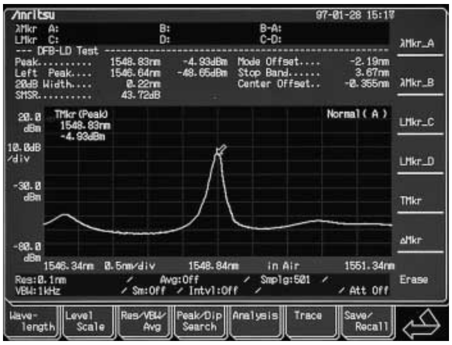
The MS9780A has achieved an improved S/N over a wide range by taking thorough countermeasures to noise and stray light. The RMS noise level at wavelengths from 1250 to 1600 nm is –90 dBm max. In addition, the S/N can be improved using sweep averaging. The screen display below shows the waveform after 10 averagings; the S/N is improved by more than 5 dB.



• Full function lineup

In addition to its excellent basic functions, the MS9780A comes with a full lineup of other useful functions summarized in the following table.

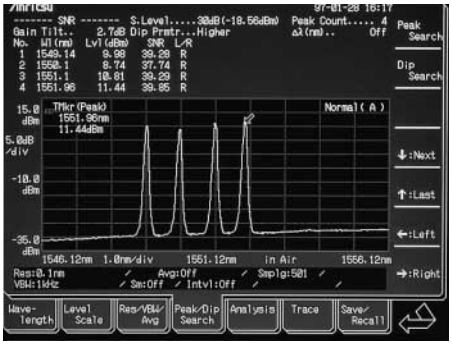
Device analysis	For analyzing and evaluating waveforms of optical elements (DFB-LDs, FP-LDs, LEDs)
Waveform analysis	For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis
Application measurement	EDFA NF and gain measurement, PMD measurement (See applications.)
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz (See applications.)
Markers	Multimarkers: Marker function for max. 128 points (See applications.) Zone markers: For waveform analysis in zone specified zone Peak/dip search: Searches for a peak or dip
Power monitor	Also functions as optical power meter
Vacuum wavelength	Converts displayed wavelength to value in display vacuum
External interfaces	GPIB, RS-232C



```
Anritsu                                              97-01-28 15:17
λMkr  A:                  B:                  B-A:
LMkr  C:                  D:                  C-D:
--- DFB-LD Test ---------------------------------------------------
Peak.........   1548.83nm    -4.93dBm  Mode Offset....    -2.19nm
Left  Peak....  1546.64nm   -48.65dBm  Stop Band......     3.67nm
20dB Width....     0.22nm              Center Offset..  -0.355nm
SMSR.........     43.72dB
TMkr (Peak)                                              Normal( A )
  1548.83nm
  -4.93dBm
Res:0.1nm        /     Avg:Off        /  Smplg:501  /
VBW:1kHz        / Sm:Off  / Intvl:Off  /                 / Att Off
```

• Spectrum analysis for WDM communication systems

Difficult problems in WDM transmission technology are the wavelength characteristics for the gain, and signal to noise ratio (SNR) between each channel. In evaluation, it is very important to measure this quantitatively. The MS9780A permits extremely quick and simple waveform analysis of up to 128 spectra. The waveform and level (SNR) of each peak exceeding the set threshold is displayed. The screen display below shows an example of the tilt gain.

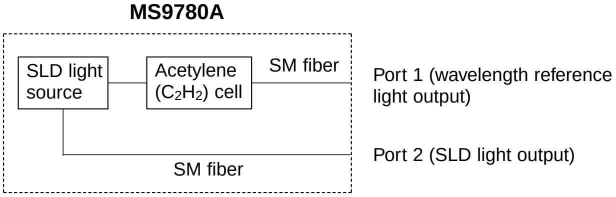


```
Anritsu                                              97-01-28 16:17
------- SNR -------  S.Level.....30dB(-18.56dBm)  Peak Count..... 4
Gain Tilt..   2.7dB Dip Prmtr...Higher            Δλ(nm)..      Off
No.  Wl(nm)   Lvl(dBm)   SNR   L/R
 1   1549.14     9.98   39.28  R
 2   1550.1      8.74   37.74  R
 3   1551.1     10.81   39.29  R
 4   1551.96    11.44   39.85  R
TMkr (Peak)                                              Normal( A )
 1551.96nm
 11.44dBm
Res:0.1nm        /     Avg:Off        /  Smplg:501  /
VBW:1kHz        / Sm:Off  / Intvl:Off  /                 /
```

• Convenient light source option (refer wavelength light) for better accuracy

Any one of the wavelength reference & SLD light source (Option 13), SLD light source (Option 14), wavelength reference light source (Option 05), and white light source (Option 02) can be installed in the MS9780A.

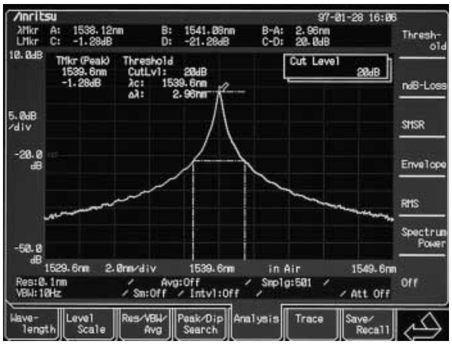
The block diagram of the wavelength reference & SLD light source option is shown below. This option has two separate output ports: Port 1 for wavelength calibration, and Port 2 for measuring transmission characteristics. When the MS9780A is calibrated automatically by inputting the reference light for the wavelength, post-calibration wavelength accuracy in the 1.52 to 1.57 µm range is better than ±0.05 nm. This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.



Block diagram of wavelength reference & SLD light

The following diagram shows the spectrum of the SLD light output from Port 2. When this light source is used instead of the earlier white light source for measurement of the wavelength transmission characteristics of optical receiver elements, it is possible to achieve a 20 dB wider dynamic range.

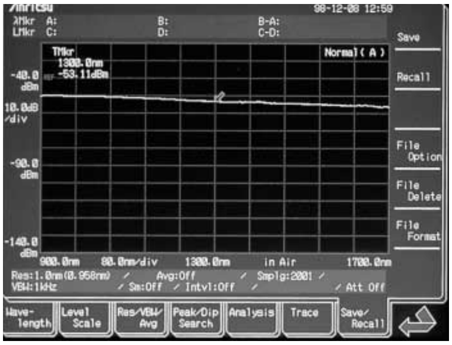
The following figure shows an example of measuring the transmission characteristics of optical band pass filter using the SLD light.



```
Anritsu                                              97-01-28 16:06
λMkr  A:  1538.12nm      B:  1541.08nm      B-A:  2.96nm
LMkr  C:  -1.28dB        D:  -21.28dB       C-D:  20.0dB
TMkr (Peak)   Threshold                     Cut Level
 1539.6nm      CutLvl:    20dB                         20dB
 -1.28dB       λc:     1539.6nm
               Δλ:       2.96nm
Res:0.1nm        /     Avg:Off        /  Smplg:501  /
VBW:10Hz        / Sm:Off  / Intvl:Off  /                 / Att Off
```

Measurement of optical band pass filter

If this dynamic range is not required, a lower-cost white light source can be installed instead. The following figure shows the spectrum of the white light source. When this light is used, transmission characteristics can be measured in wide range of 900 to 1750 nm.



```
Anritsu                                              98-12-08 12:59
λMkr  A:                  B:                  B-A:
LMkr  C:                  D:                  C-D:
TMkr                                                     Normal( A )
 1300.0nm
 -53.11dBm
Res:1.0nm(0.958nm) /     Avg:Off       /  Smplg:2001 /
VBW:1kHz          / Sm:Off  / Intvl:Off  /               / Att Off
```

Spectrum of white light source

Specifications

• MS9780A

Fiber	SM (9.5/125 µm), GI (50/125 µm)*1, GI (62.5/125 µm)*1
Wavelength	Range : 600 to 1750 nm Sweep width: 0, 0.2 to 1200 nm Accuracy: ±0.3 nm (600 to 1750 nm, after wavelength calibration with external light source) ±0.05 nm (1550 ±20 nm, resolution: 0.07 to 0.2 nm, after calibration with wavelength reference light source option)*2 ±0.1 nm (1550 ±20 nm, resolution: 0.5/1.0 nm, after calibration with wavelength reference light source option)*2 Stability: ±5 pm (1 minute)
Resolution	Setting: 0.07*2, 0.1, 0.2, 0.5, 1.0 nm Accuracy*2,*3: ±30% (1300/1550 nm, resolution: 0.1 nm), ±15% (1300/1550 nm, resolution: 0.2 nm), ±7% (1300/1550 nm, resolution: 0.5 nm)
Level	Measurement range (attenuator: off, 0° to +30°C)*4: –65 to +10 dBm (600 to 1000 nm), –85 to +10 dBm (1000 to 1250 nm), –90 to +10 dBm (1250 to 1600 nm), –75 to +10 dBm (1600 to 1700 nm), –55 to +10 dBm (1700 to 1750 nm, +10° to +30°C) Measurement range (attenuator: on, 0° to +30°C): –65 to +20 dBm (1100 to 1650 nm) Accuracy*2: ±0.6 dB (1300/1500 nm, –23 dBm, resolution: ≥0.2 nm) Stability*2: ±0.1 dB (1550 nm, –23 dBm, resolution: ≥0.2 nm, 1 minute) Linearity*2: ±0.1 dB (1550 nm, –50 to 0 dBm) Polarization dependency*2: ±0.15 dB (1300/1500 nm, resolution: ≥0.5 nm) Dynamic range*2 Normal mode: 62 dB (±1 nm), 58 dB (±0.5 nm) *1550 nm, resolution: 0.07 nm Wide dynamic range mode: 70 dB (±1 nm), 60 dB (±0.5 nm) *1550 nm, resolution: 0.07 nm, 25° ±5°C Return loss*2: 32 dB (1300/1550 nm)
Sweep	Sweep width: 0, 0.2 to 1200 nm Sweep speed (typical*5): 0.5 s (sweep width: 500 nm, normal mode measurement, VBW: 10 kHz)
Display	6.4 inch color TFT-LCD
Memory	A, B (2 trace), 3.5 inch FDD (for Windows®)
Printer	Internal (thermal type)
Interface	GPIB, RS-232C
Main functions	Optical pulse measurement, power monitor, wavelength auto-calibration
Operating conditions	Operating temperature: 0° to +50°C (FDD: 5° to 50°C), Storage temperature: –20° to +60°C Relative humidity: ≤90% (no condensation)
Power	85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*1: The NA of GI fiber is 0.2 for a core diameter of 50/125 µm and 0.275 for 62.5/125 µm. However, the permissible NA is 0.1 due to the spectroscope limitations.
*2: Connects to SM fiber (10/125 µm)
*3: Effective resolution value
*4: VBW: 10 Hz, sweep average: 10 times
*5: Typical value for reference; not guaranteed specification

• White light source (Option 02)

Optical output	≥–59 dBm/1 nm (typical value: –55 dBm/1 nm)
Wavelength range	900 to 1600 nm
Operating temperature	+18° to +28°C

• Reference wavelength light source (Option 05)

Wavelength reference	1.53 µm band Acetylene

• Wavelength Reference & SLD light source (Option 13)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C
Wavelength reference	1530 nm band Acetylene

*1: Measured after one hour warm-up

• SLD light source (Option 14)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C

*1: Measured after one hour warm-up

• VBW, sweep speed, minimum light reception sensitivity*1

VBW	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Sweep speed (typ.)	30 s	5 s	0.5 s	0.5 s	0.5 s	0.5 s
Minimum light reception sensitivity*2	–90 dBm	–80 dBm	–70 dBm	–60 dBm	–50 dBm	–40 dBm

*1: Data for reference; not guaranteed specifications
*2: RMS noise level (1.25 to 1.6 µm)

Note: Warm-up to the MS9780A for about 5 minutes to ensure stable operation. The above specifications were obtained 2 hours after power-on.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS9780A	Optical Spectrum Analyzer	
	Standard accessories	
	Optical connector adapter[*1]:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (for 100 Vac system):	2 pcs
Z0312	Printer paper:	2 rolls
W1477AE	MS9780A operation manual:	1 copy
W1478AE	Remote control operation manual:	1 copy
MX978001S	LabVIEW® driver (RS-232C):	1
MX978001G	LabVIEW® driver (GPIB):	1
B0239G	Front cover:	1 pc
	Options	
MS9780A-02	White light source[*2]	
MS9780A-05	Wavelength reference light source[*2]	
MS9780A-06	Monitor output (VGA output)[*3]	
MS9780A-13	Wavelength reference & SLD light source[*2]	
MS9780A-14	SLD light source[*2]	
MS9780A-27	E2000 (Diamond) connector[*3]	
MS9780A-37	FC connector[*4]	
MS9780A-38	ST connector[*4]	
MS9780A-39	DIN connector[*4]	
MS9780A-40	SC connector[*4]	
MS9780A-43	HMS-10/A (Diamond) connector[*4]	
	Application parts	
J0654A	RS-232C cable (9P-9P)	
J0655A	RS-232C cable (9P-25P)	
J0007	GPIB cable, 1m	
J0617B	Replaceable optical connector (FC)	
J0618D	Replaceable optical connector (ST)	
J0618E	Replaceable optical connector (DIN)	
J0618F	Replaceable optical connector (HMS-10/A)	
J0619B	Replaceable optical connector (SC)	
J0893B	FC · PC-FC · PC-2M-GI (50/125 µm)	
J0894B	FC · PC-FC · PC-2M-GI (62.5/125 µm)	
J0203	Optical fiber cord with lens attached to end (50 µm core diameter), 2 m	
J0204	Optical fiber cord with lens attached to end (200 µm core diameter), 2 m	
Z0282	Ferrule cleaner (Cletop A type, 1 pc)	
Z0283	Tape for ferrule cleaner (6 pcs/set)	
Z0284	Cleaner for optical adapter (stick-type, 200 pcs/set)	
B0330C	Tilt stand	

*1: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified, the FC connector (MS9780A-37) is supplied as standard.

*2: Factory options; Two units cannot be installed simultaneously.
Exchangeable-type optical connectors (FC, SC, ST, DIN, HMS-10/A) are supplied when specified at ordering. One conversion cord is supplied for connecting other optical connectors to the FC connector.

*3: Factory option

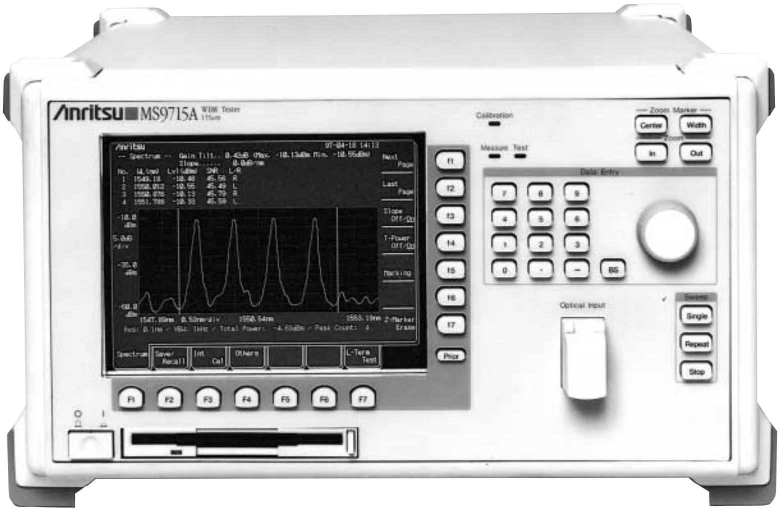
*4: User replaceable

Note:
Windows® is a registered trademark of Microsoft Corporation.
LabVIEW® is a registered trademark of National Instruments.

WDM TESTER
MS9715A
1.527 to 1.567 µm

CE GPIB

For Maintaining and Monitoring WDM Optical Communication Systems



Custom-made product

Optical communications are getting into full swing. Great things are expected of WDM optical communications in answer to the recent social demand for dramatic increases in transmission volume. In WDM communications, multiple optical elements are used in an optical amplifier and various characteristics are precisely controlled to maintain system performance.
The MS9715A is a measuring instrument for use in system manufacture, construction, and maintenance. One instrument combines accurate measurement of necessary items over long periods and satisfies conditions of simplicity of use in construction and maintenance operations, lightness and compactness, and superior environmental performance with respect to vibration and shock. In addition, since the LabVIEW driver is fitted as standard, programming by remote control is simple. A windows compatible floppy disk drive is also fitted as standard.

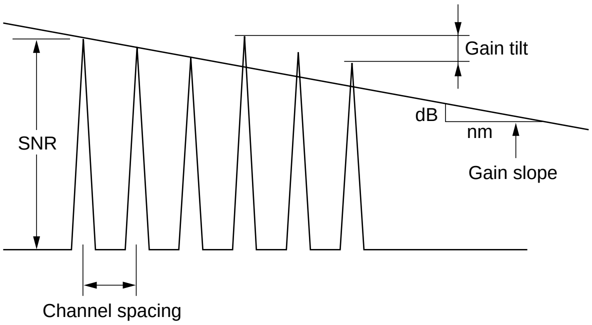
Feature

- For WDM optical communication

Performance and functions

• Measurement items
Maximum, minimum, and average values over a long period for wavelength, level, SNR[*1], channel spacing[*2], gain tilt[*3], gain slope[*4], total power, and spectrum measurement.

*1: Signal to Noise Ratio (dB). Noise resolution level of 0.1 nm. Of the signal's 2 extremes, that with the greater level (smaller SNR) is automatically selected.



*2: Wavelength difference between spectra for individual signal (nm, GHz)

*3: Difference between maximum and minimum peak values for total signal spectrum

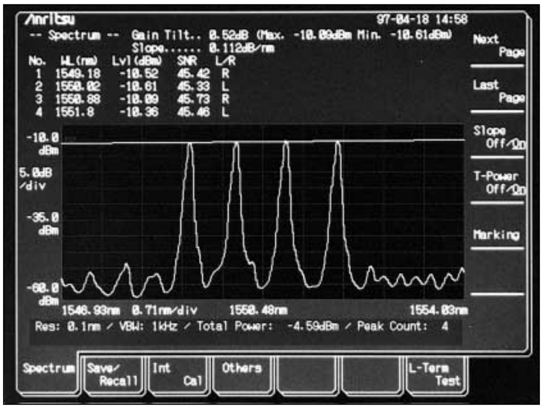
*4: Slope of least mean square regression line of total signal spectrum peaks (dB/nm)

• Superior basic functions
The MS9715A provides the high performance required for the performance testing and evaluation of WDM equipment. Wavelength measurement has ±50 pm accuracy, ±5 pm wavelength stability, and ±20 pm wavelength linearity. High performance level measurement has a dynamic range of 53 dB (0.5 nm from peak), ±0.4 dB level accuracy, ±0.02 dB level stability, and ±0.05 dB level linearity[*5].

*5: 5 performances at 0.1 nm resolution

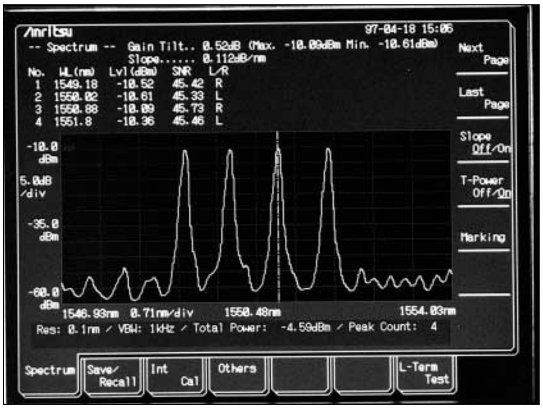
• Calculation functions
Measurement calculation functions for SNR, gain tilt, total power, gain slope, channel spacing, etc. are provided.

• 2 measurement modes
Spectrum measurement mode and long-time measurement mode are provided. As shown on the screen below, in spectrum measurement mode, the results calculated are displayed. (Spectrum is expanded or contracted using the zoom marker).



```
Anritsu                                         97-04-18 14:58
 -- Spectrum --  Gain Tilt.. 0.52dB (Max. -10.09dBm Min. -10.61dBm)
                 Slope...... 0.112dB/nm
 No.  WL(nm)   Lvl(dBm)  SNR    L/R
  1   1549.18   -10.52   45.42  R
  2   1550.02   -10.61   45.33  L
  3   1550.88   -10.09   45.73  R
  4   1551.8    -10.36   45.46  L
 1546.93nm  0.71nm/div     1550.48nm              1554.03nm
 Res: 0.1nm / VBW: 1kHz / Total Power:  -4.59dBm / Peak Count:  4
```

Example of gain tilt and gain slope display



```
Anritsu                                          97-04-18 15:06
-- Spectrum --  Gain Tilt.. 0.52dB (Max. -10.09dBm Min. -10.61dBm)
                Slope...... 0.112dB/nm
No.  WL(nm)   Lvl(dBm)  SNR    L/R
 1   1549.18  -10.52    45.42  R
 2   1550.02  -10.61    45.33  L
 3   1550.88  -10.09    45.73  R
 4   1551.8   -10.36    45.46  L
   1546.93nm  0.71nm/div    1550.48nm              1554.03nm
 Res: 0.1nm / VBW: 1kHz / Total Power:  -4.59dBm / Peak Count:  4
```

Example of specific spectrum emphasis display

- **Ease of operation**

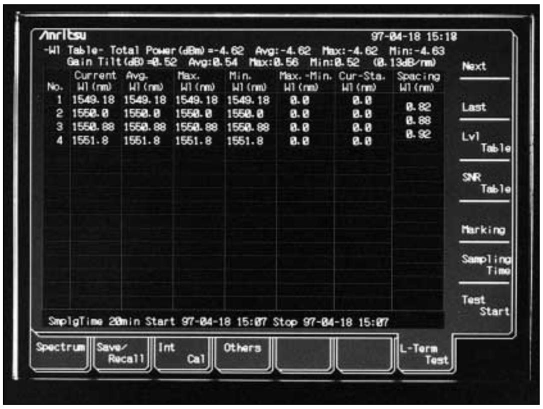
Measured wavelength settings can be freely expanded or contracted using the zoom marker. The guide spectrum for a specific spectrum can be found at a glance while freely setting the marker. In addition, the level axis is automatically set by detection of maximum and minimum. Wavelength calibration is performed automatically using an internal standard light source.

- **Long-time mode**

The long-time mode displays measurement results for wavelength, level, and SNR in tables. Besides average value, maximum value, minimum value, and maximum – minimum value for the time interval set by the user (sampling period), the table displays the difference between the current value and that at start time (initial long-time measurement). The wavelength tables also display channel spacing. The complete table value display for each sampling period is treated as one set, and a maximum of 1000 sets are recorded on floppy disk. The behavior of the measured system can be analyzed over a long time period. During the long-time measurement, wavelength calibration is performed automatically using the internal wavelength standard; even if ambient conditions change during the measurement, high wavelength measurement accuracy is secured.

Specifications

Wavelength	Range: 1.527 to 1.567 µm (integrate power: 1.52 to 1.58 µm) Accuracy: ±0.05 nm Stability: ±5 pm (1 min), ±10 pm (constant temperature: 60 min) Linearity: ±20 pm Resolution: 0.1 nm Resolution accuracy: ±10% (actual display resolution)
Level	Range: –65 to +20 dBm Accuracy: ±0.4 dB Stability: ±0.02 dB (–23 dBm, 1 min, constant temperature) Linearity: ±0.05 dB (0 to –50 dBm) Flatness: ±0.15 dB
Polarization dependency	±0.25 dB
Dynamic range	58 dB (±1 nm), 53 dB (±0.5 nm)
Measurement signal	Max. 32 waves
Return loss	≥35 dB
Wavelength reference	Acetylene (1.52 µm)
Display	6.4”, color TFT-LCD
Measurement item	Maximum, minimum and average values over a long period for wavelength, level, SNR, channel spacing, gain tilt, gain slope, total power, and spectrum
Memory	3.5” FD (for Windows)
Interface	RS-232C, GPIB
Environmental condition	Operating temperature: +5˚ to +50˚C Storage temperature: –20˚ to +60˚C Relative humidity: ≤90%
Power	AC 85 to 132/170 to 250 V, 47.5 to 63 Hz, ≤150 VA
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)



```
Anritsu                                                     97-04-18 15:18
-Wl Table- Total Power(dBm)=-4.62  Avg:-4.62  Max:-4.62  Min:-4.63
   Gain Tilt(dB)=0.52  Avg:0.54  Max:0.56  Min:0.52  (0.13dB/nm)
     Current  Avg.     Max.     Min.     Max.-Min. Cur-Sta. Spacing
No.  Wl(nm)   Wl(nm)   Wl(nm)   Wl(nm)   Wl(nm)    Wl(nm)   Wl(nm)
 1   1549.18  1549.18  1549.18  1549.18  0.0       0.0
 2   1550.0   1550.0   1550.0   1550.0   0.0       0.0      0.82
 3   1550.88  1550.88  1550.88  1550.88  0.0       0.0      0.88
 4   1551.8   1551.8   1551.8   1551.8   0.0       0.0      0.92
 SmplgTime 20min Start 97-04-18 15:07 Stop 97-04-18 15:07
```

Wavelength table

```
Anritsu                                                     97-04-18 15:27
-SNRTable- Total Power(dBm)=-4.62  Avg:-4.62  Max:-4.62  Min:-4.63
   Gain Tilt(dB)=0.52  Avg:0.54  Max:0.56  Min:0.52  (0.13dB/nm)
     Current  Current  Avg.     Max.     Min.     Max.-Min. Cur-Sta.
No.  Wl(nm)   SNR(dB)  SNR(dB)  SNR(dB)  SNR(dB)  SNR(dB)   SNR(dB)
 1   1549.18  45.33    45.36    45.39    45.33    0.06      -0.06
 2   1550.0   45.27    45.27    45.28    45.27    0.01      -0.01
 3   1550.88  45.85    45.83    45.85    45.81    0.04       0.04
 4   1551.8   45.6     45.56    45.6     45.52    0.08       0.08
 SmplgTime 20min Start 97-04-18 15:07 Stop 97-04-18 15:07
```

Level table

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Mainframe	
MS9715A	WDM Tester (custom-made product)	
	Standard accessories	
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (for 100/200 Vac system):	2 pcs
B0329G	Front cover (3/4MW4U):	1 pc
MX971501S	LabVIEW® driver (RS-232C):	1
MX971501G	LabVIEW® driver (GPIB):	1
W1234AE	MS9715A operation manual:	1 copy
W1235AE	MS9715A remote control operation manual:	1 copy
	Options	
MS9715A-27	E-2000 (Diamond) connector	
MS9715A-31	EC (Radial) connector	
MS9715A-37	FC connector	
MS9715A-38	ST connector	
MS9715A-39	DIN connector	
MS9715A-40	SC connector	
MS9715A-43	HMS-10/A (Diamond) connector	
	Optional accessories	
J0654A	Serial interface cable (IBM-PC/AT, for J-310)	
J0655A	Serial interface cable (9/25-pin, 9P-9P)	
J0007	GPIB cable, 1 m (2 pcs)	
J0617B	Replaceable optical connector (FC)	
J0618D	Replaceable optical connector (ST)	
J0618E	Replaceable optical connector (DIN)	
J0618F	Replaceable optical connector (HMS-10/A)	
J0619B	Replaceable optical connector (SC)	
J0635B	Optical fiber cord (FC-PC connector, for SM), 2 m	
Z0282	Ferrule cleaner	
Z0283	Tape for Ferrule cleaner (6 pcs/set, for Z0282)	
Z0284	Adapter cleaner (200 pcs/set)	

OPTICAL CHANNEL DROP UNIT (OCDU)

MN9320A

1528 to 1565 nm

Access to DWDM Channels and Traffic at One Location

Current System Settings
Position Units: nm
Power Units: dBm
Output Protection: -5.00 dBm
Channel Grid: ITU-T 50 GHz
Search Threshold: -25.50 dBm
Scan Range Start: 1564.68 nm
Scan Range End: 1528.77 nm
Configuration Name: Factory Default
Press SET To Change System Settings.
73 | 1540.16 nm

The technique of Dense Wavelength Division Multiplexing is well established and adopted worldwide as a means of increasing the traffic carrying capacity of a fiber. Optical cross connects, wavelength routing and translation, now make a typical network far more complex in construction. Identification of an individual channel and verification of the data passing over it during installation, commissioning and routine maintenance as part of a Service Level Agreement (SLA) is becoming more critical. The MN9320A Optical Channel Drop Unit is a test instrument that scans the DWDM optical signal and displays all those channels present in the form of a bar graph or a tabulation of channel and power. Any individual channel can be selected from this display and fed to its output port which can then be connected to a protocol analyzer such as the Anritsu MP1570A for data validation and testing. Wherever the integrity of a DWDM signal must be verified, the MN9320A can be used.

Features

Independent DWDM signal access for channels of 50 GHz spacing or higher up to data rates of 10 Gbps.

- ±10 pm wavelength accuracy (typical)
- ITU-T 50 GHz, 100 GHz or custom grid capability
- Provides DWDM channel access to any BER tester
- Measurement of channel wavelength and power
- Optical output protection mode

Proof of conformance to a customer SLA, isolation of points of failure or performance degradation in a DWDM network can be achieved by connecting the MN9320A to a monitor point in the network and connecting it to a Data Analyzer such as the Anritsu MP1570A. Any of the individual DWDM channel signals can then be directed to the input of the BERT for analysis.
Data at rates of up to 10 Gbps and at a spacing as close as 50 GHz are easily handled by the MN9320A.

Functional and simple to use

- Single button operation
- Channel table shows wavelength and optical power
- Any selected channel can be dropped
- Filter design will prevent data corruption at 10 Gbps

• Optical channel scan mode
The MN9320A will scan the entire 'C' band window at the press of one button, identify the channels present at their optical power.

• Optical power meter mode
The MN9320A measures the optical power in each channel. From the measurement window the user can select to measure optical power anywhere in the 'C' band.

• Channel search mode
The MN9320A enables a user to select a particular power level above which DWDM channels are expected. The unit will then only display these channels in the Channel Grid Display. In addition to the tabular display in the channel table, the user can see them in a bar graph format.

• Channel insert mode
Where non-standard channels are to be used to carry traffic or for co-channel cross-talk testing, the user can add these to the channel table.

• Automatic channel grid mode
From the set up screen the user can select to use the ITU-T 50 GHz or 100 GHz channel spacing. Where non standard spacings are used, custom grids can be created and stored in internal memory.

• Optical output protection mode
Any network data analyzer is an expensive test tool, yet the receiver can be easily damaged by the application of a high input power. The MN9320A offers a unique output protection mode to prevent this expensive mistake. On switch on, the unit has a preset level above which the output port will not become active. This level can be changed by the user in the set up screen.

• Incredible wavelength accuracy
The optical components within the MN9320A are of the highest quality, providing wavelength accuracy of typically ±10 pm and repeatability of ±3 pm, so you can be sure it goes back to the same spot, time after time.

Specifications

Wavelength range	1528 to 1565 nm
Channel drop mode	Channel spacing: 50 GHz and higher Data rate: 10 Gbps
Wavelength accuracy	±20 pm guaranteed (±10 pm typical)
Wavelength repeatability	±3 pm
ORR @ 0.4 nm	>40 dBc typical
Maximum input power	+18 dBm
Input power measurement range	–50 to +10 dBm
Power meter accuracy	±0.5 dBm for –40 to +10 dBm
Insertion loss	8 dB max
Display	Color STN 6" (159 mm) FVGA
External interfaces	RS-232C
EMC	EN61326: 1998 STD
Safety	EN61010-1: 1993
Dimensions and mass	320 (W) x 133 (H) x 350 (D) mm, 11 kg
Power	100 to 240 VAC, 47 to 67 Hz. 250 VA max
Temperature range	Operation: 0° to +50°C, Storage: –40° to +70°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MN9320A	'C' band Optical Channel Drop Unit
	Standard accessories supplied with this unit: FC/UPC connectors, operation manual, AC power cord, protective front cover
	Options
MN9320A-01	SC/UPC connectors
MN9320A-02	ST/UPC connectors
MN9320A-03	HMS-10/A connectors
	Application parts
760-218	Hard carry case, with storage for power cord, optical patch cords, operation manual and other accessories
J0617B	Replaceable connector (FC)
J0618D	Replaceable connector (ST)
J0618E	Replaceable connector (DIN)
J0618F	Replaceable connector (HMS-10/A)
J0619B	Replaceable connector (SC)

OPTICAL CHANNEL SELECTOR
MN9662A/9664A/9672A/9674A
1.2 to 1.65 µm

CE GPIB

For Automatic Switching of Optical Paths

The optical channel selector is a switching device used for outputting the light that is inputted to the common channels to any channel. The above devices are equipped with eight (for MN9662A/9672A) and sixteen (for MN9664A/9674A) channels, making them ideal for the evaluation of devices for WDM and various optical transmission devices*.

They possess excellent switching repeatability of 0.003 dB (typical value) and low polarization dependent loss of 0.03 dBp-p (MN9662A/9664A). Cleanable and replaceable optical adapters (FC, SC, ST, DIN and HMS-10/A) are also available as applications. Moreover, in addition to the control by the MT9810B Optical Test Set, GPIB and RS-232C interfaces are provided as standards, allowing the above devices to be used as components of an automatic measurement system.

*: Please contact us for 1 x 24, 2 x 24, 1 x 32 and 2 x 32 optical channel selectors

Features

- Low polarization-dependent Loss (0.03 dBp-p: MN9662A/9664A)
- Cleanable and replaceable optical adapters (FC, SC, ST, DIN, HMS-10/A)

Specifications

Typical values are given for reference only to assist in the use of these instruments, and are not guaranteed specifications.

Model		MN9662A	MN9664A	MN9672A	MN9674A
Number of channels		1 x 8	1 x 16	2 x 8	2 x 16
Wavelength		1.2 to 1.65 µm			
Applicable optical fiber		SM (ITU-T G.652)			
Insertion loss*1, *2		≤1.6 dB (1.1 dB typ.)		≤2.5 dB (2.0 dB typ.)	
Return loss*3		≥45 dB (PC connector)			
Polarization dependent loss*1		≤0.03 dBp-p (0.015 dBp-p typ.)*4		≤0.05 dBp-p (0.025 dBp-p typ.)*5	
Crosstalk		≤–80 dB			
Switching repeatability*6		≤0.02 dBp-p (0.003 dBp-p typ.)			
Switching time	Min.*7	≤600 ms			
	Max.	≤800 ms*8	≤1100 ms*9	≤800 ms*8	≤1100 ms*9
Switching life		≥1 x 10^7 times			
Max. input level		+23 dBm (200 mW)			
I/O optical connector		FC, SC, ST, DIN, HMS-10/A (all PC type)			
Temperature range		Operating: 0˚ to 50 ˚C, Storage: –30˚ to +71 ˚C			
Remote control		GPIB, RS-232C (D-sub 9-pin), control by MT9810B			
Power		85 to 132/170 to 250 Vac, ≤35 VA, 47.5 to 63 Hz			
Dimensions and mass		213 (W) x 88 (H) x 351 (D) mm, ≤4.5 kg			
EMC		EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class D), EN61326: 1997/A1: 1998 (Annex A)			
LVD		EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)			

*1: Specifications measured using master optical fiber cable
*2: Including connector loss at 2 points at 1.31 and 1.55 µm
*3: Loss depends on connected connector, using PC connector at ≥50 dB return loss at 1.31 and 1.55 µm
*4: At constant temperature in operating temperature range at 1.31 and 1.55 µm
*5: At constant temperature in operating temperature range at 1.55 µm
*6: At constant temperature in operating temperature range and constant polarization condition
*7: Between channel 1 and channel 2
*8: Between channel 7 and channel 8
*9: Between channel 15 and channel 16
Note: Please contact us for 1 x 24, 2 x 24, 1 x 32 and 2 x 32 optical channel selectors.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MN9662A	Optical Channel Selector (1 x 8 channels)
MN9672A	Optical Channel Selector (2 x 8 channels)
MN9664A	Optical Channel Selector (1 x 16 channels)
MN9674A	Optical Channel Selector (2 x 16 channels)
	Standard accessories
	Power cord: 1 pc
F0008	Fuse, 1 A (for 100/200 V mains): 2 pcs
Z0397A	FC adapter caps[*1]
B0329L	Front cover: 1 pc
W1489AE	MN9662A/9672A/9664A/9674A operation manual: 1 copy
	Options
MN9662A/9664A-37	FC-PC connector (with FC adapter cap)[*2]
MN9672A/9674A-37	FC-PC connector (with FC adapter cap)[*2]
MN9662A/9664A-38	ST connector (with ST adapter cap)[*2]
MN9672A/9674A-38	ST connector (with ST adapter cap)[*2]
MN9662A/9664A-39	DIN connector (with DIN adapter cap)[*2]
MN9672A/9674A-39	DIN connector (with DIN adapter cap)[*2]
MN9662A/9664A-40	SC connector (with SC adapter cap)[*2]
MN9672A/9674A-40	SC connector (with SC adapter cap)[*2]
MN9662A/9664A-43	HMS-10/A connector (with HMS-10/A adapter cap)[*2]
MN9672A/9674A-43	HMS-10/A connector (with HMS-10/A adapter cap)[*2]
	Application parts
J0617B	Replaceable optical adapter (FC-PC)
J0618D	Replaceable optical adapter (ST)
J0618E	Replaceable optical adapter (DIN)
J0618F	Replaceable optical adapter (HMS-10/A)
J0619B	Replaceable optical adapter (SC)
Z0397A	FC adapter cap
Z0411A	ST adapter cap
Z0412A	DIN adapter cap
Z0413A	SC adapter cap
Z0414A	HMS-10/A adapter cap
J0635B	Optical fiber cord (FC-PC connector), 2 m
J0006	GPIB cable, 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0009	GPIB cable, 4 m
J0654A	Serial interface cross cable (for IBM-PC/AT, J-310)
J0655A	Serial interface cross cable (for PC-98)
J0897B	MT9810B connection cable, 1 m
J0897C	MT9810B connection cable, 2 m
J0897D	MT9810B connection cable, 5 m
J0897E	MT9810B connection cable, 10 m
Z0282	Ferrule cleaner (A-type)
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
B0390G	Rack mount for 1 set
B0390H	Rack mount for 2 sets

[*1] Number differs according to model
MN9662A: 9 pcs; MN9672A: 10 pcs; MN9664A: 17 pcs; MN9674A: 18 pcs

[*2] Standard connector for specified option. If not specified, FC-PC connector (Option 37) supplied as standard.

PROGRAMMABLE OPTICAL ATTENUATOR

MN9625A/9626A

1.2 to 1.65 µm

CE GPIB

High Attenuation Accuracy, Low Polarization Dependent Loss, Excellent Wavelength Flatness

The MN9625A/9626A Programmable Optical Attenuator has excellent attenuation accuracy. It is calibrated with a high-accuracy calibration system over an attenuation range of 0 to 60 dB.
The MN9625A has a superior wavelength flatness of 0.2 dBp-p max. by using an attenuation element with very flat wavelength characteristics. It is the ideal instrument for evaluating WDM (wavelength division multiplexing) optical amplifiers in which gain flatness vs. wavelength is an important factor. Moreover, the MN9626A has a built-in optical monitor output for monitoring the level of through light.

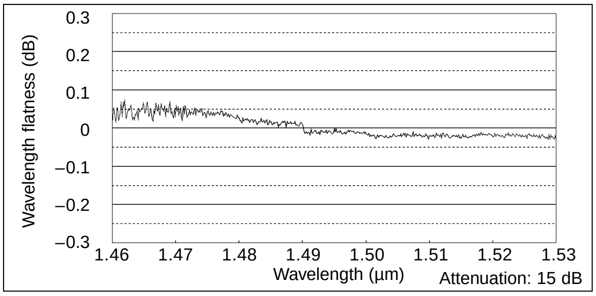
Features

- Attenuation accuracy of ±0.05 dB (typical)
- Wavelength flatness of 0.1 dBp-p (typical, 1.52 to 1.57 µm, MN9625A)
- Low polarization dependent loss of 0.05 dBp-p max. (MN9625A)
- Return loss of 45 dB min. (PC connector) and 60 dB min. (APC: Angled PC connector)
- Removable optical connector for easy cleaning and replacement

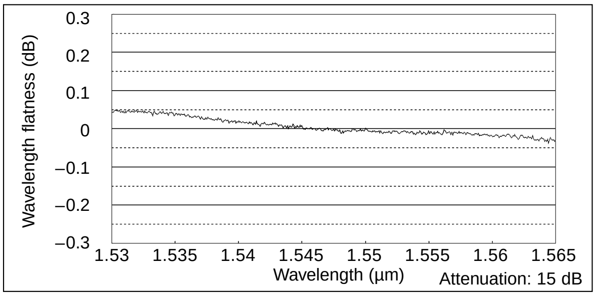
Applications

- R&D and manufacturing of WDM optical amplifiers —– Adjusting input optical level, evaluating gain flatness
- R&D and manufacturing of optical transmission systems —– Adjusting optical output and reception optical levels, testing error rates
- R&D and manufacturing of optical components —– Measuring optical fiber amplifier I/O and wavelength characteristics, measuring optical loss of isolators, etc.

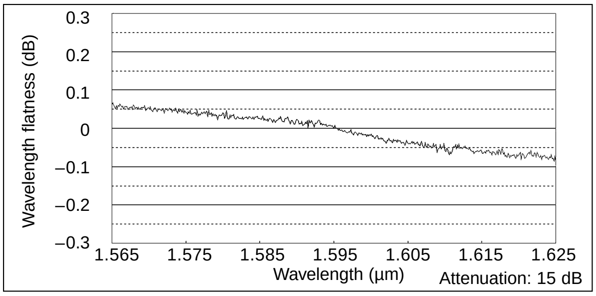
Typical characteristics



Wavelength flatness: 1.46 to 1.53 µm (MN9625A)



Wavelength flatness: 1.53 to 1.565 µm (MN9625A)



Wavelength flatness: 1.565 to 1.625 µm (MN9625A)

Specifications

(Specifications at 1.31/1.55 µm measured using master optical fiber cord. Typical values are not guaranteed.)

Model		MN9625A	MN9626A
Wavelength range		1.2 to 1.65 µm	
Applicable optical fiber		SM fiber (ITU-T G.652)	
Maximum attenuation		60 dB (except insertion loss)	
Display resolution		0.01 dB	
Attenuation accuracy		±0.1 dB (typical: ±0.05 dB)	
Polarization dependent loss		≤0.05 dBp-p (typical: 0.03 dBp-p)	≤0.1 dBp-p (typical: 0.07 dBp-p)
Wavelength flatness*1		≤0.2 dBp-p (1.46 to 1.53 µm) ≤0.2 dBp-p (1.53 to 1.565 µm) ≤0.25 dBp-p (1.565 to 1.625 µm)	–
Insertion loss		≤2.8 dB (typical: 1.8 dB)	≤4.2 dB*2
Switching repeatability		±0.01 dB*3 (typical: ±0.005 dB)	
Switching time		≤150 ms (attenuation variation: 0.01 dB), ≤500 ms (attenuation variation: 60 dB)	
I/O crosstalk		≤–80 dB (shutter closed)	
Return loss		≥45 dB (PC connector)*4, ≥60 dB (APC connector)*5	
Optical monitor output*6	Output ratio	–	10:1
	Loss difference	–	≤19.0 dB
	Output stability	–	≤0.1 dB
	Crosstalk attenuation	–	≥40 dB
I/O connector		PC*7: FC, SC, DIN, ST, HMS-10/A APC*8: FC, SC, HRL-10	
Maximum input level		18 dBm (63 mW)	
Operating temperature range		0 to 50˚C	
Power*9		85 to 132 Vac, 170 to 250 Vac, 47.5 to 63 Hz, ≤45 VA	
Dimensions and mass		132.5 (H) x 213 (W) x 351 (D) mm, ≤6.5 kg	
EMC		EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class D) EN61326: 1997/A1: 1998 (Annex A)	
LVD		EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)	

*1: Attenuation range of 0 to 30 dB
*2: Including optical fiber coupler loss
*3: At constant temperature in operating temperature range
*4: Depends on connector (using PC connector with return loss of 48 dB min.)
*5: Depends on connector (using APC connector with return loss of 63 dB min.)
*6: Between output and optical monitor output
*7: User replaceable (One connector type supplied as standard accessory. When connector type is not specified in the order, FC connectors are supplied.)
*8: Factory option, attachable/detachable front shell
*9: Specify 100 Vac or 200 Vac system when ordering (factory setting only).

Ordering information

Please specify model/order number, name, and quantity when ordering.

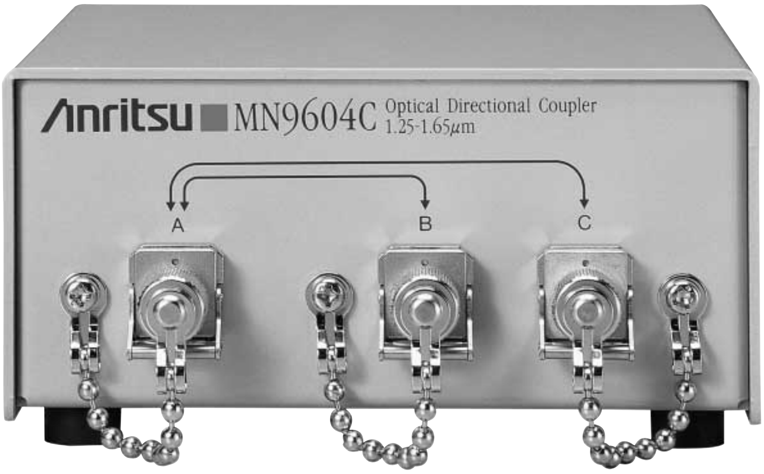
Model/Order No.	Name	
	Main frame	
MN9625A	Programmable Optical Attenuator	
MN9626A	Programmable Optical Attenuator (with optical monitor output)	
	Standard accessories	
W1834AE	MN9625A/9626A operation manual:	1 copy
	Power cord, 2.5 m:	1 pc
F0010	Fuse, 1.6 A:	2 pcs
	Options	
MN9625A/9626A-38	ST connector (both input and output)	
MN9625A/9626A-39	DIN connector (both input and output)	
MN9625A/9626A-40	SC connector (both input and output)	
MN9625A/9626A-43	HMS-10/A connector (both input and output)	
MN9625A/9626A-25	FC (APC) connector (both input and output, factory option)	
MN9625A/9626A-26	SC (APC) connector (both input and output, factory option)	
MN9625A/9626A-47	HRL-10 (APC) connector (both input and output, factory option)	
	Optional accessories	
Z0513A*1	Optical fixed attenuator [FC (PC)]	
Z0513B*1	Optical fixed attenuator [SC (PC)]	
Z0513C*1	Optical fixed attenuator [ST (PC)]	

Model/Order No.	Name
B0390E	Rack mount kit (inch type, for 1 unit, left side)
B0390F	Rack mount kit (inch type, for 2 units, side-by-side)
B0329M	Front cover (1/2MW3U)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0009	GPIB cable, 4 m
J0617B	Replaceable optical connector (FC) *For PC connector
J0618D	Replaceable optical connector (ST) *For PC connector
J0618E	Replaceable optical connector (DIN) *For PC connector
J0619B	Replaceable optical connector (SC) *For PC connector
J0618F	Replaceable optical connector (HMS-10/A) *For PC connector
J0739A	Replaceable optical connector (FC) *For APC connector
J0739C	Replaceable optical connector (SC) *For APC connector
J0739D	Replaceable optical connector (HRL-10) *For APC connector
Z0282	Ferrule cleaner
Z0283	Replacement reel for ferrule cleaner (6 pcs/set)
Z0284	Cleaner for optical adapter (stick type, 200 pcs/set)

*1: Attenuation: 6 dB ±1 dB, Maximum input level: +23 dBm, Return loss: ≥55 dB

OPTICAL DIRECTIONAL COUPLER
MN9604C/D
1.25 to 1.65 µm

For High-Accuracy Measurement of Optical Connector Return Loss



The MN9604C/D is used in combination with stabilized light source and optical power meter to measure optical return loss of optical connectors at approx. 50 dB.

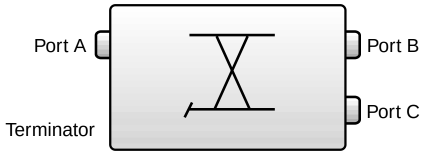
Specifications

Model	MN9604C	MN9604D
Compatible fiber	SM (10/125 µm, NA 0.1)	
Wavelength range	1.25 to 1.65 µm	
Insertion loss	<5.5 dB (1.31/1.55 µm: <5.0 dB, between ports A to B and ports A to C)	
Loss difference between ports	<2.2 dB (1.31/1.55 µm: <1.5 dB, between ports A to B and ports A to C)	
Insertion loss polarization dependency	<0.15 dB*1	
Crosstalk attenuation	>54 dB*1,*2	>70 dB*1,*3
Optical connector	FC, SC, ST, DIN, HMS-10/A	
Ambient temperature, rated range of use	0˚ to +50˚C	
Storage temperature	–40˚ to +71˚C	
Dimensions and mass	110 (W) x 52 (H) x 121 (D) mm, ≤500 g	

*1: Wavelength: 1.31/1.55 µm
*2: When using the connector with return loss of >53 dB
*3: Specified with the wavelength of 1.55 µm, except from the reflection of APC connector.

• MN9604D optical connector option

Model No.	Connector	
	Port A	Port B, C
MN9604D-25	FC-APC	FC-PC
MN9604D-26	SC-APC	SC-PC
MN9604D-47	HRL-10	DIN (47256)



Ordering information

Please specify model/order number, name and quantity when ordering.

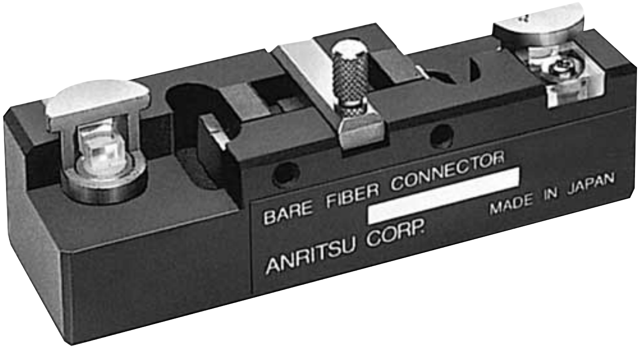
Model/Order No.	Name
	Main frame
MN9604C	Optical Directional Coupler (for SM fiber)
	Standard accessories
W1563AE	MN9604C operation manual: 1 copy
	Optical connectors
MN9604C-37	FC/PC connector
MN9604C-38	ST connector
MN9604C-39	DIN connector
MN9604C-40	SC connector
MN9604C-43	HMS-10/A (DIAMOND) connector
	Optional accessories
J0441	Total internal reflection fiber cord, 1 m (with FC · PC connector)
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A)
J0619B	Replaceable optical connector (SC)
Z0282	Ferrule cleaner (Cletop A-type, 1 pc)
Z0283	Ferrule cleaner spare tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
	Main frame
MN9604D	Optical Directional Coupler*1
	Standard accessories
MN9604D-25	FC-APC connector
MN9604D-26	SC-APC connector
MN9604D-47	HRL-10 connector
W2025AE	MN9604D operation manual: 1 copy

*1: Connector for specified options at ordering supplied as standard. Specify by appending number after model. If connector not specified, FC-PC (Option 25) supplied as standard.

BARE FIBER CONNECTOR

MA9014A

Simple to Use



The MA9014A Bare Fiber Connector has a V-groove design to permit quick connections of optical fibers. During maintenance and installation, bare optical fibers with mirrored cut-end faces can be connected. And the use of optical fiber guide and glass tube ensures that the fibers are easily and reliably set.

Features

- Simple to use
- Accommodates single-mode fibers

Applications

- Measuring breakes in optical fiber cable with optical time domain reflectometer
- Two-way communication during optical-fiber cable installation

Specifications

Compatible optical fibers	10/125 µm	50/125, 62.5/125, 100/140 µm
Connection loss*	≤0.5 dB	≤0.2 dB
Dimensions and mass	74 (W) x 28 (H) x 24 (D) mm, <100 g	

*: When optical fibers with same core and clad diameters and matching oil used

Note: Usable optical fiber jacket diameter: ø0.25 to ø1 mm

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MA9014A	Bare Fiber Connector	
	Standard accessories	
Z0049	Matching oil (3 cc volume):	1 bottle
Z0051	Toothpick:	5 pcs
Z0157	Cleaning liquid (37 cc volume)	1 bottle
Z0158	Cleaning paper (50 sheets)	1 pack
Z0156	Insertion jig:	1 pc
B0282	Storage case:	1 pc
W0483AE	MA9014A operation manual:	1 copy
	Option	
MA9014A-01	Microscope	
	Application instruments	
MP924A	Jacket Stripper	
Z0052	Optical fiber cutter	

PROGRAMMABLE OPTICAL ATTENUATOR
MN938A
0.85/1.3 µm

For Two Wavelengths of 0.85/1.3 µm

GPIB

The MN938A can set attenuation in a range of 0 to 60 dB in 0.1 dB steps. Two wavelengths can be selected. As the MN938A is provided with GPIB as standard, it can be used in a variety of automatic measuring systems for development, production, and inspection. A rotary encoder permits attenuation to be set smoothly even when used manually.

Features
- Wide attenuation range: 0 to 60 dB
- Application for two wavelengths by switch selection
- Suitable for multi-mode fibers (50/125 µm)

OPTICAL VARIABLE ATTENUATOR
MN95D
1.3 µm

High-Stabile Attenuation

The MN95D optical variable attenuator passes an optical signal from a light emitting element through an optical fiber via a lens through an attenuating filter to reduce it to an appropriate light power output. It is a reflection type using metallic film and is used in the 1.3 µm band. The MN95D can be varied continuously and in steps.

Features
- Metallic film filters assure a wide range of usable wavelengths and stable accuracy.
- Prevention of multiple reflection
- Small and lightweight
- Suitable for multi-mode fibers (50/125 µm)

OPTICAL ATTENUATOR
MN924C, MN9605C
1.3/1.55 µm

Easy-to-Change Optical Connector Adapters

The MN924C and MN9605C are high-precision optical attenuators designed for use with single mode optical fibers. A combined step attenuator and continuous attenuator permit highly accurate attenuation adjustment.
The MN9605C has PC-type optical connectors, so that internally-reflected light is thoroughly suppressed. It is precisely constructed for single-mode fiber use and can be used as a highly accurate 65 dB variable attenuator.

Features
- Suitable for 1.3 and 1.55 µm wavelengths
- Minimal light reflection at input/output connectors (return loss: ≥40 dB; MN9605C)
- Optical connector adapters easily attached and removed

BARE FIBER CONNECTOR
MP922B

For Low-Loss Connection of GI/SM Fibers

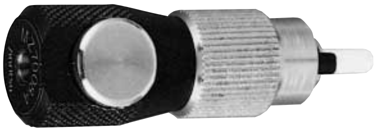
The MP922B is a bare-fiber connector using a V-shaped groove to temporarily and quickly connected optical fiber cores. The V-groove can be observed by microscope. This permits fine control of distance between optical fiber end-surfaces, and allows low-loss single mode fiber connection.

Features

- No special technical training required
- Low-loss connection even for single mode and multi-mode fibers
- Usable for optical fibers with jacket diameters from 0.25 to 1.2 mm

FIBER ADAPTER
MA9013A

Easy-to-Use Optical FIber Insertion



With the MA9013A Fiber Adapter, bare fiber connections can be made quickly and easily. The device, engineered to allow fiber core connections without need for polishing, is especially useful for simple temporary instrument connections during on-site operations. Moreover, the high-precision ferrule facilitates low-loss single-mode and multimode fiber connections.

Features

- Simple to use
- Suitable for single-mode and multi-mode fibers
- Accommodates optical fibers with external diameter error
- Compatible with various optical fibers
- Easy ferrule replacement (FC connector)

OPTICAL ACCESSORIES

Anritsu offers a full line of accessories for use with optical communications measuring equipment. Please specify model/order number, name, and quantity when ordering.

Model/Order No.		Name	Remarks		Photo No.
Optical fiber cord	J0893[∗]	FC · PC-FC · PC-<∗>M-GI	FC · PC optical fiber cord (GI)	GI (50/125)	1
	J0635[∗]	FC · PC-FC · PC-<∗>M-SM	FC · PC optical fiber cord (SM)	RL: ≥50 dB	
	J1053[∗]	FC · APC-FC · APC-<∗>M-SM	FC · APC optical fiber cord (SM)	RL: ≥65 dB	
	J0839[∗]	SC · PC-SC · PC-<∗>M-GI	SC · PC optical fiber cord (GI)	GI (50/125)	–
	J0660[∗]	SC · PC-SC · PC-<∗>M-SM	SC · PC optical fiber cord (SM)	RL: ≥50 dB	
	J1054[∗]	SC · APC-SC · APC-<∗>M-SM	SC · APC optical fiber cord (SM)	RL: ≥65 dB	
Optical conversion cord	J0952[∗]	FC · PC-FC · APC-<∗>M-SM	FC · PC-FC · APC optical fiber cord (SM)	RL: ≥50 dB (PC side), ≥65 dB (APC side)	–
	J0954[∗]	SC · PC-SC · APC-<∗>M-SM	SC · PC-SC · APC optical fiber cord (SM)	RL: ≥50 dB (PC side), ≥65 dB (APC side)	
	J0692[∗]	FC · PC-SC · PC-<∗>M-SM	FC · PC-SC · PC optical fiber cord (SM)	RL: ≥50 dB	
	J0757[∗]	FC · PC-ST · PC-<∗>M-SM	FC · PC-ST · PC optical fiber cord (SM)	RL: ≥50 dB	
	J0760[∗]	FC · PC-DIN · PC-<∗>M-SM	FC · PC-DIN · PC optical fiber cord (SM)	RL: ≥50 dB	
	J0763[∗]	FC · PC-HMS-10A-<∗>M-SM	FC · PC-HMS-10/A optical fiber cord (SM)	RL: ≥50 dB	
Replaceable optical connector	J0617B	Replacement optical connector (FC)	–		6
	J0618D	Replacement optical connector (ST)			
	J0618E	Replacement optical connector (DIN)			
	J0618F	Replacement optical connector (HMS-10/A)			
	J0618B	Replacement optical connector (SC)			
Replacement optical connector	J0739A	Replacement optical connector (FC · APC)	–		
	J0739C	Replacement optical connector (SC · APC)			
	J0739D	Replacement optical connector (HRL-10)			
	J0739G	Replacement optical connector (FC-PANDA)			–
Other accessories	J0601	Dummy fiber for optical loss measurements	–		2
	Z0052	Optical fiber cutter	–		3
	MP924A	Fiber Jacket Stripper	–		4
	MZ106C	Mode Scrambler	–		5
	J0057	Optical adapter FC type	–		∗1
	J0596	Optical adapter SC type	–		–
	J0849B	Optical conversion adapter FC to SC type	–		–

∗1: Refer to page 41.

Fiber length	Value	
	[∗]	<∗>
1 m	A	1
2 m	B	2
3 m	C	3

Optical fiber cord

Photo 1

Dummy fiber for optical loss measurements

This is a dummy fiber used in optical loss measurements to excite the normal propagation mode of the light.

Insertion loss	Applicable connector
<8 dB	FC-P

Photo 2

Optical fiber cutter

This device cuts optical fibers to produce a right-angle mirror-face break.

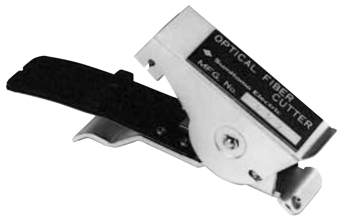


Photo 3

MP924A Fiber Jacket Stripper

This tool is used to remove the nylon jacket from around the core.

Photo 4

MZ106C Mode Scrambler

When measuring optical fiber loss or instrument insertion loss, this device is attached to LED light sources to ensure a uniform injection mode.

Insertion loss	1.5 dB^{*1}
NA (numerical aperture)	0.195 ±0.01^{*2}
Connector	FC
Optical fiber	GI (50/125 µm)^{*3}
Dimensions	20 (W) x 20 (H) x 205 (D) mm

∗1: Typical value (typical value is given for reference only and is not guaranteed specifications.)
Does not include connector loss.
∗2: Test method depends on JIS C5961
∗3: Does not include fiber

Photo 5

Replaceable and replacement optical connector

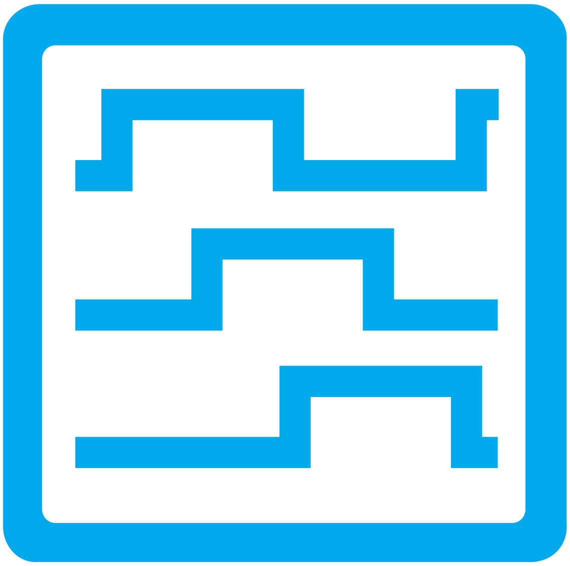
Replaceable

FC SC ST DIN HMS-10/A

Replacement

FC-APC SC-APC HRL-10

Photo 6



PULSE PATTERN GENERATORS/ ERROR DETECTORS

Selection guide

Application Model		Module test for 1 GbE SFF Module test	Module test for 10 GbE XFP, XENPAK, XPAK Module test for 10G SDH/SONET	Multi-channel test of high speed module Multi-channel signal source for 10G WDM	Ultra High Speed Pulse Generator Network test for over 40G bit/s Transponder test for 40G bit/s High Speed device test		Remarks
						Remote	
Digital Data Analyzer	MP1632C	√					10 MHz to 3.2 GHz*5
Pulse Pattern Generators	MP1763C (1ch)		√				50 MHz to 12.5 GHz
	MP1775A (4ch)			√	√	√	100 MHz to 12.5 GHz
Error Detectors	MP1764C (1ch)		√				50 MHz to 12.5 GHz
	MP1776A (4ch)			√	√	√	100 MHz to 12.5 GHz
43.5G MUX	MP1801A				√		25 to 43.5 GHz
	MP1803A					√	25 to 43.5 GHz
2.6 V Data Output	MP1803A-01					◆*1	For MP1803A
43.5G DEMUX	MP1802A				√		25 to 43.5 GHz
	MP1804A					√	25 to 43.5 GHz
10 GHz Jitter Analyzer	MP1777A		◆	◆			STM-16/32/64/FEC
E/O, O/E Converter	MP9677B		◆	◆			2.4 to 11 GHz*2
Text to MP1632A/C Pattern Conversion Software	MX163201A	◆					For MP1632A/C
MX165X to MP1632A/C Pattern Conversion Software	MX163202A						For MP1632A/C
Q and Eye Analysis Software	MX163205A	◆					For MP1632A/C
SDH/SONET Pattern Editor	MX163206A	◆					For MP1632A/C
Q and Eye Analysis Software	MX176400A		◆				For MP1762C
SDH/SONET Pattern Editor	MX176401A		◆				For MP1763C/1764C
SDH/SONET Pattern Editor	MX177601A			◆	◆	◆	For MP1758A/1775A/1776A
Q and Eye Analysis Software	MX180400A				◆	◆	For MP1804A
System Model Name*3					ME7760A*4	ME7760B*4	

√: Standard component
◆: Application

*1: Amplitude range is from 1.0 to 2.6 V. Crosspoint range is from 30 to 70%. Offset range is from –2 to +2 V.
*2: It is possible to select frequency of CDR as a unit from STM-64, 10.7G and 10.3G.
*3: Software is application for system, not part of system.
*4: It is necessary to prepare signal generator for 1/1 clock, ex. MG3695A.
*5: Please use external synthesizers (10 MHz to 50 MHz)

43.5 Gbit/s BERT SYSTEM
ME7760A/B
25 to 43.5 Gbit/s

GPIB
ME7760B

Measurement Solution for 40 Gbit/s SONET/SDH System and Modules

The ME7760A/B is bit error rate measurement equipments which measures a bit error rate of transmission signals 25 to 43.5 Gbit/s. This equipment is composed of pulse pattern generator, multiplexer, demultiplexer, error detector and synthesizer.
The ME7760A/B are applied for electrical or optical market which examines from components evaluations to communication equipments. MX177601A SDH/SONET Pattern Editor Software is provided and is used to edit a SDH/SONET frame.

Features

- **High quality waveform**

A re-timing circuit using D-type Flip-Flop realizes high quality waveform (small jitter and low wave distortion) and high output amplitude (2 Vp-p).

- **Measurement with pure PRBS**

The MP1775A Pulse Pattern Generator can generate PRBS on 43.5 Gbit/s (selectable pattern length = $2^n - 1$: n= 7, 9, 11, 15, 20, 23, 31). The phase of each channel is shifted by 1/4 cycle and multiplexed signal can be treated as pure PRBS.

- **Wide operation frequency**

ME7760A have capability to treat FEC signals on the 40 Gbit/s. 4 channels pulse pattern generator (MP1775A) and the 4 channels error detector (MP1776A) can support 100 Mbit/s to 12.5 Gbit/s signals. The multiplexer (MP1801A/1803A) and the de-multiplexer (MP1802A/1804A) can support 25 to 43.5 Gbit/s signals.

- **32 Mbits pattern memory for OC-768/STM-256**

Both the MP1775A and the MP1776A have 32 Mbits pattern memory and it is suitable for 40 Gbit/s SDH/SONET frames (OC-768/STM-256). Its pattern can be edited using the MX177601A SDH/ SONET Pattern Editor via GPIB interface.

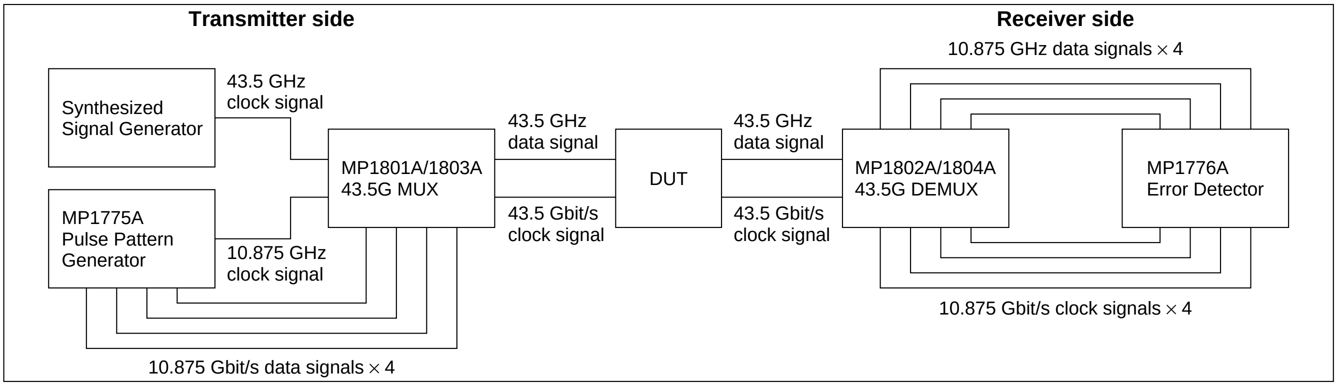
- **High flexibility**

The MP1775A Pulse Pattern Generator and the MP1776A Error Detector can be used as the single measurement equipment. It will bring you a high flexibility on the various combinations and scenes.

Selection guide

	ME7760A	ME7760B
MP1801A	√	
MP1802A	√	
MP1803A*		√
MP1804A*		√
MP1775A	√	√
MP1776A	√	√

*: Custom-made product



System configurations

Specifications

• MP1801A 43.5G MUX

Operation frequency	25 to 43.5 GHz (external)
Clock input	Input waveform: Sine or rectangular wave (duty 50%), Input amplitude: 0.7 to 1.5 Vp-p, Connector: V
Data output	Number of outputs: 2 DATA, $\overline{\text{DATA}}$, Output waveform: NRZ, Output amplitude: 2.0 Vp-p (AC coupling) fixed, Tr/Tf (10 to 90%): ≤18 ps, Pattern jitter: ≤10 ps (p-p), Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V
Clock output	Output amplitude: 1.0 Vp-p (AC coupling) fixed, Tr/Tf (10 to 90%): ≤18 ps, Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V, Phase adjust range: 120 ps
1/4 Data input	Number of inputs: 4 Input level: V_{OH}, V_{OL}: –1.0 Termination: 50 Ω/GND, Connector: K
1/4 Clock output	Number of outputs: 1 (CLOCK), Output amplitude: V_{OH}: 0 ±0.4 V, Output amplitude: 1.40 V ±0.4 V Tr/Tf (20 to 80%): 40 ps (typ.) Waveform distortion: ≤0.4 Vp-p Connector: K Phase adjust range: 120 ps
Dimensions and mass	213 (W) x 132.5 (H) x 350 (D) mm, ≤8 kg
Power	85 to 265 V, 47 to 63 Hz, ≤75 VA
Operation temperature	+20° to +30°C
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

• MP1802A 43.5G DEMUX

Operation frequency	25 to 43.5 GHz
Data input	Number of inputs: 1 (DATA), Input waveform: NRZ, Input amplitude: 0.1 to 1.0 Vp-p, Threshold voltage: +0.25 to –0.75 V (variable), Termination: 50 Ω/GND, Connector: V
Clock input	Number of inputs: 1 (CLOCK), Input waveform: Sine or rectangular wave (duty 50%), Input amplitude: 0.7 to 1.5 Vp-p, Termination: 50 Ω/GND, Connector: V, Phase adjust range: 120 ps
1/4 Data output	Number of outputs: 4 Output amplitude: V_{OH}: 0 ±0.3 V, V_{OL}: –1.0 ±0.3 V Tr/Tf (10 to 90%): ≤35 ps (typ.) Pattern jitter: ≤20 ps (peak to peak) Waveform distortion: ≤10% Termination: 50 Ω/GND Connector: K
1/4 Clock output	Number of outputs: 4 Output amplitude: V_{OH}: 0 ±0.3 V, V_{OL}: –1.0 ±0.3 V Tr/Tf (10 to 90%): ≤35 ps Waveform distortion: ≤10% Termination: 50 Ω/GND Connector: K Phase adjust range: 120 ps
DEMUX reset input	Input level: V_{OH}: 0 ±0.1 V, V_{OL}: –1.0 ±0.1 V Termination: 50 Ω/GND Connector: K
Dimensions and mass	213 (W) x 132.5 (H) x 350 (D) mm, ≤8 kg
Power	85 to 265 V, 47 to 63 Hz, ≤75 VA
Operation temperature	+20° to +30°C
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

• MP1803A 43.5G MUX

Operation frequency	25 to 43.5 GHz (external)
Clock input	Input waveform: Sine or rectangular wave (duty: 50%), Input amplitude: 0.7 to 1.5 Vp-p, Connector: V
Data output	Number of outputs: 2 (DATA, $\overline{\text{DATA}}$), Output waveform: NRZ, Output amplitude: 2.0 ±0.2 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 10 ps (typ.), Pattern jitter: Less than 10 ps (P-P), Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V
Clock output	Number of outputs: 1 (CLOCK), Output amplitude: 0.7 to 1.6 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 5 ps (typ.), Waveform distortion: ≤10%, Phase adjust range: –70.0 to +70.0 ps (0.1 ps step), Termination: 50 Ω/GND (with back termination), Connector: V,
1/4 data input	Number of inputs: 4 (D1, D2, D3, D4), Input amplitude: V_{IH} = 0 V ±0.07 V, V_{IL} = –1 V ±0.07 V, Termination: 50 Ω/GND, Connector: SMA
1/4 clock output	Number of outputs: 1 (CLOCK), Output amplitude: V_{OH} = 0 V ±0.40 V, V_{amp} = 1.40 V ±0.40 V, Phase adjust range: –70 to 70 ps (1 ps step), Termination: 50 Ω/GND, Connector: SMA

Continued on next page

Sync. output	Number of outputs: 1 (1/64 clock output), Output voltage: V_{OH} = 0 V ±0.2 V, V_{OL} = –1 V ±0.2 V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 450 (D) mm, ≤10 kg
Power	AC 100 to 240 V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category Ⅱ, Pollution degree 2)

• MP1804A 43.5G DEMUX

Operation frequency	25 to 43.5 GHz
Data input	Number of inputs: 1 (DATA), Input waveform: NRZ, Input amplitude: 0.1 to 1.0 Vp-p, Threshold voltage: –0.75 to +0.25 V (0.001 V step), Termination: 50 Ω/GND, Connector: V
Clock input	Number of inputs: 1 (CLOCK), Input waveform: Sine or rectangular wave (duty: 50%), Output amplitude: 0.7 to 1.5 Vp-p (AC coupled), Phase adjust range: –70 to +70 ps (0.1 ps step), Termination: 50 Ω/GND, Connector: V
1/4 data output	Number of outputs: 4, Output voltage: V_{OH} = 0 V ±0.2 V, V_{OL} = –1 V ±0.2 V, Termination: 50 Ω/GND, Connector: SMA
1/4 Clock output	Number of outputs: 4, Output voltage: V_{OH} = 0 ±0.25 V, V_{OL} = –1 ±0.25 V Phase adjust range: –70 to +70 ps (1 ps step), Impedance: 50 Ω/GND, Connector: SMA
DEMUX reset input	Number of inputs: 1 (1/64 clock output), Input voltage: V_{1H} = 0 ±0.1 V, V_{IL} = –1 ±0.1 V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 364 (D) mm, ≤10 kg
Power	AC 100 to 240 V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category Ⅱ, Pollution degree 2)

• MX177601A SDH/SONET Pattern Editor

Required system	Computer: IBM-PC/AT or full compatible CPU: Pentium 200 MHz or higher OS: Windows 95/98/2000/NT4.0 Memory: 128 MB or more Display resolution and color: 800 x 600 or more and 256 colors or more FDD: 3.5-inch (1.44 MB), Hard drive: require 100 MB or more GPIB: National Instruments-made GPIB Interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.)
Functions	SDH/SONET pattern editor Mapping for SDH: [MP1758A] STM-n (n = 1, 4c, 16c) [MP1775A/1776A] STM-n (n = 1, 4c, 12c, 16c, 32c, 64c, 256c) Mapping for SONET: [MP1758A] STS-n (n = 3c, 12c, 48c) [MP1775A/1776A] STS-n (n = 3c, 12c, 48c, 192c, 768c) Pattern edit: Arbitrary editing of program patterns (PRBS pattern can be inserted in the payload.), time indication, table indication/edit Payload: Free format, ALL 0, ALL 1, PRBS $2^n - 1$ (n = 7, 9, 11, 15, 20, 20z, 23, 31) [Pattern repetition up to the length of all frames] Measurement condition: ALL, payload, SOH ALL, POH ALL, OH (D1-D3), OH (D4-D12), OH (1 byte) [Pattern repetition up to the length of all frames] CID pattern: Available (Conforming to ITU-T G.958) Frame repetition: Maximum 6 frames Alarm addition: Alarm addition conforming to SDH/SONET standard SDH: [items: OOF/LOF, MS-AIS, MS-RDI, MS-REI, MS-AIS, HP-RDI, HP-REI] SONET: [items: OOF/LOF, AIS-L, RDI-L, REI-L, AIS-P, RDI-P, REI-P] BIP error addition: B1, B2 and B3 B1, B2 and B3 calculation: Automatic calculation Scramble: ON/OFF OH editor: All bytes edit are possible except B1, B2, B3, H1, H2, H3. Pointer (H1, H2, H3) is fixed value.

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Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1801A	43.5G MUX	
	Standard accessories	
J1090	Cable (V120MM-30CM), 30 cm:	3 pcs
J0696E	SMA cable (AA-165-1500), 1.5 m:	5 pcs
	Power cord, 2.5 m:	1 pc
F0012	Fuse (T3.15 A 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
B0329M	Front cover:	
J1108	Cable (V120MM-50CM), 50 cm:	1 pc
J1138	SMA cable (SF1041/SMA-451/11SMA/451/1.5M), 1.5 m:	1 pc
J1137	Terminator (HRM-601):	6 pcs
J1145	Terminator (V210):	4 pcs
W1961AE	MP1801A operation manual:	1 copy
	Main frame	
MP1802A	43.5G DEMUX	
	Standard accessories	
J0696D	Semi-flexible cable (AA-165-2000), 2 m:	1 pc
J1090	Cable (V120MM-30CM), 30 cm:	2 pcs
J0696E	SMA cable (AA-165-1500), 1.5 m:	8 pcs
	Power cord, 2.5 m:	1 pc
J1144	Fixed coaxial attenuator (41V-6):	1 pc
F0012	Fuse (T3.15 A 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
B0329M	Front cover:	1 pc
J1137	Terminator (HRM-601):	9 pcs
J1145	Terminator (V210):	2 pcs
W1960AE	MP1802A operation manual:	1 copy
	Main frame	
MP1803A	43.5G MUX (Custom-made product)	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	3 pcs
J0696E	Coaxial cable (AA-165-1500), 1.5 m:	5 pcs
J1108	Coaxial cable (V120MM-50CM), 50 cm:	1 pc
J1138	Coaxial cable, 1.5 m:	1 pc
J1145	Terminator (V210):	4 pcs
J1137	Terminator (HRM-601):	6 pcs
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2031AE	MP1803A operation manual:	1 copy
W2032AE	MP1803A GPIB remote control operation manual:	1 copy
	Options	
MP1803A-01	2.6 V data output	
MP1803A-11	Extended up to 48 Gbit/s	
	Main frame	
MP1804A	43.5G DEMUX (Custom-made product)	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	2 pcs
J0696D	Semi-flexible cable (AA-165-2000), 2 m:	1 pc
J0696E	Coaxial cable (AA-165-1500), 1.5 m:	8 pcs
J1145	Terminator (V210):	2 pcs
J1137	Terminator (HRM-601):	9 pcs
J1144	Fixed coaxial attenuator (41V-6, for MUX-DEMUX connection):	1 pc
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2033AE	MP1804A operation manual:	1 copy
W2034AE	MP1804A GPIB remote control operation manual:	1 copy
	Option	
MP1804A-11	Extended up to 48 Gbit/s	

For the details of MP1775A Pulse Pattern Generator, MP1776A Error Detector and MG3695A, please refer to page 107, 112 and 427 respectively.

PULSE PATTERN GENERATOR

MP1775A

100 MHz to 12.5 GHz (4 channels)

GPIB

Supports Measurement for up to 50 Gbit/s System (Installed with 4 Channels)

The MP1775A Pulse Pattern Generator has 4 channels data output lines and each channel has capability to generate maximum 12.5 Gbit/s signal. It is available to create PRBS (maximum pattern length is $2^n - 1$, n = 7, 9, 11, 15, 20, 23, 31) and 32 Mbits programmable pattern (user defined pattern). Combining with the MP1801A/MP1803A 43.5G Multiplexer makes it possible to generate 43.5 Gbit/s pure PRBS or programmable pattern suitable for OC-768/STM-256.

Features

- Error measurement of OC-768c/STM-256c SDH/SONET frame using 8 Mbits/channel PRGM pattern and application software (MX177601A)
- Parallel output of 12.5 Gbit/s x 4-channels
- Independent level adjustment for each of the 4-channels
- Reduce waveform distortion using back-termination
- Cross-Point adjustment capability on the front panel

Specifications

Operation frequency	From 0.1 to 12.5 GHz (internal/external selectable)
External clock	Input level from: 0.8 to 2.0 Vp-p, Input waveform: sign wave (over 500 MHz) or Pulse, Connector: APC-3.5
Internal clock (option 03)	Resolution: 1 kHz, 1 MHz, Reference signal of PLL: 10 MHz (internal/external selectable)
Pattern	Pseudo random pattern: $2^n - 1$ (n = 7, 9, 11, 15, 20, 23, 31), PRGM pattern: 8 Mbits/channel total 32 Mbits Logic: POS/NEG Error insertion: 10^{-n} (n = 4, 5, 6, 7, 8, 9 and single) insertion root selectable from 32 channels by switch on front panel
Data output	Waveform: NRZ, Number of output: 4 (CH1, CH2, CH3, CH4), Amplitude : from 0.5 to 2.0 Vp-p/10 mV step[*1] Offset: from –2.0 to 2.0 V_{OH}/5 mV step[*1], termination: GND/–2 V(ECL) selectable Load impedance: 50 Ω, Connector: APC-3.5
Clock output	Number of output : 2 (CLOCK1, CLOCK2), Amplitude: from 0.5 to 2.0 Vp-p/10 mV step[*1] Offset: from –2.0 to 2.0 V_{OH}/5 mV step[*1], termination: GND/–2 V (ECL) selectable Variable delay: from –500 to 500 ps/1 ps step, Load impedance: 50 Ω, Connector: APC-3.5
Sync. output	Number of output: 1 (1/32 clock or pattern sync.) Amplitude: 1 Vp-p fixed, termination: to GND with 50 Ω, Connector: SMA
Control interface	GPIB/Parallel port, Parameter memory: 3.5 inch FDD (MS-DOS compatible)[*2]
Dimensions and mass	426 (W) x 221 (H) x 450 (D) mm (16.8W x 8.7H x 17.7D inches), less than 35 kg (77.2 pounds), from 85 to132 Vac or from 170 to 250 Vac, power: less than 1000 Watts
Operation temperature	From 15˚ to 35˚C (59 to 95˚F)
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*1: Independently settable in each channel
*2: MS-DOS is registered trademark of Microsoft Corporation in the United States and other countries.

Ordering Information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1775A	Pulse Pattern Generator	
	Standard accessories	
J0491	Shield power cord (13 A):	1 pc
J0008	GPIB cable, 2 m:	1 pc
J0496	APC3.5J-J connector:	7 pcs
J0696A	SMA cable (AA-165-500), 0.5 m:	6 pcs
J0696B	SMA cable (AA-165-800), 0.8 m:	1 pc
J0693A	SMA cable (HRM202B-3D2W-HRM202B), 1 m:	1 pc
J1141	50 Ω terminator (BL02-6113-02):	7 pcs
F0100A	Fuse, 6.3 A:	2 pcs
W1937AE	MP1775A panel operation manual:	1 copy
W1938AE	MP1775A GPIB operation manual:	1 copy
Z0168	3.5 inch mini floppy disk (2HD, MF-2HD-3.5MF):	2 pcs
B0021	Front cover:	1 pc
Z0306A	Wrist strap:	1 pc
	Option	
MP1775A-01	Clock, $\overline{\text{Clock}}$ output (custom-made product)	
MP1775A-03	Internal synthesizer	
	Optional accessories	
J0500A	Semi-rigid cable (SMA-P UT-141 SMA-P), 0.5 m	
J0696E	SMA cable (AA-165-1500), 1.5 m	
MB24B	Portable Test Rack (with 20 A power cord)	
J0007	GPIB cable, 1 m	

PULSE PATTERN GENERATOR

MP1763C

12.5 GHz

CE GPIB

For R&D of High-Speed Logic, ICs, Optical Modules and Devices

The MP1763C is used in combination with the MP1764C Error Detector. The amplitude of the clock and data signals can be varied from 0.25 to 2 Vp-p while the offset can be adjusted to within ±2 V so that the amplitude and the offset margin can be measured. The clock has a variable delay function so that time-dependent characteristics or phase margins of the input clock and data can be measured. An M series pseudorandom pattern representative of actual conditions or a programmable pattern can be selected as cell data.

In addition, a 3.5 inch floppy disk drive is built in for storing preset data, enabling rapid measurements to be performed by simply pressing a key. A GPIB function is provided, enabling automatic or remote measurement via an external controller.

The MP1763C is a pulse pattern generator ideal for research and development of high-speed logic, ICs, and digital systems.

MX176400A Q and Eye Analysis Software controls MP1763C and MP1764C from the PC to measure Q factor, eye margin, and eye diagram. MX176401A SDH/SONET Pattern Editor controls the MP1763C and MP1764C to generate frame pattern conforming to SDH/SONET standards.

Features

- High quality waveform
- Low FM/PM-noise clock generator
- 8 Mbit programmable pattern corresponding to six frames of STM-64/STS-192
- Generates PRBS patterns with bit length from $2^7 - 1$ to $2^{31} - 1$ bits
- Complementary outputs of both data and clock
- The amplitudes and offsets of all 8 data outputs that have 1/8 speed of fundamental clock signal can be set

Specifications

- **MP1763C (main frame)**

Operation frequency		0.05 to 12.5 GHz
Internal clock (option 01)	Frequency range	0.05 to 12.5 GHz
	SSB phase noise (at 10 kHz offset, 1 Hz bandwidth)	≤–85 dBc/Hz (0.05 to 4 GHz), ≤–80 dBc/Hz (4 to 8 GHz), ≤–75 dBc/Hz (8 to 10 GHz), ≤–70 dBc/Hz (10 to 12.5 GHz)
External clock input level		0.4 to 2.5 Vp-p
Pattern	Pseudorandom binary sequence pattern (PRBS)	Pattern: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8 ($\overline{1/2}$, 3/4, 7/8, 8/8 are possible with logic inversion) Bit shifts number for mark ratio varied: 1, 3 bits selectable
	Data pattern	Data length: 2 to 8388608 bits
	Alternate pattern	A/B pattern data length: 128 to 4194304 bits (128 bit steps); Loop time: A, B pattern (1 to 127, 1 steps)
	Zero substitution pattern	Zero bit length: 1 to (pattern length – 1) bits; Pattern: 2^n (n: 7, 9, 11, 15)
	Error addition	Error rate: 10^{-n} (n: 4, 5, 6, 7, 8, 9), and single error External error injection: Provided

Continued on next page

Data output	Number of outputs	2 (DATA/$\overline{\text{DATA}}$ independently)
	Amplitude	0.25 to 2 Vp-p, 2 mV steps
	Offset voltage	V_{OH}: –2 to +2 V, 1 mV steps Display: V_{OH}, V_{TH} or V_{OL} selectable
	Rise/fall time	Typical 30 ps (10% to 90% of amplitude)
	Pattern jitter	≤20 psp-p, typical 10 psp-p
	Waveform distortion (0-peak)	≤15% or ≤150 mV whichever is greater
	Gating input	Provided
	Load impedance	50 Ω (with back termination)
	Connector	APC-3.5
	DATA/$\overline{\text{DATA}}$ tracking	$\overline{\text{DATA}}$ amplitude and offset voltage can be set to the same values as for DATA.
	Cross point adjustment function	The cross point of DATA and $\overline{\text{DATA}}$ outputs can be adjusted at semifixed resistor of side.
Clock output	Number of outputs	3 (CLOCK 1/$\overline{\text{CLOCK 1}}$, CLOCK 2)
	Amplitude	CLOCK 1/$\overline{\text{CLOCK 1}}$: 0.25 to 2 Vp-p (2 mV steps) CLOCK 2: 1 Vp-p
	Offset voltage	CLOCK 1/$\overline{\text{CLOCK 1}}$: V_{OH} –2 to +2 V (1 mV steps) CLOCK 2: V_{OH} 0 V fixed
	Rise/fall time	Typical 30 ps (10% to 90% of amplitude)
	Load impedance	50 Ω (CLOCK 1/$\overline{\text{CLOCK 1}}$: with back termination)
	Connector	CLOCK 1/$\overline{\text{CLOCK 1}}$: APC-3.5, CLOCK 2: SMA
	Delay	±500 ps (1 ps steps)
1/8 data and clock output		Number of outputs: DATA 8, CLOCK 1 Output level: ECL Connector: SMA
1/4 data and clock output (option 03)*1	Number of outputs	DATA: 4, CLOCK: 1
	Amplitude	0.5 to 2 Vp-p (2 mV steps)
	Offset voltage	V_{OH}: –1.5 to +1.5 V (1 mV steps)
	Connector	SMA
Sync. signal output	Number of outputs	1 (1/64 clock, fixed position pattern, or variable position pattern selectable)
	Output level	0/–1 V
	Connector	SMA
Parameter memory		Media: 3.5 inch FD (2HD, 2DD) Format: MS-DOS (Rev. 3.1)*2 Content: Pattern or other parameters
Operating temperature range		0˚ to +50˚C
Dimensions and mass		426 (W) x 221 (H) x 450 (D) mm, ≤33 kg
Power		≤400 VA
EMC		EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD		EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*1: When the Option 03 (1/4 speed output) is added, the 1/8 speed output is not available.
*2: MS-DOS is a registered trademark of Microsoft Corporation.

• MX176400A Q and Eye Analysis Software

Required system	Computer: IBM-PC/AT or full compatible, OS: Windows 95/98/NT, CPU: Pentium 166 MHz or higher, Memory: 64 MB or more, Hard disk space: 100 MB or more GPIB: National Instruments made GPIB interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.) Display Resolution: 800 x 600 or more, Display colors: 256 or more *If two or more applications are running simultaneously, operation cannot be guaranteed.
Functions	Measurement frequency: 2 to 12.5 GHz (eye diagram/eye margin measurement), 1 to 12.5 GHz (Q factor measurement) Measurement patterns: PRGM, PRBS 7, 9, 11, 15, 20, 23, 31 Pattern format: Continuous/burst (To be synchronized within 1 s) Eye margin measurement Measurement resolution (threshold): 1 to 10 mV (1 mV steps), Measurement resolution (phase): 1 to 10 ps (1 ps steps), Measurement rate: E-2 to E-15 Eye diagram measurement Measurement resolution (phase): 1 to 10 ps (1 ps steps) Measurement rate: E-2 to E-15 (actual measurement), E-3 to E-12 (estimate measurement) Display rate: E-2 to E-15 (actual measurement), E-2 to E-4915 (estimate measurement) Mask test judgment rate: E-2 to E-15 Q factor measurement Measurement style: Multiple measurements at fixed phase/phase vs. Q factor measurements Bit error rate range: Upper limit at E-3 to E-5, lower limit at E-7 to E-12 Minimum error count (measurement accuracy): 1, 10, 100, 1000 Vth shift width: Automatic, fixed (1 to 10 mV/1 mV/steps)

- **MX176401A SDH/SONET Pattern Editor**

Required system	Computer: IBM-PC/AT or full compatible, CPU: Pentium 200 MHz or higher, OS: Windows 95/98/NT, Memory: 64 MB or more Display Resolution: 800 x 600 or more; Display colors: 256 or more FDD: 3.5-inch (1.44 MB), Hard disk space: 100 MB or more GPIB: National Instruments-made GPIB interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.)
Functions	SDH/SONET pattern editor Mapping: STM-N (N = 1, 4c, 12c, 16c, 32c, 64c), STS-N SPE (N = 1, 3c, 12c, 48c, 192c) Pattern edit: Arbitrary editing of program patterns (PRBS pattern can be inserted in the payload.), time indication, table indication/edit Payload: Free format, ALL 0, ALL 1, PRBS 2^n – 1 (n = 7, 9, 11, 15, 20, 20z, 23, 31) *Pattern repetition up to the length of all frames Measurement condition: ALL, payload, SOH ALL, POH ALL, OH (D1-D3), OH (D4-D12), OH (1 byte) *Pattern repetition up to the length of all frames CID pattern: Available Frame repetition: Maximum 6 frames Alarm addition: Alarm addition conforming to SDH/SONET Standard; [items: OOF/LOF, MS-AIS (L-AIS), MS-RDI (L-RDI), MS-REI (L-REI), HP-AIS (P-AIS), HP-REI (P-REI), HP-RDI (P-RDI)] BIP error addition: Generates parity errors of B1, B2, and B3 B1, B2, and B3 calculation: Available Scramble: Available BIP correction: Available Bit window: Active for patterns without frame Block window: Active for patterns without frame with a pattern length of multiples of 32 OH editor: Available

Windows is a registered trademark of Microsoft Corporation of the U.S. in the United States and other countries. IBM and AT are registered trademarks of International Business Machines. Pentium is a registered trademark of Intel Corporation. PCMCIA-GPIB and AT-GPIB/TNT are registered trademarks of National Instruments.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MP1763C	Pulse Pattern Generator
	Standard accessories
J0500A	Semi-rigid cable (SMA-P · SX-36 · SMA-P), 0.5 m: 2 pcs
J0672D	Semi-rigid cable, 7 cm: 1 pc
J0672F	Semi-rigid cable, 10 cm: 1 pc
J0693A	SMA cable (HRM202B · 3D2W · HRM202B), 1 m: 1 pc
J0496	APC-3.5 J-J connector: 4 pcs
J0008	GPIB cable, 2 m: 1 pc
	Power cord: 1 pc
Z0168	3.5 inch floppy disk (MF2HD-3.5MF): 2 pcs
Z0306A	Wrist strap: 1 pc
F0014	Fuse, 6.3 A (T6.3A250V): 1 pc
W1848AE	MP1763C operation manual: 1 copy
W1849AE	MP1763C GPIB operation manual: 1 copy
Z0481	12.5G/3.2G BERTS application software demo: 1 pc
B0021	Protective cover (for 1MW · 5U): 1 pc
	Options
MP1763C-01	12.5 GHz synthesizer (50 MHz to 12.5 GHz)
MP1763C-03	1/4 speed output
	Application equipment
68347B	Synthesized Sweep Generator (10 MHz to 20 GHz)
	Application software
MX176400A	Q and Eye Analysis Software
MX176401A	SDH/SONET Pattern Editor
	Optional accessories
J0500B	Semi-rigid cable (SMA-P · SX-36 · SMA-P), 1 m
J0322A	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 0.5 m
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0007	GPIB cable, 1 m
Z0054	3.5 inch floppy disk (MF2DD-3.5MF)
MB24B	Portable Test Rack (rating current of power cord and plug: 20 A)
B0413A	Carrying case
B0163	Soft carrying case
B0044	Rack mount (for 1MW · 5U panel)
Z0292A	Stacking rack (for sweep synthesizer)
Z0416	3.5 inch head cleaning disk

ERROR DETECTOR

MP1776A

100 MHz to 12.5 GHz

Supports Measurement for up to 50 Gbit/s System (Installed with 4 Channels)

MP1776A is an error detector housing four error detectors that can measure error up to 12.5 Gbit/s. It has four-channels independent measurement mode, two-channels or four-channels combined measurement mode and be used for development, manufacturing and maintenance of transmission systems and modules from 12.5 Gbit/s to maximum 50 Gbit/s.

Features

- Max. 4-channels in one box
- Independent measurement of 4-channels
- PRBS patterns from $2^7 - 1$ to $2^{31} - 1$
- Max. 32 Mbit programmable pattern at 4-channels combined mode (corresponding six frames of STM-256/ STS-768)
- Burst data BER measurement for optical circulating loop test
- Good operability by GUI
- Display 4-channels measurement results on screen

Specifications

- **MP1776A (main frame), MU177601B (12.5 Gbit/s Error Detector)**

Operating frequency	100 MHz to 12.5 GHz
Measurement pattern	PRBS pattern: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Zero substitution pattern: 2^n (n: 7, 9, 11, 15), consecutive zero-pattern can be inserted up to pattern length – 1 Programmable data Independent: 2 to 8,388,608 bits 2-channels combined: 4 to 16,777,216 bits 4-channels combined: 8 to 33,554,432 bits Logic inversion: Positive/negative switching possible
Measurement mode	Independent[*1], 2-channels combined[*2], 4-channels combined[*3]
Synchronization method	Normal, frame
Error detection mode	Insertion, omission, total
Measurement items	Error ratio: 0.0000×10^{-16} to 1.0000×10^0 Error count: 0 to 9,999,999, 1.0000×10^7 to 9.9999×10^{16} Clock frequency: 0.1 to 12.5 GHz (independent), 0.2 to 25 GHz (2-channels combined), 0.4 to 50 GHz (4-channels combined) ∗Resolution: 1 kHz, accuracy: 10 ppm ±1 kHz
Sync threshold value	Internal, 10^{-n} (n: 2, 3, 4, 5, 6, 7, 8)
Auto search function	Supported
Data input	Input waveform: NRZ Input amplitude: 0.5 to 2.0 Vp-p Threshold voltage: –3.000 to +1.750 V (1 mV step) Termination condition: GND/–2.0 V Input impedance: 50 Ω Connector: APC-3.5 Number of input: 1 (MU177601B 12.5 Gbit/s Error Detector Unit)
Clock input	Input level: 0.5 to 2.0 Vp-p Input waveform: Square wave only (<0.5 GHz, Duty: 50%), Sine or square wave (≥0.5 GHz, duty: 50%) Clock delay: ±500 ps (1 ps step) Polarity inversion: POS/NEG inversion selectable Input impedance: 50 Ω Connector: APC-3.5 Number of input: 1 (MU177601B 12.5 Gbit/s Error Detector Unit, up to 4 channel can be added.)

Continued on next page

Resync input	Input level: 0/–1 V ±0.1 V, Connector: SMA
System environment	Display: 10.4-inch, color LCD, touch screen, 640 x 480 dots, 256 colors (16 M colors in VGA when external display is connected.) Printer: Parallel port for external printer (D-sub 25-pin) Keyboard: 101-type (English), PS/2 (mini DIN 6-pin) Mouse: Serial, PS/2 (mini DIN 6pin) FDD: 3.5-inch, 2 models (740 KB, 1.44 MB) HDD C drive: ≥474 MB (Used for system: measurement data, pattern) D drive: ≥30 MB (Not accessible to users, interface: IDE)
Remote control	RS-232C (standard, D-sub 9-pin), GPIB (IEEE488.2)
Power	90 to 120 Vac/180 to 250 Vac, 47.5 to 63 Hz, ≤1000 VA
Operating temperature	+15˚ to +35 ˚C
Dimensions and mass	426 (W) x 266 (H) x 584 (D) mm, ≤50 kg (with 4 units of MU177601B)
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

∗1: Different measurement pattern and frequency can be set for each channel.
∗2: Evaluates 1:2 DEMUX to check that the signal before demultiplexing is PRBS.
∗3: Evaluates 1:4 DEMUX to check that the signal before demultiplexing is PRBS.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/order No.	Name
	Main frame
MP1776A	Error Detector
	Standard accessories
J0491	Power cord (with shield, 13 A): 1 pc
J0670A	Power cord (L-type, C7, for 200 V main), 2.5 m: 1 pc
F0074	Fuse, 10 A: 1 pc
Z0319A	PS/2 mouse: 1 pc
Z0320	Input pen: 1 pc
J0008	GPIB cable, 2 m
W1410AE	MP1776A operation manual: 1 copy
W1411AE	MP1776A remote operation manual: 1 copy
Z0306A	List strap: 1 pc
Z0352	MP1776A recovery tool: 2 pcs
Z0396A	Pen holder: 1 pc
	Unit
MU177601B	12.5 Gb/s Error Detector Unit
	Standard accessories
J0696B	SMA cable (AA-165-800), 0.8 m: 2 pcs
J0693A	Coaxial cable (HRM202B · 3D2W · HRM202B), 1 m: 1 pc
	Optional accessories
Z0321A	Keyboard (PS/2)
J0007	GPIB cable, 1 m
B0496	Portable test rack
B0374G	Carrying case
B0497A	Dummy unit (for Slot 5)
B0497B	Dummy unit (for Slot 1 to Slot 4)
Z0416	Head cleaning disk (for 3.5-inch FDD)

ERROR DETECTOR
MP1764C
12.5 GHz

CE GPIB

For R&D of High-Speed Logic, ICS, Optical Modules and Devices

The MP1764C is used in combination with the MP1763C Pulse Pattern Generator to detect errors used to evaluate conformity with ITU-T standards. In addition, complicated searching for input thresholds or phase adjustments is simplified with the touch of a single key. These functions are ideally suited for the research and development of ultrahigh-speed logic ICs and digital communication systems.
MX176400A Q and Eye Analysis Software controls MP1764C and MP1763C from the PC to measure Q factor, eye margin, and eye diagram. MX176401A SDH/SONET Pattern Editor controls the MP1764C and MP1763C to generate frame pattern conforming to SDH/SONET standards.

Features
- Auto-search function for setting optimum values of input threshold and phase setting by a “one-touch” operation
- Synchronization of 8 Mbits pattern is easily made within a short period of time (when in frame mode)
- Errors are detected in intervals as short as 0.1 sec.
- Zero wait time counter gate

Specifications

Operation frequency		0.05 to 12.5 GHz
Data input	Input waveform	NRZ
	Input amplitude	0.25 to 2.0 Vp-p
	Threshold voltage variable range	–3.000 to +1.875 Vp-p (1 mV steps)
	Phase margin	≥70 ps (typical value at 10 Gb/s, PRBS 2^{23} – 1, and an input amplitude of 1 Vp-p)
	Input sensitivity	50 mVp-p (typical value at 10 Gb/s and PRBS 2^{23} – 1
	Termination	Connected to GND or –2 V via a 50 Ω termination
	Connector	APC-3.5
Clock input	Input waveform	Rectangular wave (<0.5 GHz), rectangular or sine wave (≥0.5 GHz), duty factor: 50%
	Input voltage	0.25 to 2.0 Vp-p
	Input delay variable range	±500 ps (1 ps steps)
	Polarity inversion	CLOCK/$\overline{\text{CLOCK}}$ inversion possible
	Termination	Connected to GND or –2 V via a 50 Ω termination
	Connector	APC-3.5
Auto search function		Provided
Receive pattern	Pseudorandom binary sequence pattern (PRBS)	Pattern: 2^n – 1 (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8 ($\overline{1/2}$, 3/4, 7/8, 8/8 are possible with logic inversion.) Number of AND bit shift at mark ratio setting: 1, 3 bits (selectable by using DIP switch on rear panel)
	Data pattern	Data length: 2 to 8388608 bits
	Alternate pattern	A/B pattern word length: 128 to 4194304 bits (128 bits steps), Number of loops: Controlled using external signal
	Zero substitution pattern	Zero bit length: 1 to (pattern length –1) bits, Pattern length: 2^n (n: 7, 9, 11, 15)

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Synchronous mode		Normal, frame, quick
Synchronous threshold		Preset value or 10^{-n} (n: 2, 3, 4, 5, 6, 7, 8)
Error detection mode		Omission insertion, total (selectable with DIP switch on rear panel)
Measure-ment item	Error rate	0.0000 x 10^{-16} to 1.0000 x 10^{-0}
	Number of errors	0 to 9.9999 x 10^{16}
	Error interval (asynchronous)	0 to 9999999 (interval: 1 ms, 10 ms, 100 ms, 1 s)
	Error free interval (EFI)	0.0000% to 100.0000%
	Clock frequency	0.05 to 12.5 GHz, (resolution: 1 kHz, accuracy: 10 ppm ±1 kHz)
Eye margin measurement function		Provided
Error performance data calculation function		Provided
Measurement CH mask		1 to 32 ch (settable independently)
Block window		Error for any block of 32-bit segments can be measured.
Error analysis (option 01)		Pattern (256 bits in total) before and after bit in which error occurred is stored.
Auxiliary output	Error output (direct)	1/128 OR error, Output level: 0/–1 V, Connector: SMA
	Error output (stretched)	Pulse width: 350 ns (typical), Output level: TTL, Connector: BNC
	Alarm output (clock loss, sync. loss)	Output level: TTL Connector: BNC
	Sync. gain output	Output level: 0/–1 V; Connector: SMA
Auxiliary input	External mask input	Input level: 0/–1 V; Connector: SMA
	Resync. input	Input level: 0/–1 V; Connector: SMA
	Alternate A/B switching input	Input level: ECL; Connector: SMA
Sync. signal output	Number of outputs	1 (1/32 clock, fixed position pattern, or variable position pattern selectable)
	Output level	0/–1 V
	Connector	SMA
Parameter memory		Media: 3.5 inch FD (2HD, 2DD) Format: MS-DOS (Rev. 3.1)[*1] Content: Pattern or other parameters
Operating temperature range		0° to +50°C
Dimensions and mass		426 (W) x 221.5 (H) x 450 (D) mm, ≤30 kg
Power		≤300 VA
EMC		EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD		EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*1: MS-DOS is a registered trade mark of Microsoft Corporation.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MP1764C	Error Detector
	Standard accessories
J0500A	Semi-rigid cable (SMA-P · SX-36 · SMA-P), 0.5 m: 2 pcs
J0693A	SMA cable (HRM202B-3D2W-HRM202B), 1 m: 3 pcs
J0496	APC-3.5 J-J connector: 2 pcs
J0008	GPIB cable, 2 m: 2 pc
	Power cord: 1 pc
Z0168	3.5 inch floppy disk (MF2HD-3.5MF): 2 pcs
F0014	Fuse, 6.3 A (T6.3A250V): 1 pc
W1850AE	MP1764C operation manual: 1 copy
W1851AE	MP1764C GPIB operation manual: 1 copy
B0306A	Wrist strap: 1 pc
B0021	Protective cover (for 1MW · 5U): 1 pc
B0481	12.5G/3.2G BERTS application software demo: 1 pc
	Option
MP1764C-01	Error analysis

Model/Order No.	Name
	Application software
MX176400A	Q/Eye Analysis Software
MX176401A	SDH/SONET Pattern Editor
	Optional accessories
J0500B	Semi-rigid cable (SMA-P · SX-36 · SMA-P), 1 m
J0322A	Coaxial cable (11SMA ·SUCOFLEX104 ·11SMA), 0.5 m
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0007	GPIB cable, 1 m
Z0054	3.5 inch floppy disk (MF2DD-3.5MF)
MB24B	Portable Test Rack (rating current of power cord and plug: 20A)
B0413A	Carrying case
B0163	Soft carrying case
B0044	Rack mount (for 1MW · 5U panel)
Z0416	3.5 inch head cleaning disk

43.5G MUX/43.5G DEMUX

MP1803A/MP1804A

25 to 43.5 Gbit/s

For R&D and Manufacturing of a 40 Gbit/s Devices and Transmission systems

MP1803A

MP1804A

Custom-made product

The MP1803A 43.5G MUX can multiplex maximum 4 data signal inputs (each transmission speed is maximum 10.875 Gbit/s) and generate 43.5 Gbit/s multiplexed signal. It can also generate 1/4 clock signal.
The MP1804A 43.5G DEMUX can de-multiplex the 43.5 Gbit/s data input into 4 signals. Its 4 output signal lines are brought to the 4 channels error detector (MP1776A) and it enables to evaluate 43.5 Gbit/s high-speed data signal.

Features

- Adopting high resolution variable delay unit (Resolution: 0.1 ps)
- High resolution threshold voltage setting suitable for the Q factor analysis (Resolution: 0.001 V)
- Digital display
- For various applications with the remote control.

Specifications

- **MP1803A 43.5G MUX**

Operation frequency	25 to 43.5 GHz (external)
Clock input	Input waveform: Sine or rectangular wave (duty: 50%), Input amplitude: 0.7 to 1.5 Vp-p, Connector: V
Data output	Number of outputs: 2 (DATA, $\overline{\text{DATA}}$), Output waveform: NRZ, Output amplitude: 2.0 ±0.2 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 10 ps (typ.), Pattern jitter: Less than 10 ps (P-P), Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V
Clock output	Number of outputs: 1 (CLOCK), Output amplitude: 0.7 to 1.6 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 5 ps (typ.), Waveform distortion: ≤10%, Phase adjust range: –70.0 to +70.0 ps (0.1 ps step), Termination: 50 Ω/GND (with back termination), Connector: V,
1/4 data input	Number of inputs: 4 (D1, D2, D3, D4), Input amplitude: V_{IH} = 0 V ±0.07 V, V_{IL} = –1 V ±0.07 V, Termination: 50 Ω/GND, Connector: SMA
1/4 clock output	Number of outputs: 1 (CLOCK), Output amplitude: V_{OH} = 0 V ±0.40 V, V_{amp} = 1.40 V ±0.40 V, Phase adjust range: –70 to 70 ps (1 ps step), Termination: 50 Ω/GND, Connector: SMA
Sync. output	Number of outputs: 1 (1/64 clock output), Output amplitude: V_{OH} = 0 V ±0.2 V, V_{OL} = –1 V ±0.2 V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 364 (D) mm, ≤10 kg
Power	AC 100 to 240 V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

- **MP1804A 43.5G DEMUX**

Operation frequency	25 to 43.5 GHz
Data input	Number of inputs: 1 (DATA), Input waveform: NRZ, Input amplitude: 0.1 to 1.0 Vp-p, Threshold voltage: –0.75 to +0.25 V (0.001 V step), Termination: 50 Ω/GND, Connector: V
Clock input	Number of inputs: 1 (CLOCK), Input waveform: Sine or rectangular wave (duty: 50%), Output amplitude: 0.7 to 1.5 Vp-p (AC coupled), Phase adjust range: –70 to +70 ps (0.1 ps step), Termination: 50 Ω/GND, Connector: V
1/4 data output	Number of outputs: 4, Output voltage: V_{OH} = 0 V ±0.2 V, V_{OL} = –1 V ±0.2 V, Termination: 50 Ω/GND, Connector: SMA
1/4 Clock output	Number of outputs: 4, Output voltage: V_{OH} = 0 ±0.25 V, V_{OL} = –1 ±0.25 V Phase adjust range: –70 to +70 ps (1 ps step), Termination: 50 Ω/GND, Connector: SMA
DEMUX Reset input	Number of inputs: 1 (1/64 clock output), Input voltage: V_{1H} = 0 ±0.1 V, V_{IL} = –1 ±0.1 V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 364 (D) mm, ≤10 kg
Power	AC 100 to 240 V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1803A	43.5G MUX	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	3 pcs
J0696E	Coaxial cable (AA-165-1500), 1.5 m:	5 pcs
J1108	Coaxial cable (V120MM-50CM), 50 cm:	1 pc
J1138	Coaxial cable, 1.5 m:	1 pc
J1145	Terminator (V210):	4 pcs
J1137	Terminator (HRM-601):	6 pcs
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2031AE	MP1803A operation manual:	1 copy
W2032AE	MP1803A GPIB remote control operation manual:	1 copy
	Options	
MP1803A-01	2.6 V data output	
MP1803A-11	Extended up to 48 Gbit/s	
	Main frame	
MP1804A	43.5G DEMUX	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	2 pcs
J0696D	Semi-flexible cable (AA-165-2000), 2 m:	1 pc
J0696E	Coaxial cable (AA-165-1500), 1.5 m:	8 pcs
J1145	Terminator (V210):	2 pcs
J1137	Terminator (HRM-601):	9 pcs
J1144	Fixed coaxial attenuator (41V-6, for MUX-DEMUX connection):	1 pc
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2033AE	MP1804A operation manual:	1 copy
W2034AE	MP1804A GPIB remote control operation manual:	1 copy
	Option	
MP1804A-11	Extended up to 48 Gbit/s	

10 GHz JITTER ANALYZER
MP1777A

STM-16 to 64, OC-48 to 192

GPIB

For Evaluating STM-64/OC-192 Jitter

The MP1777A is a measurement solution for jitter evaluation. It supports both the STM-16/32/64 and OC-48/96/192 bit rates. In addition to supporting the bit rates of 2488.32, 4976.64, and 9953.28 MHz, one of six additional bit rates used in submarine cable systems, 10 GbE and OTN can be added as option.
The MP1777A can evaluate jitter characteristics, including jitter tolerance, jitter transfer, and output jitter, which are parameters most commonly used to evaluate digital lines.
The MX177701A Jitter Performance Test Software (bundled with MP1777A) allows the MP1777A to be controlled remotely. When the Jitter Performance Test Software is used together with specified auxiliary measuring instruments, jitter tolerance and jitter transfer characteristics can be measured automatically.

Functions

- **Conforms to 0.172 new recommendations**

The MP1777A meets the STM-64/OC-192 measurement standards. It is compatible with bandwidths up to 80 MHz and jitter modulation amplitudes up to 3200 UIp-p.

- **Six optional series of bit rates**

The MP1777A supports to various uses flexibly, such as 10 GbE which has been spread increasingly, and OTN which is now drawing great attention as next-generation SDH/SONET technologies, and current submarine cable systems. The MP1777A can also support six series of bit rates by adding Option 01 (2494.16, 4988.32, 9976.64 MHz), Option 02 (2666.0571, 5332.1142, 10664.2284 MHz), Option 04 (3062.3629, 6124.7259, 12249.4517 MHz), Option 05 (3069, 6138, 12276 MHz), Option 06 (2677.3063, 5354.6127, 10709.2253 MHz) and Option 07 (2578.125, 5156.25, 10312.5 MHz).

- **Automatic jitter measurement**

The MX177701A Jitter Performance Test Software is used for automatic jitter measurement and can be used with the MP1777A to configure an automatic measurement system for jitter tolerance and jitter transfer characteristics*1.

*1: Requires MS4630B Network Analyzer, MP1763C Pulse Pattern Generator and MP1764C Error Detector for automatic measurement of jitter tolerance. Requires MS4630B Network Analyzer and MP1763C Pulse Pattern Generator for automatic measurement of jitter transfer. Also requires controller, MX177701A Jitter Performance Test Software, GPIB card, and cables.

Application examples

- **Jitter Generation**

To generate jitter, an external signal generator is required to source a modulation signal. The MX177701A Jitter Performance Test Software and a GPIB card are required for automatic measurement. It is also possible to perform manual measurements, which does not require these items.

- **Jitter measurement**

The MP1777A can measure the jitter of input signals directly without using an external BPF. When Option 10 (High Sensitive Input) is installed, it can measure the jitter of input signals with amplitudes down to 150 mVp-p. In this case, it can perform evaluation by direct device connection. The MX177701A Jitter Performance Test Software and a GPIB card are required for automatic measurement. Manual measurement is also possible and the measurement results are checked on the MP1777A screen. Furthermore, UIp-p, UI+p, UI-p, and UIrms can also be measured.
By combining the MP9677B E/O, O/E converter, the MP1777A can measure the jitter measurement of optical interfaces.

- **Jitter tolerance measurement**

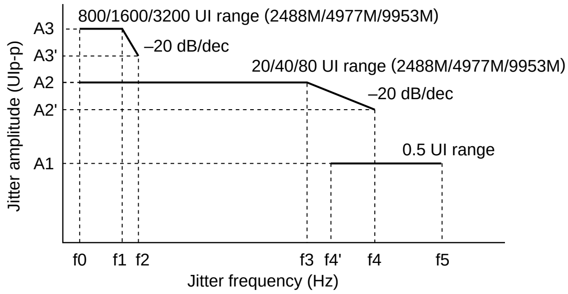
By combining the O/E and E/O converters, the MP1777A can measure the jitter tolerance of optical interfaces. The MX177701A Jitter Performance Test Software and a GPIB card are required for automatic measurement. It is also possible to perform manual measurements without these items.

- **Measuring Jitter Transfer Characteristics**

The MP1777A can evaluate jitter transfer characteristics up to 80 MHz in applications such as 10 Gbit/s clock recovery module (O/E converter) evaluation. Automatic (using MX177701A external software/GPIB) and manual measurements are possible.
By combining the MP9677B E/O, O/E converter, the MP1777A can evaluate the jitter transfer characteristics up to 80 MHz at optical interfaces.

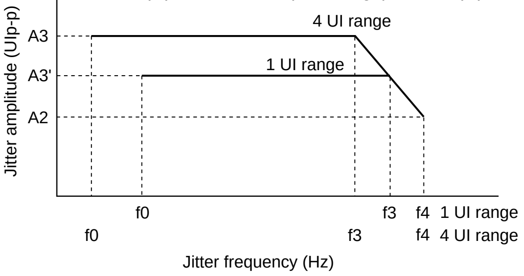
Specifications

<table>
<tr><td>Bit rate</td><td>Standard: 2488.32, 4976.64, 9953.28 Mbit/s
Option 01: 2494.16, 4988.32, 9976.64 Mbit/s
Option 02: 2666.0571, 5332.1142, 10664.2284 Mbit/s
Option 04: 3062.3629, 6124.7259, 12249.4517 Mbit/s
Option 05: 3069,6138,12276 Mbit/s
Option 06: 2677.3063, 5354.6127, 10709.2253 Mbit/s
Option 07: 2578.125, 5156.25, 10312.5 Mbit/s
∗Choose the one of Options from 02 to 07.</td></tr>
<tr><td>Jitter generation
MHz)</td><td>Modulation frequency: 10 Hz to 80 MHz
Amplitude: 0 to 3200 UIp-p
Resolution: 0.001 UIp-p (0.5 UI range), 0.01 UIp-p (20, 40, 80 UI range), 1 UIp-p (800, 1600, 3200 UI range)



<table>
<tr><th>Bit rate (bit/s)</th><th>f0 (Hz)</th><th>f1 (Hz)</th><th>f2 (Hz)</th><th>f3 (kHz)</th><th>f4 (MHz)</th><th>f4’ (kHz)</th><th>f5 (MHz)</th><th>A1 (UIp-p)</th><th>A2’ (UIp-p)</th><th>A2 (UIp-p)</th><th>A3’ (UIp-p)</th><th>A3 (UIp-p)</th></tr>
<tr><td>2488M</td><td>10</td><td>15</td><td>480</td><td>100</td><td>2</td><td>100</td><td>20</td><td>0.5</td><td>1</td><td>20</td><td>25</td><td>800</td></tr>
<tr><td>4977M</td><td>10</td><td>15</td><td>480</td><td>100</td><td>2</td><td>100</td><td>40</td><td>0.5</td><td>2</td><td>40</td><td>50</td><td>1600</td></tr>
<tr><td>9953M</td><td>10</td><td>15</td><td>480</td><td>100</td><td>2</td><td>100</td><td>80</td><td>0.5</td><td>4</td><td>80</td><td>100</td><td>3200</td></tr>
</table>

Accuracy:
±5% ±10 UIp-p/Fr (3200 UI range), ±5% ±8 UIp-p/Fr (1600 UI range), ±5% ±5 UIp-p/Fr (800 UI range),
±5% ±0.8 UIp-p/Fr (80 UI range), ±5% ±0.6 UIp-p/Fr (40 UI range), ±5% ±0.3 UIp-p/Fr (20 UI range),
±5% ±0.1 UIp-p/Fr (0.5 UI range/10G), ±5% ±0.08 UIp-p/Fr (0.5 UI range/5G), ±5% ±0.05 UIp-p/Fr (0.5 UI range/2.5G)
Fr: 100 kHz (0.5, 20, 40, 80 UI range), 10 Hz (800, 1600, 3200 UI range)
Frequency response error (Fr Hz):
±5% (10 to 20 Hz), ±2% (20 Hz to 300 kHz), ±3% (300 kHz to 1 MHz), ±5% (1 to 3 MHz), ±10% (3 to 10 MHz), ±15% (10 to 80</td></tr>
<tr><td>Frequency offset</td><td>Range: ±50 ppm (0.1 ppm steps)
Accuracy: ±0.1 ppm (after power-on, calibrates after 60 min. warm-up 23 ±5°C)</td></tr>
<tr><td>Auxiliary interface</td><td>External modulation input, external 10 MHz reference input, DCS input, external reference clock input</td></tr>
<tr><td>Jitter measurement</td><td>Modulation frequency: 100 Hz to 80 MHz
Amplitude: 0 to 4.00 UIp-p, 0 to 1.41 UIrms
Resolution: 0.001 UIp-p/0.001 UIrms (1 UI range), 0.01 UIp-p/0.01 UIrms (4 UI range)



<table>
<tr><th colspan="2">Bit rate (bit/s)</th><th>A2 (UIp-p)</th><th>A3’ (UIp-p)</th><th>A3 (UIp-p)</th><th>f0 (Hz)</th><th>f3 (MHz)</th><th>f4 (MHz)</th></tr>
<tr><td rowspan="2">2488M</td><td>1 UI range</td><td>0.5</td><td>1</td><td>—</td><td>100</td><td>10</td><td>20</td></tr>
<tr><td>4 UI range</td><td>0.5</td><td>—</td><td>4</td><td>100</td><td>2.5</td><td>20</td></tr>
<tr><td rowspan="2">4977M</td><td>1 UI range</td><td>0.5</td><td>1</td><td>—</td><td>100</td><td>20</td><td>40</td></tr>
<tr><td>4 UI range</td><td>0.5</td><td>—</td><td>4</td><td>100</td><td>5</td><td>40</td></tr>
<tr><td rowspan="2">9953M</td><td>1 UI range</td><td>0.5</td><td>1</td><td>—</td><td>100</td><td>40</td><td>80</td></tr>
<tr><td>4 UI range</td><td>0.5</td><td>—</td><td>4</td><td>100</td><td>10</td><td>80</td></tr>
</table></td></tr>
</table>

Continued on next page

<table>
<tr><td>Jitter measurement</td><td>Accuracy
[UIp-p]: ±5% ±W UIp-p (Fr Hz)
[UIrms]: ±5% ±Y UIrms (Fr Hz), Fr: 100 kHz
Frequency response error (Fr Hz):
±5% (10 to 20 Hz), ±2% (20 Hz to 300 kHz), ±3% (300 kHz to 1 MHz), ±5% (1 to 3 MHz), ±10% (3 to 10 MHz), ±15% (10 to 80 MHz)
<table>
<tr><th rowspan="2">Bit rate (bit/s)</th><th colspan="2">W (UIp-p)[*1]</th><th colspan="2">Y (UIrms)[*2]</th></tr>
<tr><th>1 UI</th><th>4 UI</th><th>1 UI</th><th>4 UI</th></tr>
<tr><td>2488M</td><td>0.05</td><td>0.22</td><td>0.008</td><td>0.08</td></tr>
<tr><td>4977M</td><td>0.07</td><td>0.24</td><td>0.009</td><td>0.09</td></tr>
<tr><td>9953M</td><td>0.09</td><td>0.26</td><td>0.010</td><td>0.10</td></tr>
</table>
*1: With HP1 + LP, *2: With HP + LP
Filters: LP, HP1 + LP, HP1' + LP, HP2 + LP, HP + LP, HP' + LP
<table>
<tr><th>Bit rate (bit/s)</th><th>HP1 (kHz)</th><th>HP1' (kHz)</th><th>HP2 (MHz)</th><th>HP (kHz)</th><th>HP' (kHz)</th><th>LP (MHz)</th></tr>
<tr><td>2488M</td><td>5</td><td>—</td><td>1</td><td>12</td><td>—</td><td>20</td></tr>
<tr><td>4977M</td><td>8</td><td>—</td><td>2</td><td>12</td><td>—</td><td>40</td></tr>
<tr><td>9953M</td><td>10</td><td>20</td><td>4</td><td>12</td><td>50</td><td>80</td></tr>
</table>
</td></tr>
<tr><td>Auxiliary interface</td><td>Demodulation output</td></tr>
<tr><td>Internal memory</td><td>Measurement conditions: 10</td></tr>
<tr><td>Others</td><td>GPIB, Buzzer, Time</td></tr>
<tr><td>Dimensions and mass</td><td>426 (W) x 221.5 (H) x 451 (D) mm, ≤23 kg (with options)</td></tr>
<tr><td>Power</td><td>100 to 240 Vac, 47.5 to 63 Hz, ≤350 VA</td></tr>
<tr><td>Temperature</td><td>10˚ to 40˚C</td></tr>
<tr><td>EMC</td><td>EN61326: 1997/A1: 1998 (Class A)
EN61000-3-2: 1995/A2: 1998 (Class A)
EN61326: 1997/A1: 1998 (Annex A)</td></tr>
<tr><td>LVD</td><td>EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)</td></tr>
</table>

- **Operation environment**

Applicable instruments	Pulse Pattern Generators: MP1763C (12.5 GHz), MP1570A (SONET/SDH/PDH/ATM Analyzer) Error Detectors: MP1764C (12.5 GHz), MP1570A (SONET/SDH/PDH/ATM Analyzer) Network Analyzer: MS4630B (300 MHz, with Option 10)
Recommended controller	Personal computer: IBM-PC/AT compatible OS: Windows®95 (English) or Windows®98 (English) CPU: Pentium (75 MHz or faster) Memory size: 16 Mbyte min. HDD free space: ≥300 kbyte for full install GPIB interface: National Instruments AT-GPIB/TNT (PnP), AT-GPIB/TNT+, PCMCIA-GPIB, or PCMCIA-GPIB+ and Windows® driver (for Windows®95 or Windows®98) Swap file size: ≥40 Mbyte guaranteed Display colors: Set to 256 Number of applications running simultaneously: 1 (unable to run other applications simultaneously)

Windows®95 and Windows®98 are registered trademarks of Microsoft® Corporation.

Ordering information

Please specify model/order number, name, and quality when ordering.

Model/Order No.	Name	
	Main frame	
MP1777A	10 GHz Jitter Analyzer	
	Standard accessories	
	AC power cord:	1 pc
F0014	Fuse, 6.3 A:	2 pcs
B0329D	Front cover:	1 pc
W1497AE	MP1777A operation manual:	1 copy
W1498AE	MP1777A remote control operation manual:	1 copy
J0496	APC 3.5 J-J connector:	2 pcs
J0900E	SMA cable (50 Ω), 1.5 m (AA-165-1500):	2 pcs
J0776C	BNC cable (50 Ω), 1 m:	3 pcs
J0008	GPIB cable, 2 m:	1 pc
MX177701A	Jitter Performance Test Software[*1]:	1 pc
W1499AE	MX177701A operation manual:	1 copy

Model/Order No.	Name
	Options
MP1777A-01	2494M/4988M/9977M jitter[*2]
MP1777A-02	2666M/5332M/10664M jitter[*3]
MP1777A-04	3062M/6124M/12249M jitter[*4, *5]
MP1777A-05	3069M/6138M/12276M jitter[*6]
MP1777A-06	2677M/5355M/10709M jitter[*7]
MP1777A-07	2578M/5156M/10313M jitter[*8]
MP1777A-10	High sensitive input (0.15 to 1.3 Vp-p)
	Application equipment
MS4630B	Network Analyzer (10 Hz to 300 MHz, with Option 10)
MP1763C	Pulse Pattern Generator (12.5 GHz)
MP1764C	Error Detector (12.5 GHz)
MP1570A	SONET/SDH/PDH/ATM Analyzer
MP9677B	E/O, O/E Converter

*1: Please confirm the operating system.
*2: 2494.16, 4988.32, 9976.64 MHz
*3: 2666.0571, 5332.1142, 10664.2284 MHz
*4: 3062.3629, 6124.7259, 12249.4517 MHz
*5: Custom-made product
*6: 3069, 6138, 12276 MHz
*7: 2677.3063, 5354.6127, 10709.2253 MHz
*8: 2578.125, 5156.25, 10312.5 MHz

E/O, O/E CONVERTER

MP9677B

10 Gbit/s

For STM-64, OC-192 or FEC Jitter Evaluation

MP9677B is the 10 Gbit/s E/O and O/E converter for STM-64, OC-192 or FEC jitter evaluation and BER measurement. It has a jitter bandwidth of 80 MHz, and can measure jitter tolerance, jitter transfer, and output jitter at 10 Gbit/s optical interface when used with MP1777A. It can be also used with MP1570A.

Functions

- **SDH/SONET network test**

Measurements such as jitter tolerance, jitter transfer, output jitter, and BER at 9.95328 Gbit/s optical interface are available. These measurements can be performed manually, with no need for a personal computer.

- **FEC test**

Measurements such as jitter tolerance, jitter transfer, output jitter, and error at 10.66423 Gbit/s optical interface are available. These measurements can be performed manually, with no need for a personal computer.

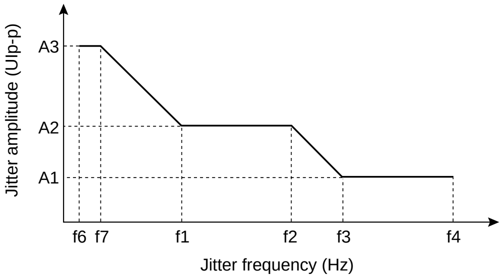
Specifications

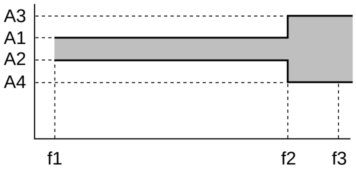
- **MP9677B E/O, O/E Converter**

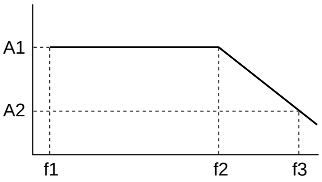
Bit rate	2.4 to 11 Gbit/s (typical)
Optical signal output	Level: –5 dBm ±3 dBm (average power) Output waveform: NRZ Wavelength: 1545 nm ±20 nm (any one wavelength within range[*1]) Wavelength width: ≤1 nm (20 dB down point) Side mode suppression ratio: ≥30 dB Extinction ratio: ≥10 dB Connector: FC-SPC[*2] (single mode fiber)
Electrical signal input	Data level: 0 V ±0.3 V(V_H)/–1 V ±0.3 V(V_L), 50 Ω Output waveform: NRZ Clock level: 1 V(p-p) ±0.3 V, 50 Ω Connector: SMA Phase adjustable range: ≥100 ps
Optical signal input	Sensitivity Wide: –11 to –5 dBm, Narrow: –11 to –3 dBm Input waveform: NRZ Wavelength: 1480 to 1580 nm Maximum input level: 0 dBm (average power) Return loss: ≥20 dB Connector: FC-SPC[*2] (single mode fiber)
Electrical signal output	Data level: 0 V ±0.2 V(V_H)/ –1 V ±0.2 V(V_L), 50 Ω Output waveform: NRZ Clock level: 1 V(p-p) ±0.33 V, 50 Ω Connector: SMA Phase adjustable range: ≥100 ps
External optical input[*3] (Option 01)	Maximum input level: +10 dBm Wavelength: 1530 to 1570 nm (guaranteed range)
Others	Through data input: 0 V ±0.3 V(V_H)/–1 V ±0.3 V(V_L), 50 Ω Retiming clock input: 1 V(p-p) ±0.3 V, 50 Ω Internal phase adjustable range: ≥100 ps Reshaped data output: 0 V ±0.2 V(V_H)/–1.5 V ±0.2 V(V_L), 50 Ω Connector: SMA
Dimensions and mass	426 (W) x 177 (H) x 450 (D) mm, ≤20 kg (including clock recovery unit)
Power	AC 85 to 132 V/170 to 250 V (auto-switching), 47 to 63 Hz, ≤300 VA (including clock recovery unit)
Environmental condition	Operating temperature: +10˚ to +40˚C, Storage temperature: –20˚ to +60˚C, Humidity: 40 to 90%
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*1: When ordering, the option specified connector is supplied as standard.
*2: User replaceable
*3: Using this with the application parts' polarization rotating module is recommended.

• MU967701A/967702A Clock Recovery Unit

<table>
<tr><td>Data input</td><td>Reshaped data input
Bit rate: 9.95328 Gbit/s ±50 ppm (MU967701A), 10.66423 Gbit/s ±50 ppm (MU967702A)
Level: 0.5 to 1.5 V(p-p), 50 Ω
Input waveform: NRZ
Connector: SMA</td></tr>
<tr><td>Data output</td><td>Through data output
Bit rate: 9.95328 Gbit/s ±50 ppm (MU967701A, depend on input signal), 10.66423 Gbit/s ±50 ppm (MU967702A, depend on input signal)
Level: 0 V ±0.2 V(V_H)/–1 V ±0.2 V(V_L), 50 Ω
Output waveform: NRZ
Connector: SMA</td></tr>
<tr><td>Clock output</td><td>Retiming clock output, monitor clock output
Frequency: 9.95328 GHz ±50 ppm (MU967701A, depend on input signal), 10.66423 GHz ±50 ppm (MU967702A, depend on input signal)
Level: 1 V(p-p) ±0.2 V, 50 Ω
Connector: SMA</td></tr>
<tr><td>Jitter tolerance*1</td><td>


<table>
<tr><th>A1</th><th>A2</th><th>A3</th></tr>
<tr><td>0.2 UIp-p</td><td>2 UIp-p</td><td>2490 UIp-p</td></tr>
</table>
<table>
<tr><th>f6 (Hz)</th><th>f7 (Hz)</th><th>f1 (Hz)</th><th>f2 (Hz)</th><th>f3 (Hz)</th><th>f4 (Hz)</th></tr>
<tr><td>10</td><td>12.1</td><td>20k</td><td>400k</td><td>4M</td><td>80M</td></tr>
</table>
</td></tr>
<tr><td>Jitter transfer characteristics</td><td>
Wide mode


<table>
<tr><th>A1</th><th>A2</th><th>A3</th><th>A4</th><th>f1</th><th>f2</th><th>f3</th></tr>
<tr><td>1.5 dB</td><td>–1.5 dB</td><td>3.5 dB</td><td>–3.5 dB</td><td>100 Hz</td><td>10 MHz</td><td>80 MHz</td></tr>
</table>
Narrow mode


<table>
<tr><th>A1</th><th>A2</th><th>f1</th><th>f2</th><th>f3</th></tr>
<tr><td>0.1 dB</td><td>–19.9 dB</td><td>100 Hz</td><td>8 MHz</td><td>80 MHz</td></tr>
</table>
</td></tr>
<tr><td>Environmental condition</td><td>Same as MP9677B (main frame)</td></tr>
</table>

*1 MP9677B: Wide mode, –8 to –6 dBm input level, 10˚ to 30˚C
MU967701A: SDH internal, VC4-64c-Bulk, PRBS 2^{23} – 1 used with MP1570A and MU150000A
MU967702A: PRBS 2^{23} – 1 used MP1763C/1764C

Ordering information

Please specify model/order number, name, and quantity when ordering.

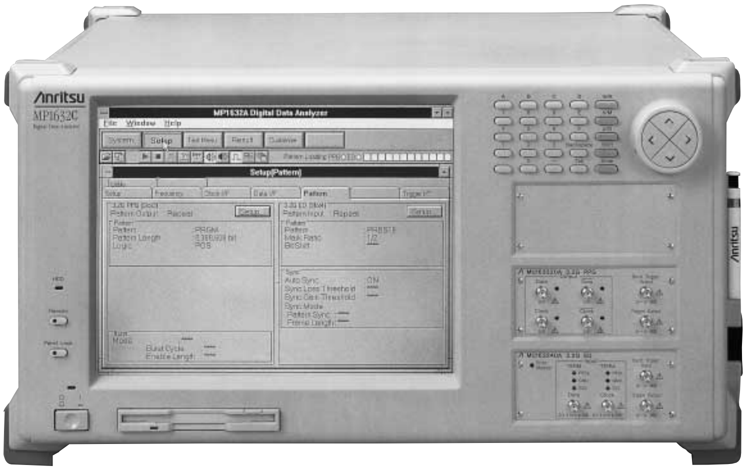
Model/Order No.	Name	
	Main frame	
MP9677B	E/O, O/E Converter	
MU967701A	Clock Recovery Unit (9.95328 Gbit/s)	
MU967702A	Clock Recovery Unit (10.66423 Gbit/s)	
	Standard accessories	
	AC power cord, 2.5 m:	1 pc
J0670A	Power cord (L-type, C7), 2.5 m:	1 pc
F0014	Fuse, 6.3 A:	2 pcs
J0900E	Coaxial cord:	4 pcs
W1765AE	MP9677B operation manual:	1 copy
W1710AE	MU967701A operation manual (supplied to MU967701A):	1 copy
W1761AE	MU967702A operation manual (supplied to MU967702A):	1 copy
B0329C	Front cover:	1 pc
E0008A	Optical output control key:	2 pcs
J0995	U link (for connection with MU967701A or MU967702A):	3 pcs
	Options	
MP9677B-01	External optical input function (external light source usable)	
MP9677B-03	High output, high sensitivity	
MP9677B-10	E/O converter minus option	
MP9677B-38	ST connector	
MP9677B-39	DIN connector	

Model/Order No.	Name
MP9677B-40	SC connector
MP9677B-43	HMS-10/A connector
	Peripheral instruments
MP1777A	10 GHz Jitter Analyzer
MS4630B	Network Analyzer (10 Hz to 300 MHz, with Option 10)
MP1763C	Pulse Pattern Generator (12.5 Gbit/s)
MP1764C	Error Detector (12.5 Gbit/s)
MP1570A	SONET/SDH/PDH/ATM Analyzer (with MU150000A)
	Application parts
J0796A	ST connector (user replaceable, with protective cap, 1 set)
J0796B	DIN connector (user replaceable, with protective cap, 1 set)
J0796C	SC connector (user replaceable, with protective cap, 1 set)
J0796D	HMS-10/A connector (user replaceable, with protective cap, 1 set)
J0796E	FC connector (user replaceable, with protective cap, 1 set)
Z0478	Polarization rotating module (for MP9677B-01)
J0747A	Fixed optical attenuator (5 dB)
J0635B	SM optical fiber cord (both-ends FC-SPC connector), 2 m

DIGITAL DATA ANALYZER
MP1632C
50 MHz to 3.2 GHz

GPIB OPTION

For Development, Manufacturing and Inspection of Transmission Systems, Optical Modules and Logic Devices



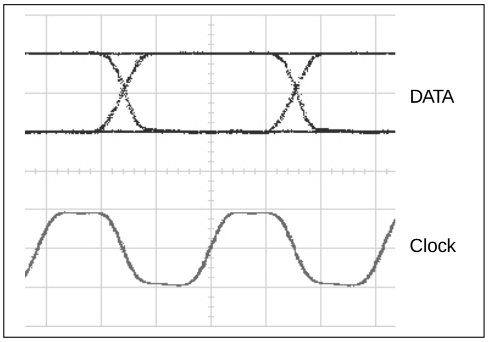
Core networks and computer networks are increasing rapidly as the volume of data transmitted in this multimedia data is growing. In addition to the STM-16/OC-48 (2.488 Gbit/s), Fibre channel, Giga-bit Ethernet, etc. are being commercialized. Compact and high performance digital data analyzer are required for inspecting products like digital transmission systems, optical modules, and logic devices.
The MP1632C realizes a compact solution that incorporates former measuring equipment (MP1652A Pulse Pattern Generator and MP1653A Error Detector) into a case.
MX163201A TEXT to MP1632A/C Pattern Conversion Software, MX163202A MP165X to MP1632A/C Pattern Conversion Software, MX163205A Q and Eye Analysis Software, and MX163206A SDH/SONET Pattern Editor are available as application software.

Features
- 3.2 Gb/s PPG and ED in a case
- Eye diagram measurement and burst signal measurement supported

Performance and functions

• Easy operation
The MP1632C has a large, color LCD with touch screen. Microsoft Windows® operating system version 3.1 displays measurement results graphically. Customized screens enable one-key and one-parameter operation.

• High-quality pulse pattern generator
Programmable patterns of 8 Mbit max, PRBS patterns [(2^7 – 1) to (2^{31} – 1) with variable mark ratio], and zero substitution patterns can be generated. Variable cross-point of data output waveform is also supported.



H: 100 ps/div, V: 1 V/div
MU163220C output waveform (3.2 GHz)

• Error detector with many functions
High input sensitivity (25 mVp-p*) and wide phase margin (250 ps*) performance is provided. The autosearch function enables PRBS pattern search with usual phase and threshold search. Insertion error and omission error can be measured simultaneously.
∗Typical values at 3 Gb/s, PRBS 2^{23} – 1

• Internal synthesizer with high signal purity (Option)
Highly pure signals, SSB phase noise characteristics of –85 dBc/Hz or less (10 kHz offset), is generated.

• Support of various applications
The MP1632C supports testing of SDH/SONET (STM-0, 1, 4, 16/OC-1, 3, 12, 48) devices and modules, research and development on WDM components, Fibre channels, Giga-bit Ethernet, evaluation of E/O and O/E module, GaAs IC, and high-speed ASIC/FPGAs

Specifications

• MU163220C 3.2G Pulse Pattern Generator

Operating frequency	10 MHz to 3.2 GHz (50 MHz to 3.2 GHz when using MP1632C-03 3.2G Internal Synthesizer)
External clock input	0.5 to 2 Vp-p (<0.5 GHz: square wave, ≥0.5 GHz: square wave or sine wave, 50% duty cycle)
Generation pattern	Pseudo random pattern (PRBS) Pattern length: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8, $\overline{1/2}$, 3/4, 7/8, 8/8 AND bit shift upon mark ratio setting: 1, 3 bits Data pattern Data length: 2 to 8,338,608 bits Zero substitution pattern Continuous 0 bit length: 1 to (pattern length – 1) bits Pattern length: 2^n (n: 7, 9, 11, 15) Error insertion Error ratio: 10^{-n} (n: 3, 4, 5, 6, 7, 8, 9), single error External error input: Provided
Data output	Number of outputs: 2 (DATA/$\overline{\text{DATA}}$, independent) Amplitude: 0.5 to 2 Vp-p (10 mV steps, setting error: ±15% or ±0.1 V, whichever is greater) Offset voltage V_{OH}: –2 to +2 V (at 2 Vp-p amplitude), –3.5 to +2 V (at 0.5 Vp-p amplitude) (5 mV steps, setting error: ±15% of offset voltage, ±0.1 V or ±15% of amplitude, whichever is the greatest) Display: V_{OH}, V_{TH}, and V_{OL} selectable Rise/fall time: ≤80 ps (10% to 90% of amplitude) Pattern jitter: ≤30 psp-p Waveform distortion: 10% or 0.1 V of amplitude, whichever is greater Load impedance: 50 Ω (with back termination) Connector: SMA DATA/$\overline{\text{DATA}}$ tracking: $\overline{\text{DATA}}$ amplitude and offset voltage can be set to same value as DATA. Crosspoint adjustment function: Provided
Clock output	Number of output: 2 (CLOCK/$\overline{\text{CLOCK}}$, independent) Amplitude: 0.5 to 2 Vp-p (10 mV steps, setting error: ±15% or ±0.1 V, whichever is greater) Offset voltage V_{OH} : –2 to +2 V (at 2 Vp-p amplitude), –3.5 to +2 V (at 0.5 Vp-p amplitude) (5 mV steps, setting error: ±15% of offset voltage, ±0.1 V or ±15% of amplitude, whichever is the greatest) Display: V_{OH}, V_{TH}, and V_{OL} selectable Rise/fall time: ≤80 ps (10% to 90% of amplitude) Load impedance: 50 Ω (with back termination) Connector: SMA Clock delay: –1 to +1 ns (2 ps steps)
External burst trigger input	Input level: 0/–1 V, connector: SMA
Internal burst signal	Burst cycle: 2 µs to 50 ms (1 µs steps), Enable length: 1 µs to 49.999 ms (1 µs steps)
Burst trigger output	Output level: 0/–1 V, connector: SMA
Sync signal output	Number of outputs: 1 (1/8 clock, variable pattern synchronization output selectable), Output level: 0/–1 V, Connector: SMA
Operating temperature	+5 to +45˚C
Power	≤200 VA
Dimensions and mass	232 (W) x 49 (H) x 449 (D) mm, ≤4.5 kg

• MU163240C 3.2G Error Detector

Operating frequency	10 MHz to 3.2 GHz (50 MHz to 3.2 GHz when using MP1632C-03 3.2G Internal Synthesizer)
Data input	Input waveform: NRZ Input voltage: 0.5 to 4 Vp-p Variable threshold voltage: –4 to +4 V (1 mV steps) Termination: Connected to GND, –2 V or +3 V via 50 Ω Connector: SMA
Clock input	Input waveform: Square wave (<0.5 GHz), square wave or sine wave (≥0.5 GHz), duty: 50% Input amplitude: 0.5 to 4 Vp-p Variable input delay: –1 to +1 ns (2 ps steps) Polarity inversion: POS/NEG inversion selectable Termination: Connected to GND, –2 V or +3 V via 50 Ω Connector: SMA
Auto search function	Phase, threshold, phase & threshold, PRBS pattern (allowed if the mark ratio is between 1/8 and 7/8)
Receive pattern	Pseudo random pattern (PRBS) Pattern length: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Marker ratio: 1/2, 1/4, 1/8, 0/8, $\overline{1/2}$, 3/4, 7/8, 8/8 AND bit shift upon mark ratio setting: 1, 3 bits Data pattern Data length: 2 to 8,338,608 bits Zero substitution pattern Continuous 0 bit length: 1 to (pattern length – 1) bits Pattern length: 2^n (n: 7, 9, 11, 15)
Sync mode	Normal, frame
Sync threshold	AUTO or 10^{-n} (n: 2, 3, 4, 5, 6, 7, 8)
Error detection mode	Omission, insertion, total

Continued on next page

Measurement items	Error rate: 0.0000 x 10^{-16} to 1.0000 x 10^{0} Number of errors: 0 to 9.9999 x 10^{16} Error interval (async): 0 to 9999999 (Interval: 100 ms, 1 s) Error free interval (EFI): 0.0000 to 100.0000% Clock frequency: 0.01 to 3.2 GHz (resolution: 1 Hz, accuracy: 10 ppm ±1 kHz)
Eye margin measurement function	Provided
Error performance calculation function	Provided
Measurement channel mask	1 to 8 channels, each channel settable independently
Error output	Number of output: 1 (1/32 bit rate OR error), Output level: 0/–1, Connector: SMA
Sync signal output	Number of outputs: 1 (switchable among 1/8 clock, fixed pattern sync, sync gain output) Output level: 0/–1 V, Connector: SMA
Burst trigger input	Input level: 0/–1 V, connector: SMA
Operating temperature	+5˚ to +45˚C
Power	≤250 VA
Dimensions and mass	232 (W) x 54 (H) x 449 (D) mm, ≤5 kg

• MP1632C (Main frame)

System environment	OS: Microsoft Windows® operating system Version 3.1 Display: 10.4 inch, color LCD (touch screen), 640 x 480 dots, 256 colors Printer: Parallel port for external printer (D-sub, 25-pins) Keyboard: 101 type (English), PS/2 (mini DIN 6-pin connector) Mouse: Serial, PS/2 (mini DIN, 6-pin connector) FDD: 2 modes (1.44 MB, 740 KB) HDD C drive: ≥474 MB (used for system: measurement data, pattern), D drive: ≥30 MB (not accessible to users, interface: IDE)
Remote control	RS-232C (standard), GPIB (option): IEEE488.2, Ethernet (option): 10 Base-T
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Power supply	100 to 120 Vac/200 to 240 Vac, 47.5 to 63 Hz, ≤150 VA
Operating temperature	+5˚ to +45˚C
Dimensions and mass	426 (W) x 221.5 (H) x 451(D) mm, ≤20 kg

• 3.2G internal synthesizer (Option 03)

Frequency range	50 MHz to 3.2 GHz (1 kHz steps)
Frequency accuracy	±2 ppm
SSB phase noise	≤–85 dBc/Hz (10 kHz offset, 1 kHz bandwidth)
Non-harmonic spurious	≤–60 dBc (limited to spurious 10 kHz or more distant from carrier frequency)
Reference lock range	10 MHz ±10 ppm
Power	≤50 VA
Mass	≤5 kg

• MX163201A TEXT to MP1632A/C Pattern Conversion Software

Required system	Computer: IBM-PC/AT or full compatible, OS: Windows 3.1/95/98, CPU: Pentium 133 MHz or higher, Memory: 32 MB or more, Hard disk space: 25 MB or more Display Resolution: 640 x 480 or more, Display colors: 256 or more FDD: 3.5-inch (1.44 MB)
Text file	A text file describing the program pattern in hex format (maximum number of characters in a line: 32696 bits including spaces and return characters)
MP1632A/C pattern data file (PTN)	All the MP1632A/C set data and patterns (file format for reading/writing on the MP1632A/C main screen)
MP1632A/C pattern clip file (PCP)	Only patterns (a file format that can be read or written in the MP1632A/C Pattern Editor)

• MX163202A MP165X to MP1632A/C Pattern Conversion Software

Required system	Computer: IBM-PC/AT or full compatible, OS: Windows 3.1/95/98, CPU: Pentium 133 MHz or higher, Memory: 32 MB or more, Hard disk space: 25 MB or more Display Resolution: 640 x 480 or more, Display colors: 256 or more FDD: 3.5-inch (1.2/1.44 MB)
Input file	MP165X program pattern files: MP165X's reading/writing and edit File name: T∗∗.PTN (for pulse pattern generator), R∗∗.PTN (for error detector)
Output file	MP1632A/C pattern data file (PTN): All the MP1632A/C set data and patterns (file format for reading/writing on the MP1632A/C main screen) MP1632A/C pattern clip file (PCP): Only patterns (File format that can be read or written in the MP1632A/C's pattern editor.)

Note: Since the FD format of MP165X is 1.2 MB, the PC must read 1.2 MB format FD.

• MX163205A Q and Eye Analysis Software

Required system	Computer: IBM-PC/AT or full compatible, OS: Windows 95/98/NT, CPU: Pentium 166 MHz or higher, Memory: 64 MB or more, Hard disk space: 100 MB or more, GPIB: National Instruments made GPIB interface (PCMCIA-GPIB or AT- GPIB/TNT series boards are recommended.) Display Resolution: 800 x 600 or more, Display colors: 256 or more *If two or more applications are running simultaneously, operation cannot be guaranteed.
Function	Measurement frequency: 1 to 3.2 GHz Measurement patterns: PRGM, PRBS 7, 9, 11, 15, 20, 23, 31 Pattern format: Continuous/burst (To be synchronized within 1 s) Eye margin measurement Measurement resolution (threshold): 1 to 10 mV (1 mV steps), Measurement resolution (phase): 2 to 10 ps (2 ps steps), Measurement rate: E-2 to E-15 Eye diagram measurement Measurement resolution (phase): 2 to 10 ps (2 ps steps) Measurement rate: E-2 to E-15 (actual measurement), E-3 to E-12 (estimate measurement) Display rate: E-2 to E-15 (actual measurement), E-2 to E-4915 (estimate measurement) Mask test judgment rate: E-2 to E-15 Q factor measurement Measurement style: Multiple measurements at fixed phase/phase vs. Q factor measurements Bit error rate range: Upper limit at E-3 to E-5, lower limit at E-7 to E-12 Minimum error count (measurement accuracy): 1, 10, 100, 1000 Vth shift width: Automatic, fixed (1 to 10 mV/1 mV steps)

• MX163206A SDH/SONET Pattern Editor

Required system	Computer: IBM-PC/AT or full compatible, CPU: Pentium 200 MHz or higher, OS: Windows 95/98/NT, Memory: 64 MB or more Display Resolution: 800 x 600 or more; Display colors: 256 or more FDD: 3.5-inch (1.44 MB), Hard disk space: 100 MB or more, GPIB: National Instruments made GPIB interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.)
Functions	SDH/SONET pattern editor Mapping: STM-N (N = 1, 4c, 12c, 16c), STS-N SPE (N = 1, 3c, 12c, 48c) Pattern edit: Arbitrary editing of program patterns (PRBS pattern can be inserted in the payload.), time indication, table indication/edit Payload: Free format, ALL 0, ALL 1, PRBS 2^n – 1 (n = 7, 9, 11, 15, 20, 20z, 23, 31) *Pattern repetition up to the length of all frames CID pattern: Available Frame repetition : Maximum 26 frames Alarm addition: Alarm addition conforming to SDH/SONET Standard *items: OOF/LOF, MS-AIS (L-AIS), MS-RDI (L-RDI), MS-REI (L-REI), HP-AIS (P-AIS), HP-REI (P-REI), HP-RDI (P-RDI) BIP error addition: Generates parity errors of B1, B2, and B3 B1, B2, and B3 calculation: Available Scramble: Available BIP correction: Available OH editor: Available

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Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1632C	Digital Data Analyzer	
	Standard accessories	
	Power cord (shielded):	1 pc
F0090	Fuse, 8 A:	2 pcs
Z0319A	PS/2 mouse:	1 pc
Z0320	Input pen:	1 pc
Z0527	Recovery disk*1:	1 set
Z0528	Application disk*1:	1 set
Z0529	Remote sample disk*1:	1 set
Z0396A	Pen holder:	1 pc
W1859AE	MP1632C operation manual:	1 copy
W1860AE	MP1632C remote control operation manual:	1 copy
B0447B	Dummy unit for EXTENSION:	1 pc
B0329D	Front cover:	1 pc
	Options	
MP1632C-01	GPIB	
MP1632C-02	Ethernet	
MP1632C-03	3.2G internal synthesizer	
	Application software	
MX163201A	TEXT to MP1632A/C Pattern Conversion Software	
MX163202A	MP165X to MP1632A/C Pattern Conversion Software	
MX163205A	Q and Eye Analysis Software	
MX163206A	SDH/SONET Pattern Editor	

Model/Order No.	Name	
	Peripherals	
Z0321A	Keyboard (PS/2)	
J0008	GPIB cable, 2 m	
B0447A	Dummy unit for CG	
B0447C	Dummy unit for PPG	
B0447D	Dummy unit for ED	
Z0416	3.5 inch head cleaning disk	
MB24B	Portable Test Rack (specified current: 20 A)	
B0348	Soft case	
B0329D	Front cover	
B0333D	Rack mount kit	
J0905A	Semi-rigid cable (for Option 03)	
Z0398	Ethernet installation disk (for Option 02)	
W1529AE	Ethernet operation manual (for Option 02)	
MU163220C	3.2G Pulse Pattern Generator*2	
	Standard accessories	
J0693A	Coaxial cord (HRM202B · 3D2W · HRM202B), 1 m:	1 pc
J0696A	Coaxial cord (AA-165-500), 0.5 m:	2 pcs
W1857AE	MU163220C/163240C operation manual:	1 copy
Z0306A	Wrist strap:	1 pc
MU163240C	3.2G Error Detector*2	
	Standard accessories	
J0693A	Coaxial cord (HRM202B · 3D2W · HRM202B), 1 m:	1 pc
J0696A	Coaxial cord (AA-165-500), 0.5 m:	2 pcs
W1857AE	MU163220C/163240C operation manual*3:	1 copy

*1: Only for MP1632C customer
*2: Units are factory options (not user replaceable)
*3: Not supplied when 3.2G pulse pattern generator purchased as same time

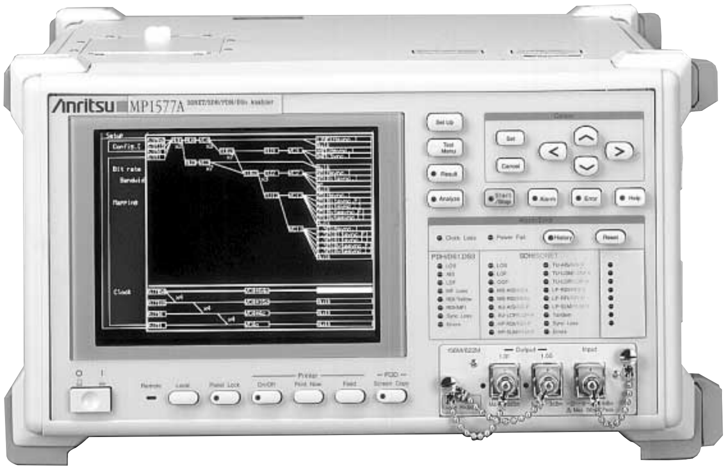
SONET/SDH/PDH/DSn ANALYZER

MP1577A

1.5 Mbit/s to 10 Gbit/s

GPIB OPTION

Comprehensive Testing of Core Networks from One Compact Portable Analyzer

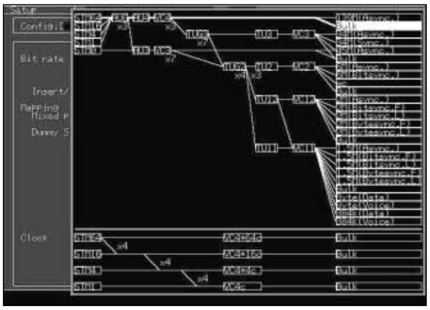


The MP1577A analyzer is designed for development, manufacturing, construction, maintenance, and inspection of SDH, SONET, PDH, and ATM equipment and networks.
A variety of plug-in units and options are available that offer the flexibility to the users to configure various analysis systems for different applications.
The MP1577A is scalable from 1.5 Mbit/s to 10 Gbit/s, and perform SONET/SDH/PDH/DSn tests such as concatenation mapping, tandem connection, APS switching time measurement.
The MP1577A has a built-in printer and a 3.5-inch floppy disk drive as standard output devices to print measurement results, and to save and read measurement data to and from the floppy disk (FD), which can also be read on an external PC. The user can also save screen data to the FD. The MP1577A has a "HELP" key function that explains operations, functions and connections.

SDH, SONET and PDH measurement

- **Measurement at bit rates from 1.5 Mbit/s to 10 Gbit/s**

A mapping route to a bit rate of up to 10 Gbit/s can be set.
The MP1577A mainly supports SDH, SONET, and Japanese mapping, European PDH and North American DSn for digital communications. For concatenation mapping, a route can be set from STM-1c/STS-3c up to STM-64c/STS-192c. Furthermore, the MP1577A supports a combination of channels. For example, 64 channels of VC4c/STS3c, 16 channels of VC4-4c/STS-12c, and four channels of VC4-16c/STS-48c (See Figure 1 or Figure 2 in page 4 or 6).



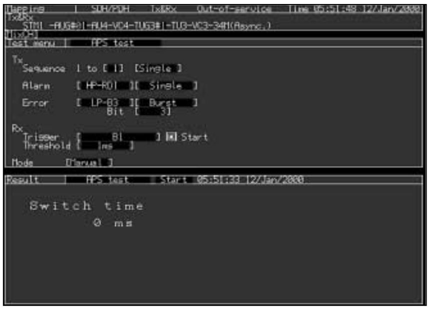
Mapping

- **Overhead setting and testing**

The user can modify and capture the overhead, and test the overhead portion with overhead change, pointer 64 frames, overhead add/drop and overhead bit errors.

- **APS function**

The user can test the automatic protection switch (APS) by measuring the equipment switching time accurately in milliseconds. The MP1577A also conforms to ITU-T Rec. G.783 and G.841.



```
Mapping   | SDH/PDH   Tx&Rx   Out-of-service   Time 05:51:48 12/Jan/2000
Tx&Rx
  STM1 -AUG#01-AU4-VC4-TUG3#1-TU3-VC3-34M(Async.)
Test menu | APS test

 Tx
  Sequence  1 to [ 1]  [Single ]
  Alarm     [ HP-RDI  ][  Single  ]
  Error     [  LP-B3  ][  Burst   ]
                Bit  [     3]
 Rx
  Trigger   [       B1       ] ■ Start
  Threshold [    1ms    ]
 Mode       [Manual ]

Result    |   APS test    | Start  05:51:33 12/Jan/2000

   Switch time
         0  ms
```

APS test sub-screen

- **Mixed payload**

At mapping measurement in TUG-3 and AU3, the user can set different mapping for three additional channels other than the target measurement channel.

- **Tandem connection**

The N1/Z5 and N2/Z6 bytes can be set and measured.

- **Various analysis functions**

The internal optical power meter and frequency counter allows the user to measure optical power and frequency during error and alarm measurement without changing the connections of the signal cables.
Measured errors and alarms can be displayed as a graph with a time scale in 1 second, 1 minute, 15 minutes, or 60 minutes.

- **Pointer value monitoring**

Changes in pointer value can be displayed as a graph with values updated in real time.

• MUX/DEMUX function (option)
When the MUX/DEMUX option is added, the multiplexing structure including the frame alignment signal can be generated, and multiplexer/demultiplexer measurement can be performed.

• Through modes
One of the three through modes can be selected: (1) Transparent, (2) Overhead/Overwrite, and (3) Payload/Overwrite. The external DS1/DS3/PDH signal can be added/dropped to/from payload at payload overwrite.

• Enhanced error/alarm simulation
The MP1577A can generate normal and abnormal frames alternately to test the frame synchronization function of terminal equipment. (This is an SDH/SONET FAS error addition function.)

Specifications

• MP0121A 2/8/34/139/156M*[1] Unit

Bit rate	2.048, 8.448, 34.368, 139.264 Mbit/s
Level/waveform	Conforms to ITU-T G.703 (with 20 dB monitoring point)
Connectors	BNC (75 Ω, unbalanced), 3-pin Siemens (120 Ω, balanced) 2.048 Mbit/s: HDB3 (balanced/unbalanced) 8.448, 34.368 Mbit/s: HDB3 (unbalanced) 139.264 Mbit/s: CMI (unbalanced)
Clock	Internal (accuracy: ±7 ppm, jitter unit not installed), external (ECL [AC] 50 Ω), received signal
Frame format	Unframed: 2, 8, 34, 139 Mbit/s Framed: 2 Mbit/s (with/without CRC-4 at channels 30/31, G.704), 8 Mbit/s (G.742), 34 Mbit/s (G.751), 139 Mbit/s (G.751), MUX/DEMUX (Option 06)
Test patterns	PRBS: $2^{11}-1$, $2^{15}-1$, $2^{20}-1$, $2^{23}-1$ (O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit (all, test pattern), code, E-bit Timing: Single, rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7) FAS: n in 16 (n: 1 to 4), all
Alarm addition	LOS, LOF, AIS, RDI, RDI (MF) Timing: All
Measurements	Mode: Single, repeat, manual In-service Errors: Frame, code, CRC-4, E-bit Alarms: Power-fail, LOS, AIS, LOF, MF loss, RDI, RDI (MF) Error performance: G.821 (inc. Annex D), M.2100, G.826 Out-of-service Errors: Frame, code, CRC-4, E-bit, bit Alarms: Power-fail, LOS, AIS, LOF, MF loss, RDI, RDI (MF), sync loss Error performance: G.821 (inc. Annex D), M.2100, G.826
LEDs	LOS, AIS, LOF, MF loss, RDI, RDI (MF), sync loss, errors
Monitor	Frame word
Trouble search	Auto search for errors/alarms in all measured channels
Delay measurement	0 to 1 s
Auxiliary interface	Clock sync output, frame sync output, error output

*1: Built-in 156M CMI (electrical) interface
Can not used simultaneously with the MP0122A or MP0122B (when installed option 20, 21).

• MP0122A 1.5/45/52M*[1] Unit, MP0122B 1.5/45/52/52M*[2] (1.31) Unit

Bit rate	1.544, 44.736 Mbit/s
Level/waveform	1.544 Mbit/s: ANSI T1.102 (with 20 dB monitoring point), 0/655 ft 44.736 Mbit/s: ANSI T1.102 (with 20 dB monitoring point), 0/450/900 ft
Connectors	BNC (75 Ω, unbalanced), BANTAM (100 Ω, balanced) 1.544 Mbit/s: AMI/B8ZS (balanced), 44.736 Mbit/s: B3ZS (unbalanced)
Clock	Internal (accuracy: ±7 ppm), external (ECL [AC] 50 Ω) received signal
Frame format	Unframed: 1.5, 45 Mbit/s Framed: 1.5 Mbit/s (D4, ESF, Japan ESF*[3]), 45 Mbit/s (M13, C-bit), MUX/DEMUX (Option 07)
Test patterns	PRBS: $2^{11}-1$, $2^{15}-1$, $2^{20}-1$ (zero suppress), $2^{20}-1$, $2^{23}-1$ (O.151) Invert: On/off Word: 16-bit program, all 0, all 1, 3 in 24 (1.5 Mbit/s)
Error addition	Bit (all, test pattern), code, parity, CRC-6, C-bit, REI Timing: Single, rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7) FAS (45 Mbit/s): n in 16 (n: 1 to 4), all
X-bit setting	00, 01, 10, 11
Alarm addition	LOS, LOF, AIS, RDI Timing: All

Continued on next page

Measurements	Mode: Single, repeat, manual In-service Errors: FAS, code, parity, CRC-6, C-bit, REI Alarms: Power-fail, LOS, AIS, LOF, RDI Error performance: G.821 (inc. Annex D), M.2100, G.826 Out-of-service Errors: FAS, code, parity, CRC-6, C-bit, REI, bit Alarms: Power-fail, LOS, AIS, LOF, RDI, sync loss Error performance: G.821 (inc. Annex D), M.2100, G.826
LEDs	LOS, LOF, AIS, RDI, sync loss, errors
Trouble search	Auto search for errors/alarms in all measured channels
Delay measurement	0 to 1 s
Auxiliary interface	Clock sync output, frame sync output, error output

*1: Built-in 52M B3ZS (electrical) interface
*2: Built-in 52M B3ZS (electrical) and optical interfaces
*3: Mounted Option 09 (Japan mapping)
Can not used simultaneously with the MP0121A or MP0122B (when installed option 20, 21).

• MP0122B 1.5/45/52/52M (1.31) Unit

Optical interface

Bit rate	51.84 Mbit/s (NRZ)
Transmit	Wavelength: 1310 nm Output level: –11.5 dBm ±3.5 dB Optical safety: IEC 825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SM-F)
Receive	Sensitivity 52M: –33 to –8 dBm (test pattern: PRBS $2^{23}-1$, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SM-F) Power measurement Measurement range: –30 to 0 dBm (peak power), Accuracy: ±1 dB (–20 dBm), Linearity: ±1 dB (–30 to 0 dBm) Monitor input Level: 0.1 to 1.0 Vp-p (AC), Connector: SMA (50 Ω)

Can not be used simultaneously with the MP0121A or MP0122A (when installed option 20, 21).

• 52/156/622/2488/9953M (SDH)

Bit rate	51.84, 155.52, 622.08, 2488.32[*1], 9953.28[*1] Mbit/s
Level/waveform	52M (electrical: B3ZS)[*2]: ANSI T1.102, 0/450 ft 52M (optical): As per MP0122B unit optical interface specifications 156M (electrical: CMI)[*3]: ITU-T G.703 156M (optical): As per optical 156M/622M unit specifications 622M (electrical/optical): As per optical 156M/622M unit and NRZ unit specifications 2488M (electrical/optical): As per 2.5G unit and 2.5G/10G unit specifications 9953M (electrical/optical): As per 2.5G/10G unit specifications
Clock	Internal (accuracy: ±3.5 ppm, jitter unit not installed), Lock (2 MHz, 1.5 MHz, 64 kHz + 8 kHz, 2 Mbit/s, 1.5 Mbit/s), external (ECL [AC] 50 Ω, 9953M: 1.02 to 0.58 Vp-p, 50 Ω), received signal
Frame	SDH/SONET
Mapping	See Fig. 1
Through	Trance parent, over head overwrite, payload overwrite
Test patterns	PRBS: $2^{11}-1$, $2^{15}-1$, $2^{20}-1$ (zero suppress, MP0122A/B installed), $2^{20}-1$, $2^{23}-1$, $2^{31}-1$ (only concatenation mapping 16c/64c, conform to O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit all (all, test pattern), FAS, B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI Timing: Single, single (burst) bit (1 to 64000), rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7, 1E–8, 1E–9) User program AE-B [A: 1.0 to 9.9 (step: 0.1), B: 2 to 10] Alternative: Error frame (0 to 8000), normal frame (1 to 8000)
Alarm addition	LOS, LOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ, TU-AIS, TU-LOP, TU-LOM, LP-SLM, LP-TIM, LP-RDI, LP-UNEQ, LP-RFI Timing: Single, single (burst) frame Alternative: Alarm frame (0 to 8000), normal frame (1 to 8000), all
Measurements	Mode: Single, repeat, manual In-service/Out-of-service Errors: B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI Alarms: Power-fail, LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ, TU-AIS, TU-LOP, TU-LOM, LP-SLM, LP-TIM, LP-RDI, LP-UNEQ, LP-RFI Error performance: G.826, M2101, M2110, M2120 Preset: Alarm measurement condition
LEDs	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-SLM, TU-AIS, TU-LOM, TU-LOP, LP-RDI, LP-RFI, LP-SLM, Tandem, sync. loss, errors
Tandem connection	N1 byte (Type 1, Type 2), N2 byte Errors: N2 BIP-2, TC-REI, OEI, IEC Alarms: VC-AIS, ISF, FAS, HP-Incoming-AIS, HP-TC-RDI, HP-ODI, LP-Incoming-AIS, LP-TC-RDI, LP-ODI
Justification	AU pointer, TU pointer, C, C1/C2 Measurement: NDF, +PJC, –PJC, Cons, C, C1/C2

Continued on next page

Monitor	SOH, POH, K1/K2, pointer, path trace (TIM alarms detectable), Tandem, payload
Dummy channel setting	Payload: Dummy, copy, mixed payload Setting: POH, pathtrace, SS bit, Tandem
Simultaneous measurement	VC2, VC12, VC11
Trouble search	Auto search for errors/alarms in all measured channels
Delay	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, time out Display accuracy: ±5 µs (0.5, 1 s), ±50 µs (2, 5, 10 s)
APS (K1/K2)	Switching time measurement Measurement range: 1 to 2000 ms, >2000 ms Trigger Internal: B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI, MS-AIS, AU-AIS, AU-LOP, HP-RDI, TU-AIS, TU-LOM, TU-LOP, LP-RDI, LP-RFI, Bit External: Measures trigger input signal (active high) Threshold: Specify non-error alarm between 1 ms, 10 ms, 100 ms Sequence generation: 2 to 64 word, repeat (8000 frame) Sequence capture: 2 to 64 word, repeat (8000 frame)
Frequency measurement	Range: ±100 ppm, Accuracy: ±3.5 ppm
Japan mapping (option 09)	VC11 Signaling (8-multiframe, 64-multiframe setting)
Payload offset	±100 ppm/0.1 ppm step
Auxiliary interface	Clock sync output, trigger input, trigger output, DCC interface (V.11), orderwire, receive clock output

*1: Mounted option 20, 21
*2: Mounted MP0122A/B
*3: Mounted MP0121A

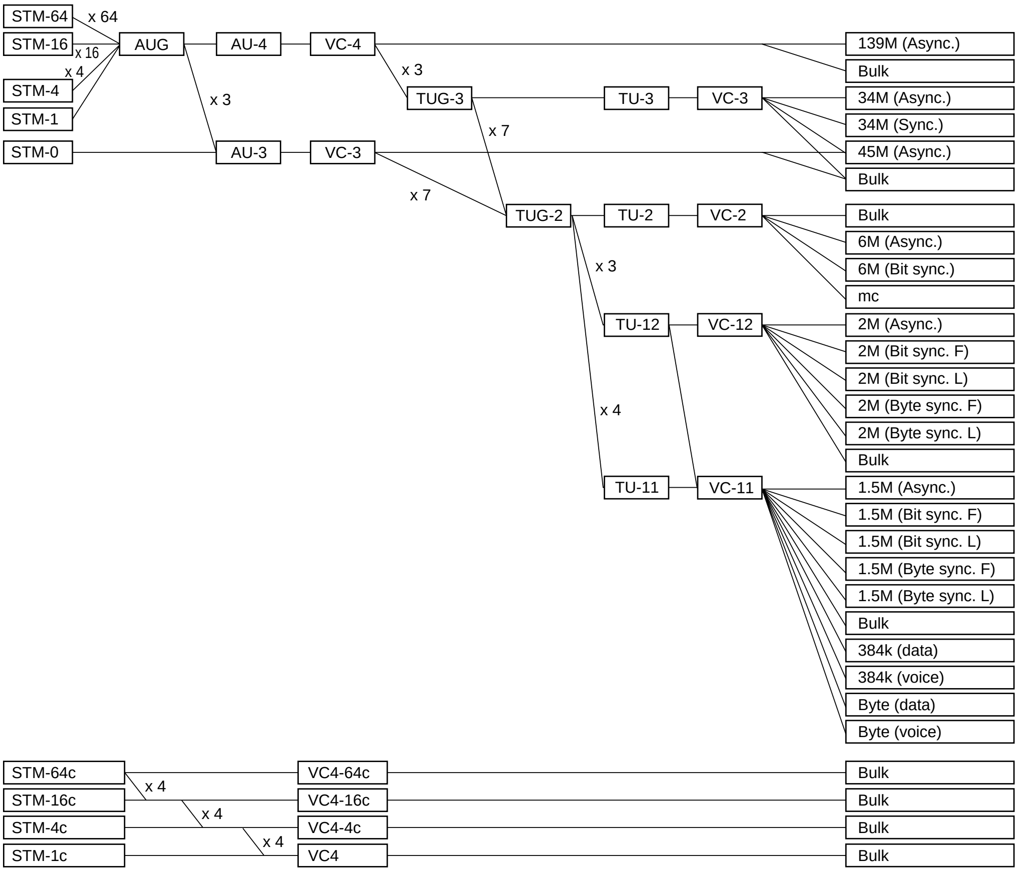


Fig. 1 Mapping structure (SDH)

The mapping depends on the option and unit configuration.

• 52/156/622/2488/9953M (SONET)

Bit rate	51.84, 155.52, 622.08, 2488.32[*1], 9953.28[*1] Mbit/s
Level/waveform	52M (electrical: B3ZS)[*2]: ANSI T1.102, 0/450 ft 52M (optical): As per MP0122B unit optical interface specifications 156M (electrical: CMI)[*3]: ITU-T G.703 156M (optical): As per optical 156M/622M unit specifications 622M (electrical/optical): As per optical 156M/622M unit and NRZ unit specifications 2488M (electrical/optical): As per 2.5G unit and 2.5G/10G unit specifications 9953M (electrical/optical): As per 2.5G/10G unit specifications
Clock	Internal (accuracy: ±3.5 ppm, jitter unit not installed), Lock (2 MHz, 1.5 MHz, 64 kHz + 8 kHz, 2 Mbit/s, 1.5 Mbit/s), External (ECL [AC] 50 Ω, 9953M: 1.02 to 0.58 Vp-p, 50 Ω), received signal
Frame	SDH/SONET
Mapping	See Fig. 2
Through	Trance parent, over head overwrite, payload overwrite
Test patterns	PRBS: 2^{11} – 1, 2^{15} – 1, 2^{20} – 1 (zero suppress, MP0122A/B installed), 2^{20} – 1, 2^{23} – 1, 2^{31} – 1 (only concatenation mapping 16c/64c, conform to O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit all (all, test pattern), FAS, B1, B2, B3, BIP-2, REI-L, REI-P, REI-V Timing: Single, single (burst) bit (1 to 64000), rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7, 1E–8, 1E–9) User program AE-B [A: 1.0 to 9.9 (step: 0.1), B: 2 to 10] Alternative: Error frame (0 to 8000), normal frame (1 to 8000)
Alarm addition	LOS, LOF, AIS-L, RDI-L, AIS-P, LOP-P, PLM-P, HP-TIM, RDI-P, UNEQ-P, AIS-V, LOP-V, LOM-V, PLM-V, LP-TIM, RDI-V, UNEQ-V, RFI-V Timing: Single, single (burst) frame Alternative: alarm frame (0 to 8000), normal frame (1 to 8000), all
Measurements	Mode: Single, repeat, manual In-service/Out-of-service Errors: B1, B2, B3, BIP-2, REI-L, REI-P, REI-V Alarms: Power-fail, LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, LOP-P, PLM-P, HP-TIM, RDI-P, UNEQ-P, AIS-V, LOP-V, LOM-V, PLM-V, LP-TIM, RDI-V, UNEQ-V, RFI-V Error performance: G.826, M2101, M2110, M2120 Preset: Alarm measurement condition
LEDs	LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, LOP-P, RDI-P, PLM-P, AIS-V, LOM-V, LOP-V, RDI-V, RFI-V, PLM-V, Tandem, sync. loss, errors
Tandem connection	Z5 byte (Type 1, Type 2), Z6 byte Errors: Z6 BIP-2, TC-REI, OEI, IEC Alarms: VC-AIS, ISF, FAS, HP-Incoming-AIS, HP-TC-RDI, HP-ODI, LP-Incoming-AIS, LP-TC-RDI, LP-ODI
Justification	STS pointer, VT pointer, C, C1/C2 Measurement: NDF, +PJC, –PJC, Cons, C, C1/C2
Monitor	TOH, POH, K1/K2, pointer, path trace (TIM alarms detectable), Tandem, payload
Dummy channel setting	Payload: Dummy, copy, mixed payload Setting: POH, pathtrace, SS bit, Tandem
Simultaneous measurement	VT6SPE, VT2SPE, VT1.5SPE
Trouble search	Auto search for errors/alarms in all measured channels
Delay	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, time out Display accuracy: ±5 µs (0.5, 1 s), ±50 µs (2, 5, 10 s)
APS (K1/K2)	Switching time measurement Measurement range: 1 to 2000 ms, >2000 ms Trigger Internal: B1, B2, B3, BIP-2, REI-L, REI-P, REI-V, AIS-L, AIS-P, LOP-P, RDI-P, AIS-V, LOM-V, LOP-V, RDI-V, RFI-V, Bit External: Measures trigger input signal (active high) Threshold: Specify non-error alarm between 1 ms, 10 ms, 100 ms Sequence generation: 2 to 64 word, repeat (8000 frame) Sequence capture: 2 to 64 word, repeat (8000 frame)
Frequency measurement	Range: ±100 ppm, Accuracy: ±3.5 ppm
Japan mapping (option 09)	VT1.5SPE Signaling (8-multiframe, 64-multiframe setting)
Payload offset	±100 ppm/0.1 ppm step
Auxiliary interface	Clock sync output, trigger input, trigger output, DCC interface (V.11), orderwire, receive clock output

*1: Mounted option 20,21
*2: Mounted MP0122A/B
*3: Mounted MP0121A

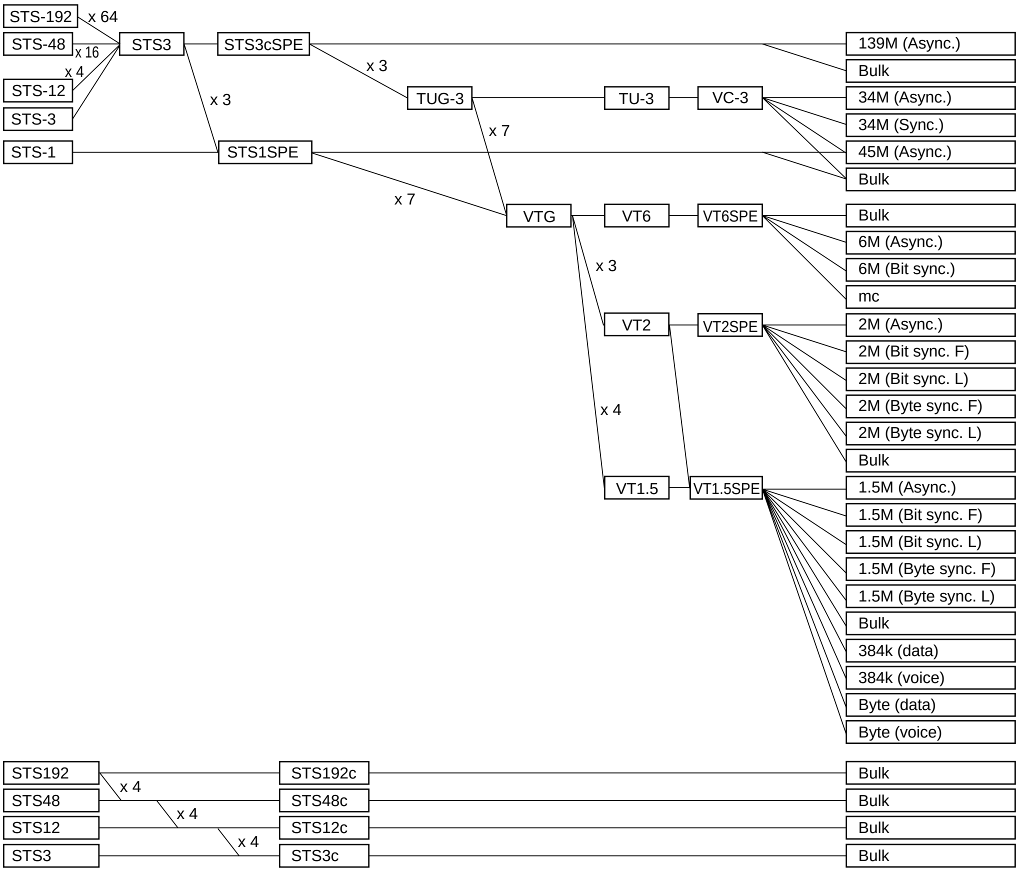


Fig. 2 Mapping structure (SONET)

The mapping depends on the option and unit configuration.

- **General**

Printer	Internal, external
Internal memory	Measurement settings memory: 10, Graphics memory: 15
Others	FDD, RS-232C (Option 01)*1, GPIB (Option 02)*1, Ethernet (Option 03)*1, video output (Option 04)*1, buzzer, clock, help, screen copy
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, 15 kg approx.
Power	100 to 240 Vac, 47.5 to 63 Hz, ≤500 VA
Temperature	0° to +40°C

*1: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously.
Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MP1577A[*1]	SONET/SDH/PDH/DSn Analyzer (requires Option 20 or Option 21)
	Standard accessories
	AC power cord: 1 pc
Z0169	Printer paper (5 rolls/pack): 1 pack
F0079	Fuse, 10 A: 2 pcs
B0329G	Front cover: 1 pc
Z0486	Side cover: 1 pc
J0907Q	Remote interlock cord (for 2.5G/10G optical output): 1 pc
J0908	Remote interlock terminator (for 2.5G/10G optical output): 1 pc
E0008A	Optical output control key (for 2.5G/10G optical output): 1 pc
J0747B	Fixed optical attenuator (10 dB, for 2.5G/10G optical input)): 1 pc
J0635A	Optical fiber cable (FC · PC-FC · PC) 1 m: 1 pc
W2002AE	MP1577A operation manual (Vol. 1 Basic operation for SDH): 1 copy
W2003AE	MP1577A operation manual (Vol. 1 Basic operation for SONET): 1 copy
W2004AE	MP1577A operation manual (Vol. 2 Remote control): 1 copy
J1002A	Semi-rigid cable (for 2.5G/10G optical output, 2 pcs/set): 1 set
J1002B	Semi-rigid cable (for 2.5G/10G optical input, 2 pcs/set): 1 set
J1002C	Semi-rigid cable (for 2.5G/10G electrical I/O, 3 pcs/set): 1 set
	Plug-in units
MP0121A	2/8/34/139/156M Unit
MP0122A	1.5/45/52M Unit
MP0122B[*1]	1.5/45/52/52M (1.31) Unit
	Options
MP1577A-01[*2]	RS-232C
MP1577A-02[*2]	GPIB
MP1577A-03[*2]	Ethernet
MP1577A-04[*2]	VGA output
MP1577A-06	MUX/DEMUX (2/8/34/139 Mb/s, for MP0121A)
MP1577A-07	MUX/DEMUX (1.5/45 Mb/s, for MP0122A/B)
MP1577A-09	Japan mapping (requires MP0122A or MP0122B)
MP1577A-20[*3]	10G (1.55 µm)/2.5G (1.31/1.55 µm) Transmission
MP1577A-21[*3]	10G (1.31 µm)/2.5G (1.31 µm) Transmission
MP1577A-22[*3]	2M - 622M Transmission with Jitter and Wander (included MP0121A)
MP1577A-23[*3]	1.5M - 622M Transmission with Jitter and Wander (included MP0122A)
MP1577A-24[*3]	1.5M/2M - 622M Transmission with Jitter and Wander (included MP0121A and MP0122A)
MP1577A-25[*3]	2M - 622M Transmission (included MP0121A)
MP1577A-26[*3]	1.5M - 622M Transmission (included MP0122A)
MP1577A-27[*3]	1.5M/2M - 622M Transmission (included MP0121A and MP0122A)
MP1577A-37	FC connector (replaceable, with protective caps, 6 sets)
MP1577A-38	ST connector (replaceable, with protective caps, 6 sets)
MP1577A-39	DIN connector (replaceable, with protective caps, 6 sets)
MP1577A-40	SC connector (replaceable, with protective caps, 6 sets)
MP1577A-43	HMS-10/A connector (replaceable, with protective caps, 6 sets)
MP1577A-90	Extended three year warranty service
MP0121A-90	Extended three year warranty service
MP0122A-90	Extended three year warranty service
MP0122B-90	Extended three year warranty service
MP0122B-37	FC connector (replaceable, with protective caps, 2 sets)
MP0122B-38	ST connector (replaceable, with protective caps, 2 sets)
MP0122B-39	DIN connector (replaceable, with protective caps, 2 sets)
MP0122B-40	SC connector (replaceable, with protective caps, 2 sets)
MP0122B-43	HMS-10/A connector (replaceable, with protective caps, 2 sets)
	Application equipment
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0162A	Balanced cable (Siemens 3P/Siemens 3P), 1 m
J0162B	Balanced cable (Siemens 3P/Siemens 3P), 2 m
J0845A	Balanced cable (BANTAM 3P/ BANTAM 3P), 6 ft
J0775B	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620), 0.5 m (75 Ω)
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620), 2 m (75 Ω)
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W), 2 m (50 Ω)
J0635A	Optical fiber cable (SM, FC-SPC connector both ends), 1 m
J0635B	Optical fiber cable (SM, FC-SPC connector both ends), 2 m
J0635C	Optical fiber cable (SM, FC-SPC connector both ends), 3 m
J0747A	Fixed optical attenuator (5 dB)
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0008	GPIB cable, 2 m
B0448	Soft case
B0336C	Carrying case
B0454C	Blank panel (for slot 1)
MA1314A	I-214/3-pole CF adapter
MP35A	Matching Transformer (75 Ω: unbalance/120 Ω: balance)
J0698	High impedance pad (attenuator: 20 dB)
J0697	T-pad (BNC-TA619)

[*1] Specify one of FC, ST, DIN, SC or HMS-10/A. If the connector is not specified, an FC connector will be supplied as standard.

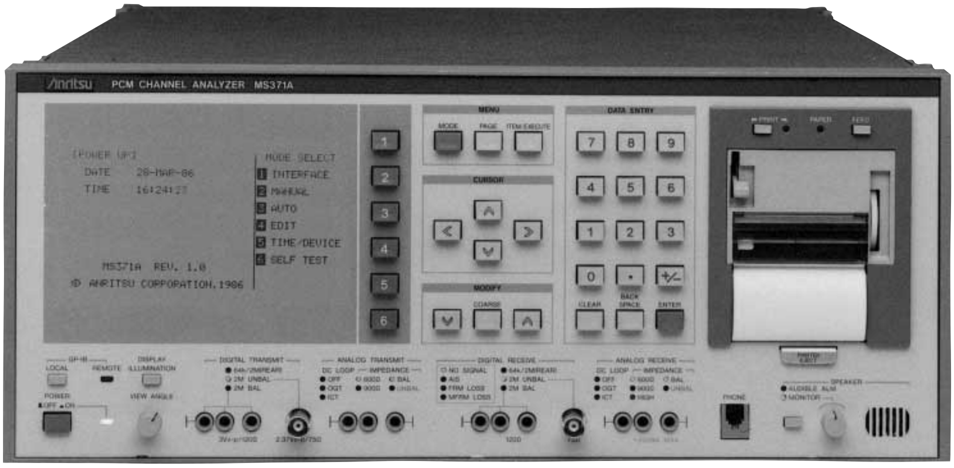
[*2] The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously. Only the video output + RS-232C, video output + GPIB or video output + Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

[*3] The Option 20, 21, 22, 23, 24, 25, 26 and Option 27 can not be installed simultaneously.

PCM CHANNEL ANALYZER
MS371A/A1

GPIB
(MS371A1)

For Simultaneous Measurement of 30 Channels with MS120A



The MS371A/A1 is an overall measuring instrument with many measuring functions for digital primary hierarchy transmission. It can be used to measure (1) voice encode/decode performance characteristics, (2) frame alignment/alarm test, (3) bit, code, and frame errors, (4) timing jitter, and (5) signalling, etc.

The primary hierarchy (PCM) digital transmission system has been commonly used as the foundation for ISDNs. Therefore, there are many existing equipment and transmission channels to be maintained. The necessary measurements are diverse and much time and labor is needed to evaluate them when commissioning and maintaining transmission circuits and equipment. The increasing number of PCM systems has made improved measurement evaluation efficiency a necessity.

The Anritsu MS371A/A1 has most of the functions required to measure PCM systems. It is an all-purpose measuring instrument designed to improve measurement efficiency. Measurements of PCM voice encode/decode performance require much time and labor. The MS371A/A1 stores the measurement sequence and parameters in its internal memory and makes automatic measurements to markedly improve efficiency. It has a GPIB control function, which with the MS120A Channel Selector permits measurement of 30 channels in one sequence. It also compares the measured results to a reference value, judges them, and displays GOOD or NO GOOD automatically. The measured results can then be printed out on the built-in printer. Another special feature is that the report of the measured results can also be printed out an external printer.

In conventional measuring systems, the results are edited by a personal computer or some other external device. However, the MS371A/A1 performs this function internally and prints out to the external printer. This unique function can instantaneously prepare test performance sheets during installation and report the results of periodic maintenance without the need for manual or computer evaluation.

Features

- **Automatic measurement of A-A, A-D, D-A and D-D (A: analog, D: digital)**

This analyzer automatically measures most of the items stipulated in ITU-T Rec. G.712/713/714. The test sequence and parameters are stored internally, and new test sequences or parameters can be entered by the operator. Also, measurement can be done manually or via GPIB.

- **Frame alignment/alarm test**

Frame alignment and alarm tests stipulated in ITU-T Rec. G.704/O.162 can be made.

- **Error measurement**

Error rate, error count, error second, and % error-free second can be measured by detecting the bit, frame, and code errors.

- **Timing jitter measurement**

Jitter modulation is available. Also jitter amplitude and jitter immunity can be measured.

- **Signalling measurement**

Manipulation/monitoring of the signalling bit and E&M signalling distortion can be measured.

- **GPIB controller**

A GPIB controller function has been incorporated. One to thirty channels can be tested automatically and continuously through the channel selector.

- **Built-in printer**

Results are printed out by the built-in printer. In automatic measurement, all results can be printed out or the printout can be limited to results failing the evaluation.

- **External printer**

Results from channels 1 to 30 can be edited according to measuring item and printed out. A report, such as a test performance sheet, can be prepared immediately after the completion of measurements.

For product ordering information, see pages 3 – 6

Functions

• Automatic measurement mode

In the automatic measuring mode, voice encode and decode performance characteristics can be measured. Encode and decode performance characteristics in the voice frequency are recommended in ITU-T Rec. G712/713/714/792 Q.507. Many items are required for voice frequency evaluation, and many points must be measured for each item.

In attenuation/frequency distortion, some compensation of the measurement value is required for each measurement frequency because of the absolute level difference caused in the reference frequency. Manual correction requires much time and effort to obtain the correct result.

The MS371A/A1 stores the reference frequency, the level difference in the frequency, the subsequent frequency for measurement, and the procedure for compensation operations at each frequency. As a result, the corrected result is reached automatically. Then the measured result is compared to a reference value in the memory to evaluate whether or not it passes or fails; evaluation is automatic.

If it fails, the item, condition, and results can be printed out (fail-only printout or complete printout of results can be selected). In automatic measurement, the MS371A/A1 can measure the 15 items shows in the table below, including attenuation/frequency distortion. The measurement table summary indicates whether items can be measured or not by comparing the measurement configuration with measurement items. Functions that cannot be executed cannot be measured in principle.

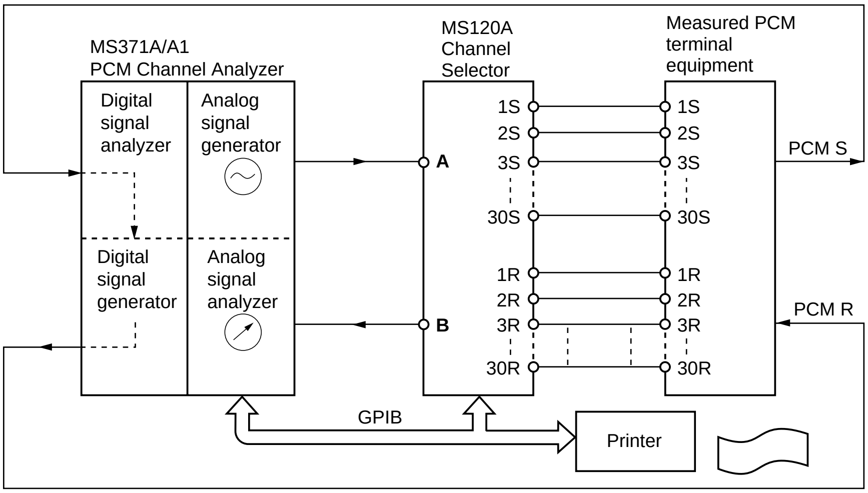
Summary of automatic measurement

Measurement item	Measurement configuration				
	A-A	A-D	D-A	D-D	A-D/D-A[*2]
Level setting	√	√	√	√	√
Attenuation frequency distortion	√	√	√	√	√
Variation of gain with input level (tone)	√	√	√	√	√
Variation of gain with input level (noise)	√	√	√	√	√
Total distortion including quantizing distortion (tone)	√	√	√	√	√
Total distortion including quantizing distortion (noise)	√	√	√	√	√
Idle channel noise	√	√	√	√	√
Far-end crosstalk		√[*1]	√[*1]		√[*1]
Near-end crosstalk	√[*1]			√	
Go-to-return crosstalk	√			√	
Return loss	√[*1]	√[*1]	√[*1]		√[*1]
Spurious out-of-band signal	√		√		√
Discrimination against out-of-band input signal	√	√			√
Longitudinal balance	√	√	√		√
E&M signalling distortion	√	√	√	√	√

∗1: Only when used with channel selector
∗2: Measures D/A immediately after measuring A/D

As an application example, the measurement of PCM terminal voice encode and decode performance characteristics is shown below. This measuring method is used when installing PCM terminal equipment. Measurement items shown in the table of measurement summary are executed in the measuring sequence programmed into the MS371A/A1. (The operator can set individual items to be executed or omitted.) After measurement in channel 1, the MS371A/A1 controls the MS120A Channel Selector via the GPIB, connects the measuring terminal of the MS371A/A1 to channel 2 of the PCM terminal equipment, and remeasures.

Measurement of one system portion of the terminal equipment is finished from channel 1 to 30 automatically in the same way. Upon completion of measurement, the measured results of channel 1 to 30 are edited according to each measurement item and output to the external printer. As mentioned above, voice channel measurement is fully automated, with no chance for miss operation.



The MS371A/A1 controls the MS120A Channel Selector via GPIB. Port A scans from 1R to 30R and port B scans from 1S to 30S. This permits automatic testing of 30 PCM channels (1 system).

Four-wire VF interface PCM terminal equipment automatic testing

• Manual measurement mode

Table 1 summarizes the manual measurements. Manual measurements can be classified broadly as follows: voice channel, word test, alarm simulation, error measurement, signalling measurement, jitter measurement, and order wire.

Voice channel measurement

Manual measurement is used when varying the parameters more finely than in automatic measurement or when no measurement can be made in automatic measuring sequences, as in end-to-end measurement. Manual measurement is also suited to observing changes in results over time.

Word test

Voice channel, frame, non-frame, and multiframe words can be manipulated or monitored. Thus, spare bits included in the multiframe and non-frame can be functionally tested and defined and by the circuit user. The drop insert function of the voice channel can also be tested.

Alarm simulation

Frame, multiframe, or signal loss pseudo-errors can be inserted into the signal by the MS371A/A1 to test the alarm response of the equipment.

Error measurement

Per-channel (64 kbit/s) bit errors can be measured. Bit, line code, and frame word errors at 2 Mbit/s can also be measured. The error rate, error second, and % error-free second of these errors can then be automatically calculated.

Jitter measurement

In the digital signal generator, jitter can be generated at 2 Mbit/s interface and the digital signal analyzer can measure the jitter in a received signal. Combined use of jitter generation and error measuring functions enables measurement of jitter immunity.

Order wire

The front panel of the MS371A/A1 has a phone jack. Connection of a handset permits use of the circuit to be measured as an order wire.

Table 1 Manual measurement summary

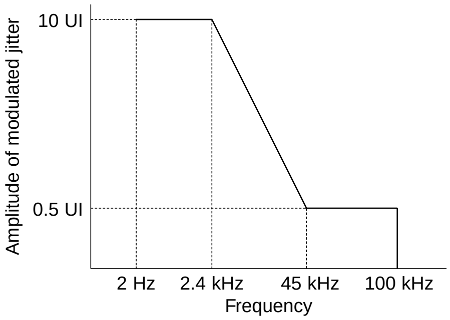
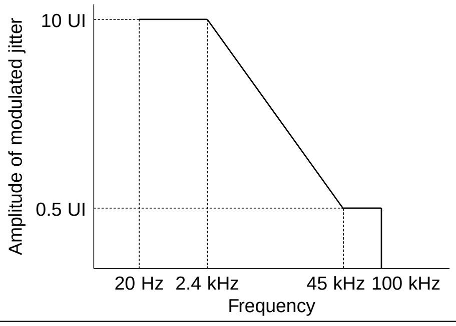
Measurement item		Measurement configuration			
		A-A	A-D	D-A	D-D
Level measurement	Tone (FLM)	√	√	√	√
	Tone (SLM)	√	√	√	√
	Noise	√	√	√	√
Gain measurement	Tone (FLM)	√	√	√	√
	Tone (SLM)	√	√	√	√
	Digital mW (FLM)			√	√
	Digital mW (SLM)			√	√
	Noise	√	√	√	√
Total distortion including quantizing distortion	Tone	√	√	√	√
	Noise	√	√	√	√
Idle channel noise		√	√	√	√
Return loss		√			
Spurious out-of-band signal		√		√	
Coder offset	Tone		√		√
	Noise		√		√
Peak code detection	Tone		√		√
	Noise		√		√
Longitudinal balance		√	√	√	
Word test	Voice channel				√
	Frame				√*1
	Non frame				√*1
	Multiframe				√*2
Alarm simulation	AIS				√*1
	Signal loss				√*1
	Frame error				√*1
	Multiframe error				√*1
	Remote end frame error				√*1
	Remote end multiframe alarm				√*2
Error measurement	Error rate				√
	Number of errors				√
	Error seconds				√
	% error free seconds				√
Signalling measurement	E&M signalling distortion	√	√*3	√*4	√*2
	Bit test				√*2
Jitter measurement	Jitter immunity				√*5
	Jitter				√*6
Order-wire circuit		√	√	√	√

*1: When both digital interfaces of the transmitter/receiver are 2 M balanced or unbalanced
*2: When both digital interfaces of the transmitter/receiver are 2 M balanced or unbalanced 30 channels, CAS
*3: When the digital interfaces of the receiver is 2 M balanced or unbalanced 30 channels, CAS
*4: When the digital interfaces of the transmitter is 2 M balanced or unbalanced 30 channels, CAS
*5: When the digital interface of the transmitter is 2 M balanced or unbalanced
*6: When the digital interface of the receiver is 2 M balanced or unbalanced

Specifications

Analog signal generator	Sine wave signal output	Frequency range: 200 Hz to 10 kHz Frequency resolution: 10 Hz Frequency accuracy: ±0.1% ±0.1 Hz Spurious including harmonics: >70 dB down (400 to 3500 Hz, +5 dBm), >60 dB down (200 to 400 Hz, +5 dBm), >50 dB down (3500 to 10000 Hz, +5 dBm) Level range: –80 to 13.1 dBm Level resolution: 0.1 dB
	Noise signal output Conforms to ITU-T Rec. O.131	Spectral span: 3.9 Hz Bandwidth: 200 Hz (350 to 550 Hz) Repetition rate: 256 ms Level range: –85 to 0 dBm Level resolution: 0.1 dB
	Output interface	Connector: 3-pole CF Impedance: 600, 900 Ω balanced Relative level: –20 to 10 dBr, 0.1 dB steps Max. DC isolation: ±60 V DC loop: ICT, OGT selectable Current direction: Normal, reverse selectable (ICT only)
Activating signal generator		Spectral span: 7.81 Hz Bandwidth: 200 Hz Output level: –55 dB0 nominal Output interface: Same as analog signal generator
Analog receiver	Filters	In-band pre-filter: 200 to 6000 Hz Out-of-band pre-filter: 4.2 to 72 kHz Psophometric filter: Conforms to ITU-T Rec. O.41 3 kHz flat filter: 300 to 3400 Hz Band pass filters: 200, 300, 420, 500, 600, 820, 1020, 2400 2800, 3000, 3400, 3600 Hz selectable Notch filters: 820, 1020 Hz selectable Filter for S/N meter: Conforms to ITU-T Rec. O.131
	Input interface	Connector: 3-pole CF Impedance: 600, 900 Ω, high (> 20 kΩ), balanced, unbalanced selectable Relative level: –20 to +10 dBr, 0.1 dB steps Max, DC isolation: ±60 V DC loop: ICT, OGT selectable Current direction: Normal, reverse, selectable (ICT only)
Digital signal generator	Sine wave signal output	Frequency range: 200 to 3990 Hz Frequency resolution: 10 Hz Frequency accuracy: ±0.1%, ±0.1 Hz Level range: –60 to 3.1 dBm0 Level resolution: 0.1 dB
	Noise signal output Conform to ITU-T Rec. O.131	Spectral span: 3.9 Hz Bandwidth: 200 Hz (350 to 550 Hz) Repetition rate: 256 ms Level range: –65 to 0 dBm0 Level resolution: 0.1 dB
	Digital mW signal	Conforms to ITU-T Rec. G.711
	Alarm simulation signal	PCM alarm signals: AIS, signal loss selectable Frame error signals: 1 in 2, 2 in 4, 3 in 4, 1.5 x 10^{-3}, 1.5 x 10^{-4}, 1.5 x 10^{-5}, 1.5 x 10^{-6} selectable Multiframe error signal: 1 in 2, 2 in 2 Remote end frame alarm: Alarm bit "0" or "1" settable Remote end multiframe alarm: Alarm bit "0" or "1" settable
	Word pattern manipulation	Telephone channel time slot: 00000000 to 11111111 settable Frame word: 00000000 to 11111111 settable Non-frame word: 00000000 to 11111111 settable Multiframe word: 00000000 to 11111111 settable
	Error measurement signal	Pseudo-random binary sequence for 64 kbit/s: 2^{11}–1 (ITU-T Rec. O.152) Pseudo-random binary sequence for 2.048 Mbit/s: 2^{15}–1 (ITU-T Rec. O.151)
	Signalling bit test signal	Possible to set logic "0" or "1" to selected signalling channel in any bit: a, b, c
	Signalling distortion measurement signal (possible to inject measurement signal to selected signalling channel in any bit: a, b, c, d)	Pulse speed: 10, 20 pps selectable Marker ratio: 10 to 90%, 1 % steps
	PCM output interface Conforms to ITU-T Rec. G.703, G.704 (2.048 MHz, however, CRC code is not inserted)	Output impedance: 120 Ω balanced, 75 Ω unbalanced selectable Telephone channel number: 30, 31 channels selectable Signalling: Channel associated signalling, common channel signalling selectable Coding: HDB3, AMI selectable Synchronization: Internal, external 8 kHz frame signal (TTL), external 2.048 MHz clock signal (TTL) or from digital signal receiver selectable Connector: 3-pole CF (120 Ω bal.), BNC (75 Ω unbal.)
	TTL output interface	Telephone channel number: 32 channels at 2.038 Mbit/s, signal channel at 64 kHz Synchronization: Internal, external 8 kHz frame signal (TTL), external 64 kHz (64 kbit/s interface), external 2.048 MHz (2.048 Mbit/s interface) or frame signal from digital signal receiver Connector: D-sub 25 pole (rear panel)

Continued on next page

Digital receiver	Filters	Psophometric filter: Conforms to ITU-T Rec. O.41 3 kHz flat filter: 300 Hz to 3.4 kHz Band pass filter: 200, 300, 420, 500, 600, 820, 1020, 2400, 2800, 3000, 3400, 3600 Hz selectable Notch filter: 820, 1020 Hz selectable Filter for S/N meter: Conforms to ITU-T Rec. O.131
	Alarm display	Signal loss, AIS, frame loss, multiframe loss is indicated with the red LED display.
	Coder offset detection	Measurement range: –128 to +128
	Peak code detection	Measurement range: –128 to +128
	Remote end alarm detection	Remote end frame alarm, remote end multiframe alarm
	World pattern monitor	Telephone channel, frame word, non-frame word, multiframe word
	Error detection	Detectable error: Code, frame, word, bit Measurement item: Error ratio, errored second, % error-free second, error count Acceptable bit error measurement pattern (64 kbit/s): $2^{11}–1$ (ITU-T Rec. O.152) Acceptable bit error measurement pattern (2.048 Mbit/s): $2^{15}–1$ (ITU-T Rec. O.151) Time base: 1 to 9999 s
	Signalling bit monitor	Possible to display on selected signalling channel in a, b, c, d bit
	Signalling distortion meter (possible to measure selected signalling channel in any bit: a, b, c, d)	Acceptable pulse speed: 10, 20 pps Mark ratio range: 0 to 100%
	PCN input interface Conforms to ITU-T Rec. G.703, G.704 (2.048 MHz)	Input impedance: 120 Ω balanced, 75 Ω unbalanced selectable Number of telephone channels: 30, 31 channels selectable Signalling: Channel associated signalling, common channel signalling selectable Coding: HDB3, AMI selectable Synchronization: Regenerated frame and multiframe from incoming PCM signals Connector: 3-pole CF (120 Ω bal.), BNC (75 Ω, unbal.)
	TTL input interface	Number of telephone channels: 32 channels at 2.048 Mbit/s, single channel at 64 bit/s Synchronization: External 8 kHz frame signal Connector: D-sub 25-pole (rear panel)
Jitter detection (PCM interface only)		Frequency mode: Conforms to ITU-T Rec. O.171 Amplitude of modulated jitter:  Range: 1 UI, 10 UI selectable Amplitude and frequencies: Conforms to ITU-T Rec. O.171 Amplitude of measured jitter: 
E&M test signal generator	Measurement parameters	Pulse speed: 10, 20 pps selectable Mark ratio: 10 to 90%, 1% steps
	Interface	DC sink current: 100 mA maximum (make) Output impedance: >22 kΩ (brake) Switch voltage: 53 V maximum Connector: 3-pole CF (rear panel)
E&M signalling receiver	Measuring range	Pulse speed: 10 to 20 pps Mark ratio: 0 to 100%
	Interface	Input impedance: 3.3 kΩ internally pulldown to –48 V Connector: 3-pole CF (rear panel)

Continued on next page

Others	Order wire	Voice signal output: Analog signal generator or selected digital signal generator output port Voice signal input: Analog signal receiver or selected digital signal receiver input port Headset connector: 4-pole modular telephone jack
	Loudspeaker (for audible alarm and received voice monitor)	Monitor: Selected telephone channel in digital signal or analog input signal Monitor level: Adjustable with knob on front panel
	Display	128 x 256 dots LCD with back light
	Built-in printer	Printing method: Thermal Printing letter: 20 characters/line
	Real time clock	YY, MM, HH, mm, ss (Y: year, M: month, D: date, H: hour, m: minute, s: second)
	GPIB (conforms to IEEE Std. 488-1978)	Implementation: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C27
General	Power	AC: 100 V $^{+10}_{-15}$%, 50/60 Hz, approx. 130 VA
	Dimensions and mass	425 (W) x 177 (H) x 451 (D) mm, ≤25 kg
	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

The MS371A1 is the same as the MS371A but also has 64 kb/s co-contradirectional interface.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS371A	PCM Channel Analyzer	
MS371A1	PCM Channel Analyzer	
	Standard accessories	
J0162B	Balanced cable (both ends with Siemens 3P-type plug):	4 pcs
J0081	BNC cable (both ends with BNC-type plug):	2 pcs
J0586	TTL interface connector:	1 pc
	AC power cord, 2.5 m:	1 pc
J0443	DC power plug:	1 pc
F0011	Fuse, 2 A:	1 pc
F0012	Fuse, 3.15 A:	2 pcs
F0040	Fuse, 0.315 A:	1 pc
F0043	Fuse, 1 A:	3 pcs
F0044	Fuse, 1.6 A:	1 pc
F0046	Fuse, 3.15 A:	2 pcs
Z0031A	Thermal paper for printer:	2 rolls/set
W0161AE	MS371A/A1 operation manual:	1 copy
	Optional accessories	
MS120A[*1]	Channel Selector	
J0162A	Balanced cable, 1 m	
J0081	BNC cable (both ends with BNC-type plug, 3C-2V), 2 m	
A0006	Headset	
MB23A	Portable Test Rack	
MB24A	Portable Test Rack	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
B0169A	Transport quilting	
B0239A	Protective carrying case (for MS371A)	
B0239B	Protective carrying case (for MS371A1)	
B0043	Rack mount kit 4U (2 pcs/set)	
B0020	Protective cover (2 pcs are needed.)	

[*1] Do not meet the EMC and low voltage directives of European Union.

PCM CODEC ANALYZER
MS369B

For Measuring CODECs

GPIB

The MS369B uses new technology to measure the characteristics of PCM CODECs (Coder, Decoder). Single-channel CODECs (SCC) are already being produced by many semiconductor makers for PCM terminal equipment, digital exchanges, PBX, digital telephones, and so on. The number of SCCs in use is increasing gradually. In addition, former common-channel CODECs used time sharing among a number of channels. Measuring the characteristics of one single channel make it possible to dispense with measurement of the other common channels. For equipment using SCCs, however, the encoding and decoding characteristics for each channel must be measured. As a result, more channels must be measured which will lead to demands for improved measuring performance.

The MS369B uses DSP (Digital Signal Processing) technology to reduce measuring time and to improve measuring accuracy. It also incorporates a high-performance, special-purpose LSI developed by Anritsu. The MS369B reduces measuring time and automates measurement using GPIB, and increases production and maintenance efficiency.

Features

- Both A-law and µ-law measurement
- A-A, D-A, A-D, and D-D measurement

For product ordering information, see pages 3 – 6

IP/NETWORK MEASURING INSTRUMENTS

Selection guide

- **Bit rate/Interface**

Model Bit rate/Interface	MP1220A	MP1570A/A1	MP1580A	MP1590A	MD1231A	MD1230A	MT7407A	MD6420A	MD6430A
50 bit/s to 200 kbit/s: V.24/V.28 (RS-232C)								√	√
50 bit/s to 10 Mbit/s: V.35								√	√
50 bit/s to 10 Mbit/s: V.36 (RS-449)								√	√
50 bit/s to 10 Mbit/s: X.20 (RS-423)/X.21 (RS-422)								√	√
50 bit/s to 10 Mbit/s: TTL								√	√
64 kbit/s								√	√
192 kbit/s: ISDN								√	√
1.544 Mbit/s: DS1	√	√		√				√	√
2.048 Mbit/s: E1	√	√		√					√
6.312 Mbit/s: DS2	√							√	√
8.448 Mbit/s: E2		√		√					
32.00 Mbit/s: ATM25M	√								
34.368 Mbit/s: E3	√	√		√					
44.736 Mbit/s: DS3	√	√		√					
139.264 Mbit/s: E4	√	√		√					
51.84 Mbit/s: STM-0/OC-1	√	√		√					
155.52 Mbit/s: STM-1/OC-3	√	√		√	√	√	√		
622.08 Mbit/s: STM-4/OC-12	√	√		√	√	√	√		
2488.32 Mbit/s: STM-16/OC-48		√	√	√		√	√		
9953.28 Mbit/s: STM-64/OC-192		√	√	√		√	√		
2666.057 Mbit/s: OTU-1				√					
10709.225 Mbit/s: OTU-2				√					
10M/100M Ethernet					√	√	√		
Gigabit Ethernet					√	√	√		
10 Gigabit Ethernet						√	√		

- **Measurement functions**

Model Measurement functions		MP1220A	MP1570A/A1	MP1580A	MP1590A	MD1231A	MD1230A	MT7407A	MD6420A	MD6430A
ISDN, PDH/DSn	Analog measurements								√	
	Digital level measurements A-law, μ-law									√
	Frequency measurements		√		√				√	√
	Pattern trace								√	√
	Error measurement (G.821, etc.)	√	√		√	√	√	√	√	√
	ISDN origination/termination								√	√
	Frame relay									√
OTN/ SDH/ SONET/ EOS	OTN frame				√					
	SDH/SONET frame	√	√		√	√	√	√		
	GFP frame						√	√		
	O.191 test cells	√	√							
	1 point CDV, 2 point CDV	√	√							
	ATM cell capture	√	√							
	CID pattern G.958		√							
	Tandem connection pattern G.707		√		√					
	Automatic Protection Switch		√		√	√	√	√		
	Frame memory/Capture		√							
	PDH/DSn mapping		√		√					
	POS		√			√	√	√		
	Through mode		√		√	√	√	√		
	Optical power measurements		√		√	√	√	√		
	Jitter/wander measurements		√	√	√					
	Frequency offset		√		√	√	√	√		
Ethernet	Packet capture					√	√	√		
	Protocol decoding					√	√	√		
	Protocol emulation					√	√	√		
	XENPAK measurements						√	√		
	RFC2544 Automatic test					√	√	√		
	RFC2889 Automatic test					√	√	√		
	Through mode					√	√	√		
	Traffic map					√	√	√		
	Traffic monitor					√	√	√		
	Full wire rate transmission					√	√	√		
	Packet BER measurement					√	√	√		
	Latency					√	√	√		
Remote Control		√	√	√	√	√	√	√	√	√

MD1230A FAMILY

MD1230A DATA QUALITY ANALYZER
MD1231A IP NETWORK ANALYZER
MT7407A MULTISLOT CHASSIS

GPIB

A Total Communications Test Solution from Devices to Networks

NEW

Real time network data, such as voice and video, is increasingly important as IP networks grow and become faster. The need for performance enhancements for core networks also increases with the growth in the scale of networks.

The development of network equipment and systems requires performance measurement as well as QoS evaluation.

The MD1230A Family achieves all this network monitoring and performance testing in one device with efficiency and cost savings.

The MD1230A Family comes in 3 chassis types matched to user needs. Measuring modules operate in all 3 chassis, so one or more chassis can be selected based on usage requirements without incurring extra module expense.

• Verifying network load provided

High-speed frame processing capabilities are required to test routers and switches. The MD1230A Family full wire rate transmission function permits the continuous sending of frames on multiple ports at a rate of 10 Gbps. Near-actual network conditions can also be recreated by combining transmitted packets with protocols such as IPv4, IPv6, TCP, and UDP.

In addition, adding sequence numbers to the frames to be sent can check for duplicate and out-of-sequence frame delivery. The MD1230A Family can test the performance of switch or Router using the variety of the transmitted data.

• Checking network traffic

The MD1230A Family can measure simultaneous real-time counts of transmitted bytes/frames, received bytes/frames, QoS frames in 8 priority levels, every error type, and SONET/SDH alarms among others. Specific frame traffic can also be measured for each port when the filter function is used.

For example, specific MPLS VoIP frame traffic (with a specified UDP port number) can be extracted from a VPN service.

• System QoS verification

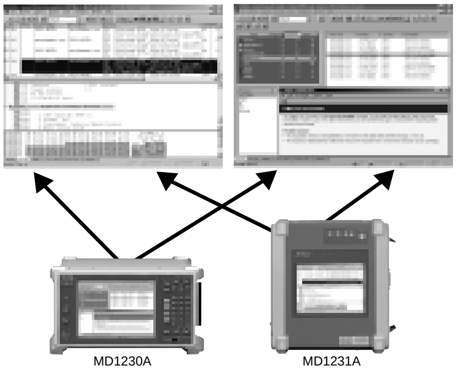
The MD1230A Family comes equipped with an 8-stage QoS counter. Priority controls can be checked through real-time counting of frames with the priority set in the VLAN tag or TOS fields. QoS of a total System can be verified with one test device because the transmission functions of the MD1230A Family create pseudo-application traffic.

• RFC2544 standard measurements

Even Multi-function network devices must be evaluated for their core performance. Core performance is checked by the automatic RFC2544 measurements of the MD1230A Family. After setting up test conditions in advance, five performance parameters, (throughput, latency, frame loss rate, back-to-back frames, and system recovery) can be measured automatically with a single start button. Measurement results are graphically displayed, making them useful in preparing reports. The auto measurement functions of the MD1230A Family enable effective manpower utilization.

• Global protocol analysis standard

Anritsu has licensed Sniffer® Technologies from Network Associates Inc. for use with MD1230A Family products. Employing the functionality of Sniffer® Technologies software with the 10 Gbps capture ability of MD1230A Family high-speed interfaces provides powerful support for construction, installation, and maintenance of modern networks.



Sniffer® Technologies software is employed.

Decode module (Option 04 Decode Module)

Network data where failures have occurred can be captured so that troubleshooting can be performed quickly using the protocol translation functions of the decode module. This supports, for example, CDP, DISL, DRiP, PAGP and Cisco CGMP as well as H.225, H.245, MGCP and SIP VoIP protocols. The decode module can also save and export .CAP file formats, enabling failure analysis using separate analysis applications that support the .CAP format.

Packet level failure analysis via expert analysis functions (MX123002A/MU740701A-30 Expert Analysis Module)
The expert analysis module can automatically find areas where failures or damage might occur in frames captured by the MD1230A Family, and display countermeasure advice for them. Analysis work that used to require enormous expenditures of time and labor can now be reduced as the possible problem areas are narrowed.

- **High resolution network analysis (Option 20 Application Traffic Monitor)**

Streaming video distribution systems frequently have problems due to the relationship between the burst nature of the picture encoder equipment and the performance of the network

equipment. Traditional traffic monitoring every second is not sufficient to identify most of these problems because of the very short bursts in the traffic and the behavior of network equipment. The MD1230A Family Application Traffic Monitor can discover these momentary traffic peaks that are equalized and ignored by traditional measurements. It can check whether traffic is over the performance limits of a network device such as a switch by measuring the bandwidth peaks in a traffic flow with 1 msec. resolution.

- **IPv6 protocol support function (Option 12 IPv6 Expansion)**

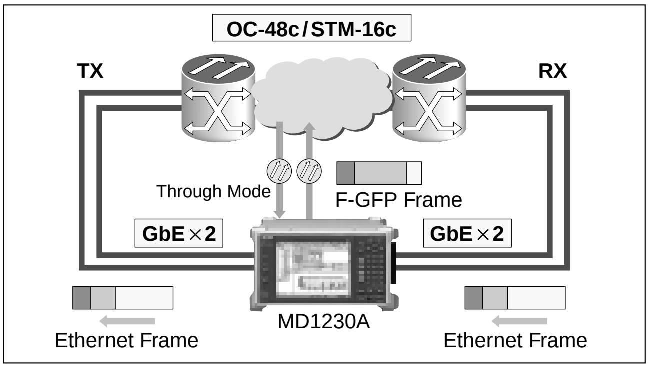
The MD1230A Family support NDP (Neighbor Discovery Protocol) in IPv6 network.
Then the MD1230A Family perform Address Autoconfiguration and Address Resolution using NDP to help your measurement in IPv6 network.

- **10 Gigabit Ethernet modules**

MD1230A Family 10 Gigabit Ethernet modules have 2 ports, enabling full bidirectional performance measurements using one module. Modules support various 10 Gigabit Ethernet standard by employing XENPAK transceivers.

- **EOS measurement application**

By using EOS measurements in combination with the Gigabit Ethernet module, performance of the Ethernet layer and the GFP layer can be measured simultaneously.



EOS measurement application example

- **Rich protocol emulation functions (Options 07, 08, 09, 14)**

To verify routers, an actual network environment must be built. However, it is difficult to prepare a large-scale network in terms of time and physical requirements. The MD1230A Family provides routing protocol emulation functions as tools for measuring existing network and core router performance. The protocol emulation function establishes a virtual network for a router under test. The emulation function supports stream transmit, frame count and frame capture on the virtual network.

- **Remote PC control (MX123001A)**

Up to eight remote PCs can control up to 8 linked MD1230A Family instruments over an Ethernet network using Windows compatible MX123001A Data Quality Analyzer Control Software (sold separately). Integrated management of devices is enabled when many MD1230A Family instruments are used in the manufacturing line (operates on Windows®98, Windows®2000 or Windows®XP).
[MT7407A can be connected up to 8 side (Side A and/or Side B)]

- **Software upgrade service**

The MD1230A Family permits service upgrades for compatible software. A CD-ROM containing the latest applications can be sent to the user when the MD1230A Family is upgraded if the software upgrade (maintenance) option is purchased. The user can then perform measurements using the latest applications.

Selection guide

• MD1230A Family module table

Model	Name	Power consumption*1	MD1230A	MD1231A	MT7407A
MU120101A	10M/100M Ethernet Module	4.5	√	√	√
MU120102A	Gigabit Ethernet Module	3.5	√	√	√
MU120103A	2.5G (1.31) Module	5.0	√		√
MU120103B	2.5G (1.31) Module	8.0	√		√
MU120104A	2.5G (1.55) Module	5.0	√		√
MU120104B	2.5G (1.55) Module	8.0	√		√
MU120105A	10G (1.31) Module	10.0	√		√
MU120106A	10G (1.55) Module	10.0	√		√
MU120111A	10/100M Ethernet Module	5.5	√	√	√
MU120112A	Gigabit Ethernet Module	5.5	√	√	√
MU120118A	10 Gigabit Ethernet Module	17.0	√		√
MU120119A	OC-3/12 STM-1/4 Module (1310 nm)	3.5	√	√	√
MU120120A	OC-3/STM-1 Module (1310 nm)	3.5	√	√	√
MU740701A*2, *3	IP Tester Control Module	2.0			√
MU740702A*2, *4	Power Unit for IP Tester	*1			√

*1: The maximum output current of each MU740702A is 65A. The requirements of total power consumption of module installed should not exceed 65A for each side.
*2: It is a module only for MT7407A. Up to two modules are inserted for one MT7407A.
*3: One MU740701A supports up to 7 slots.
*4: One MU740701A requires one MU740702A. When adding MU740702A, chassis hardware modification is required.

• MD1230A Family Option Table

Name	MD1230A	MD1231A	MU740701A	MX123001A
RS-232C control	MD1230A-01			MX123001A-07*1
GPIB Control	MD1230A-02	MD1231A-02		MX123001A-09*1
Ethernet Control	MD1230A-03	MD1231A-03		MX123001A-10*1
Decode Module	MD1230A-04	MD1231A-04	MU740701A-04*2, *4	MX123001A-01*2, *4
GPS Module	MD1230A-05	MD1231A-05	MU740701A-05*3	
Tcl Interface	MD1230A-06	MD1231A-06		MX123001A-06*1
OSPF Protocol	MD1230A-07	MD1231A-07	MU740701A-07	
MPLS (LDP/CR-LDP) Protocol	MD1230A-08	MD1231A-08	MU740701A-08	
MPLS (RSVP) Protocol	MD1230A-09	MD1231A-09	MU740701A-09	
RFC2889 Benchmarking Test	MD1230A-10	MD1231A-10	MU740701A-10	
Packet BER Test	MD1230A-11	MD1231A-11	MU740701A-11	
IPv6 Expansion	MD1230A-12	MD1231A-12	MU740701A-12	
XENPAK Test	MD1230A-13		MU740701A-13	
IGAP Protocol	MD1230A-14	MD1231A-14	MU740701A-14	
Auto Negotiation Analysis	MD1230A-15	MD1231A-15	MU740701A-15	
Link Fault Signaling	MD1230A-16		MU740701A-16	
Application Traffic Monitor	MD1230A-20	MD1231A-20		MX123001A-20
Expert Analysis Module	MX123002A	MX123002A	MU740701A-30*4	MX123003A*4

*1: PC on which MX123001A is installed can be operated by another PC.
*2: When using a decode module with MT7407A, MU740701A-04 and MX123001A-01 are required.
Each MU740701A module require one MU740701A-04 when using Decode module in both Side A and Side B.
*3: When using GPS module with MT7407A, it is required MT7407A-01. However two MU740701A-05 can be inserted to MT7407A, it is enough only one MU740701A-05 for one MT7407A.
*4:When using a Expert Analysis module with MT7407A, MX123001A-01, MX123003A, MU740701A-04 and MU740701A-30 are required. Each MU740701A module require one MU740701A-04 and one MU740701A-30 when using Expert Analysis module in both Side A and Side B.

- **MD1230A Family selection guide**

	Module / Function	10M/100MbE		GbE		10 GbE	POS			EOS
		MU120101A	MU120111A	MU120102A	MU120112A	MU120118A	MU120103A /120104A	MU120105A /120106A	MU120119A /120120A*1	MU120103B /120104B
	Bit Rate	10/125 Mbps		1.25 Gbps		Depends on XENPAK	2488.320 Mbps	9953.280 Mbps	155.52/622.08 Mbps	2488.320 Mbps
	Optical Input Level (dBm)			Depends on GBIC		Depends on XENPAK	–18 to 0/ –28 to –9	–12 to 0/ –14 to –3	–28 to –8	–18 to 0/ –28 to –9
	Optical Output Level (dBm)						–5 to 0/ –2 to +3	–4 to 0/ –1 to +2	–15 to –8	–5 to 0/ –2 to +3
Options (sold separately)	OSPF Protocol		√		√					
	MPLS (LDP/CR-LDP) Protocol		√		√					
	MPLS (RSVP) Protocol		√		√					
	RFC2889 Benchmarking Test		√	√	√					
	Packet BER Test		√	√	√	√	√	√	√	√
	IPv6 Expansion		√		√					
	XENPAK Test					√				
	IGAP Protocol		√		√					
	Auto Negotiation Analysis				√*2					
	Link Fault Signaling					√				
	Application Traffic Monitor				√					
	MU120119A/120120A Optical Power Meter								√	
	MU120103B/120104B EOS Mapping									√
	MU120103B/120104B Virtual Concatenation									√
Standard functions	1000BASE-T GBIC				√					
	RFC2544 Automatic Test	√	√	√	√	√	√	√	√	√
	BGP-4 Emulation Function	√	√	√	√	√	√	√	√	√
	BGP-4 Emulation Route Expansion		√		√					
	IGMP	√	√	√	√	√	√	√	√	√
	Through Mode Function	√	√	√	√	√	√	√	√	√
	Monitor Mode Function	√	√	√	√	√	√	√	√	√
	Address Swap Function		√		√					
	Unframe BER Measurement Function		√	√	√	*3	√	√	√	√
	TCP/UDP Port Number Increment		√	√	√	√	√	√	√	√
	CRC32						√	√	√	√
	CRC16									√

*1: For MU120120A, only 155.52 Mbps is supported.
*2: Supported optical interfaces are 1000BASE-SX/LX/LH/ZX.
*3: XENPAK Test Option supports Unframe BER Measurement Function.

Specifications

- **MD1230A Data Quality Analyzer**

LCD	8.4 Type, TFT
LED	Power fail, Errors, Alarms, Remote, Local, HDD, Power, FDD
User Interface	0 to 9, “.”, A to F, Cursor (↑, ↓, →, ←, →|F, R|←), Set, Cancel, View, Display 1 to 3, Hist., H.Reset, Print now, Local, Panel Lock, Power
External Interface Connector	RS-232C, GPIB, Ethernet (10BASE-T/100BASE-TX), USB port x 2, PS/2 keyboard connector, GPS antenna, Video output (VGA)
Trigger Input Connector	Usable as capture buffer trigger, Level: TTL (active high), Impedance: 75 Ω (BNC)
Trigger Output Connector	Usable as capture buffer trigger, Level: TTL (Active high), Impedance: 75 Ω (BNC)
Sync I/O	MD1230A/MD1231A/MT7407A time sync signal, Impedance: 75 Ω (BNC)
SONET/SDH Sync Clock Input	Frequency: 64 kHz + 8 kHz ±50 ppm, 2.048 MHz ±50 ppm, 1.544 MHz ±50 ppm, 2.048 Mbit/s ±50 ppm, 1.544 Mbit/s ±50 ppm Interface 2M: ITU-T G.703 Table 10, HDB3 1.5M: B8ZS, AMI ANSI T1.403 Level (64k): 0.63 to 1.1 Vo-p Code (64k): AMI 8 kHz with violation Connector BNC (75 Ω): 2 MHz, 2Mbit/s Siemens (120 Ω balanced): 2 MHz, 2 Mbit/s, 64 kHz + 8 kHz Bantam (100 Ω balanced): 1.5 MHz, 1.5 Mbit/s
OS	Windows®98 (Second Edition)
Built-in Memory	Measurement conditions: 10 sets, Measurement results: 10 sets, HDD
External Storage	3.5” FDD

Continued on next page

Power Supply	AC 85 to 132 V/170 to 250 V (auto switching) , 47.5 to 63 Hz, ≤530 VA
Operating Temperature	0° to +40 °C (except when HDD or FDD are active.)
Storage Temperature	–20° to +60 °C
Dimensions and Mass	320 (W) x 177 (H) x 350 (D) mm, ≤15 kg (excluding options and modules)
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Corresponding Options	MD1230A-01: RS-232C Control[*1], MD1230A-02: GPIB Control[*1], MD1230A-03: Ethernet Control[*1, *2, *3], MD1230A-04: MD1230A Decode Module[*4], MD1230A-05: GPS Module, MD1230A-06: Tcl Interface[*3], MD1230A-07: OSPF Protocol[*5], MD1230A-08: MPLS (LDP/CR-LDP) Protocol[*5], MD1230A-09: MPLS (RSVP) Protocol[*5], MD1230A-10: RFC2889 Benchmarking Test[*5], MD1230A-11: Packet BER Test[*5], MD1230A-12: IPv6 Expansion[*5], MD1230A-13: XENPAK Test[*6], MD1230A-14: IGAP Protocol[*5], MD1230A-15: Auto Negotiation Analysis[*7], MD1230A-16: Link Fault Signaling[*6], MD1230A-20: Application Traffic Monitor[*7, *8], MD1230A-40: Software Upgrade Service for MD1230A[*9]
Number of Slots	5
Corresponding Module	MU120101A: 10M/100M Ethernet Module, MU120102A: Gigabit Ethernet Module, MU120103A: 2.5G (1.31) Module, MU120103B: 2.5G (1.31) Module, MU120104A: 2.5G (1.55) Module, MU120104B: 2.5G (1.55) Module, MU120105A: 10G (1.31) Module, MU120106A: 10G (1.55) Module, MU120111A: 10/100M Ethernet Module, MU120112A: Gigabit Ethernet Module, MU120118A: 10 Gigabit Ethernet Module, MU120119A: OC-3/12 STM-1/4 Module (1310 nm), MU120120A: OC-3 STM-1 Module (1310 nm)

∗1: The MD1230A-01/02/03 options are required only for remote control using GPIB commands.
Note that these options may be installed together, although only one of them can be used at a time.

∗2: The MD1230A-03 option is required for remote control using GPIB remote commands via Ethernet interface. The MD1230A-03 option is not required for external PC control using MX123001A.

∗3: MD1230A-03 and MD1230A-06 may be implemented together, although only one of them can be used at a time.

∗4: Purchase MD1230A-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.

∗5: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide (pages 8, 9).

∗6: MD1230A-13 and MD1230A-16 support only MU120118A.

∗7: MD1230A-15 and MD1230A-20 support only MU120112A.

∗8: Purchase MD1230A-20 and the operation manuals (W2134AE) on CD-ROM. Printed versions sold separately.

∗9: MD1230A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase.

• MD1231A IP Network Analyzer

LCD	8.4 Type, TFT
LED	Remote, Local, HDD, Power
User Interface	Pointing device, Mouse SW, Local, Panel Lock, Power
External Interface Connector	GPIB, Ethernet (10BASE-T/100BASE-TX), USB port x 2, PS/2 keyboard connector, GPS antenna, Pointing device
Trigger Input Connector	Usable as capture buffer trigger, Level: TTL (Active HIGH), Impedance: 75 Ω (SMB)
Trigger Output Connector	Usable as capture buffer trigger, Level: TTL (Active HIGH), Impedance: 75 Ω (SMB)
Sync I/O	MD1230A/MD1231A/MT7407A time sync signal, Impedance: 75 Ω (SMB)
OS	Windows®98 (Second Edition)
Built-in Memory	Measurement conditions: 10 sets, Measurement results: 10 sets, HDD
Power Supply	AC 85 to 132 V/170 to 250 V (auto switching), 47.5 to 63 Hz, ≤150 VA
Operating Temperature	0° to +40 °C (except when HDD are active.)
Storage Temperature	–20° to +60 °C
Dimensions and Mass	320 (W) x 100 (H) x 300 (D) mm, ≤5 kg (excluding options and modules)
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Corresponding Options	MD1231A-02: GPIB Control[*1], MD1231A-03: Ethernet Control[*1, *2, *3], MD1231A-04: MD1231A Decode Module[*4], MD1231A-05: GPS Module, MD1231A-06: Tcl Interface[*3], MD1231A-07: OSPF Protocol[*5], MD1231A-08: MPLS (LDP/CR-LDP) Protocol[*5], MD1231A-09: MPLS (RSVP) Protocol[*5], MD1231A-10: RFC2889 Benchmarking Test[*5], MD1231A-11: Packet BER Test[*5], MD1231A-12: IPv6 Expansion[*5], MD1230A-14: IGAP Protocol[*5], MD1231A-15: Auto Negotiation Analysis[*6], MD1231A-20: Application Traffic Monitor[*6, *7], MD1231A-40: Annual Software Upgrade Service for MD1231A[*8]
Number of Slots	2
Corresponding Module	MU120101A: 10M/100M Ethernet Module, MU120102A: Gigabit Ethernet Module, MU120111A: 10/100M Ethernet Module, MU120112A: Gigabit Ethernet Module, MU120119A: OC-3/12 STM-1/4 Module (1310 nm), MU120120A: OC-3/STM-1 Module (1310 nm)

∗1: The MD1231A-02/03 options are required only for remote control using GPIB commands.
Note that these options may be installed together, although only one of them can be used at a time.

∗2: The MD1231A-03 option is required for remote control using GPIB remote commands via Ethernet interface. The MD1230A-03 option is not required for external PC control using MX123001A.

∗3: MD1231A-03 and MD1231A-06 may be implemented together, although only one of them can be used at a time.

∗4: Purchase MD1231A-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.

∗5: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide (pages 8, 9).

∗6: MD1231A-15 and MD1231A-20 support only MU120112A.

∗7: Purchase MD1231A-20 and the operation manuals (W2134AE) on CD-ROM. Printed versions sold separately.

∗8: MD1231A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase.

• MT7407A Multislot Chassis

LED	For Power Module
External Interface Connector	Ethernet (10BASE-T/100BASE-TX)
Trigger Input Connector	Usable as capture buffer trigger, Level: TTL (Active HIGH), Impedance: 75 Ω (BNC)
Trigger Output Connector	Usable as capture buffer trigger, Level: TTL (Active HIGH), Impedance: 75 Ω (BNC)
Power Supply[*1]	AC 85 to 132 V/170 to 250 V (auto switching), 47.5 to 63 Hz, ≤1100 VA[*2]
Operating Temperature	0° to +40 °C
Storage Temperature	–20° to +60 °C
Dimensions and Mass	426 (W) x 355 (H) x 501 (D) mm, ≤20 kg (excluding options and modules)
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category Ⅱ, Pollution degree 2)
Corresponding Options	MT7407A-01: Interface Board for IP Tester, MT7407A-40: Annual Software Upgrade Service for MT7407A[*3]
Number of Slots	14 (except slot for control module)
Exclusive Module	MU740701A: IP Tester Control Module, MU740702A: Power Unit for IP Tester
Corresponding Module	MU120101A: 10M/100M Ethernet Module, MU120102A: Gigabit Ethernet Module, MU120103A: 2.5G (1.31) Module, MU120103B: 2.5G (1.31) Module, MU120104A: 2.5G (1.55) Module, MU120104B: 2.5G (1.55) Module, MU120105A: 10G (1.31) Module, MU120106A: 10G (1.55) Module, MU120111A: 10/100M Ethernet Module, MU120112A: Gigabit Ethernet Module, MU120118A: 10 Gigabit Ethernet Module, MU120119A: OC-3/12 STM-1/4 Module (1310 nm), MU120120A: OC-3/STM-1 Module (1310 nm)

∗1: Power supply is MU740702A
∗2: MT7407A include two MU740702A.
∗3: MT7407A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase. One license supports two MU740701A.

• Standard Ethernet Module

Model		MU120101A	MU120102A	MU120118A
Ports		10BASE-T/100BASE-TX Number of ports: 8 Connector: RJ-45 Link speed: 10 Mbit/s, 100 Mbit/s Duplex mode: Full, Half Auto negotiation: On/Off Flow control: On/Off	1000BASE-SX/LX/LH/ZX[*1] Number of ports: 2 Connector: GBIC interface (SC connector) Link speed: 1 Gbit/s Duplex mode: Full Auto negotiation: On/Off Flow control: On/Off	10GBASE-LR[*2] Number of ports: 2 Connector: XENPAK interface (SC connector) Link speed: 10 Gbit/s Duplex mode: Full Flow control: On/Off
LEDs		Link, Tx/Collision, Rx/Error	Link, Tx, Rx, Error	
Frame Settings		MAC address: Fixed, Increment, Decrement, Random (changeable portions specified in 4 bits units) VLAN tag[*3]: Fixed, Increment, Decrement, Random MPLS label[*3]: Up to 10 MPLS labels can be appended. Fixed setting Protocol editing: IPv4, IPv6, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPX, ARP, MAC control, IS-IS Data field Can set any 4 portions of data field: All 1, All 0, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9 Data field 1 only: Time stamp, Sequence number, User defined, Test frame		
Frame Length		12 to 10000 byte (Settable as auto, Fixed, Increment[*4], or Random[*4])	48 to 65280 byte (Settable as auto, Fixed, Increment[*4], or Random[*4])	
Stream Transport Mode		Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count (Loop count: 1 to 16,000,000, Frame count per burst: 1 to 16,777,215, Burst count per stream: 1 to 16,777,215)		
Stream Gap Setting	Inter Frame Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed, Random 100BASE-TX: Resolution of 80 ns 800 ns to 170 s, Settable as fixed, Random	Resolution of 8 ns 64 ns to 120 s, Settable as fixed, Random	Resolution of 0.8 ns 7.2 ns to 120 s, Settable as fixed, Random
	Inter Burst Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed 100BASE-TX: Resolution of 80 ns 800 ns to 170 s, Settable as fixed	Resolution of 8 ns 64 ns to 120 s, Settable as fixed	Resolution of 0.8 ns 7.2 ns to 120 s, Settable as fixed
	Inter Stream Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed 100BASE-TX: Resolution 80 ns 800 ns to 170 s, Settable as fixed	Resolution of 8 ns 64 ns to 120 s, Settable as fixed	Resolution of 0.8 ns 64 ns to 120 s, Settable as fixed
Number of Streams		256 Streams/Port		
Error Insertion	Frame Error	FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error, Alignment error, Dribble bit error, Collision	FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error	
	Packet Error	IPv4 header checksum error, TCP/UDP checksum error		
	Packet BER Test (Option 11)[*5]	—	PRBS bit error	

Continued on next page

Model		MU120101A	MU120102A	MU120118A
Counter	Common	Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate		
	Ethernet	Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Dribble bit error, Line error, Fragment, Undersize, Oversize, Oversize & FCS error, FCS error, Alignment error, Collision	Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Line error, Fragment, Undersize, Oversize, Oversize & FCS error, FCS error, Byte alignment error	Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Fragment, Undersize, Oversize, Oversize & FCS error, FCS error
	IP/TCP/UDP	Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, IPv4 header checksum error, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, Fragments, Received TCP packet count/rate, TCP checksum error, Received UDP packet count/rate, UDP checksum error, QoS 0 to 7 frame count/rate		
	Unframe	—	Bit error count/rate, Pattern Sync Loss count/second	Option 13*6
	Packet BER Test (Option 11)*5	—	Transmitted test frame, Received test frame, Sequence error, Received PRBS bit error count/rate, Received PRBS error frame count/rate	
	XENPAK Test (Option 13)*6	—		Bit error count/rate, Pattern sync loss count/rate, Bit error count lane 0 to 3, Bit error rate lane 0 to 3, Pattern sync loss lane 0 to 3, Pattern sync loss second lane 0 to 3
	Link Fault Signaling (Option 16)*7	—		Transmitted LFS, Received LFS
Latency		Maximum, Minimum, Average		
Frame Arrival Time Variation Measurement		Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s		
QoS Counter Setting		Using Qos described below, 8-level priority frame count: IEEE802.1D VLAN tag user priority field, 3 LSB of RFC2474 DSCP field		
Unframe BER Setting*6		—	Test pattern: All 0, All 1, User-defined 16-bit pattern, PRBS23, PRBS31, CJPAT, CRPAT Error insertion: Bit error Error insertion timing: Single error, Single rate (1E-3, 4, 5, 6, 7, 8, 9), Programmable rate (9.9 E-3 to 1.0 E-10)	
Capture Buffer		8 Mbyte/port	32 Mbyte/port	256 Mbyte/port
Capture Filter		At following conditions for each port, capture filter condition settings: Destination MAC address, Source MAC address, 32-bit pattern (settable bit length and offset) x 2, Error conditions		
Capture Trigger		At following conditions for each port, capture trigger condition settings: Destination MAC address, Source MAC address, 32-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input		
Protocol Decode		ARP, BGP-4, DHCP, DVMRP, Ethernet, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LCP, LDP, MAC Control Frame, MPLS, MPLSCP, OSPFv2, RIP, RSVP, SNAP, TCP, UDP, VLAN, MD1230A Test Frame		
Protocol Emulation		ARP, PING, IGMP, BGP-4		
Traffic Monitor		Ethernet frame count for up to 64 flows, IP packet count for up to 64 flows, Frame count for up to 64 protocols		
Traffic Map		Ethernet data flow for up to 256 flows, IP data flow for up to 256 flows		
Service Disruption Time		Time of frame disruption		
RFC2544 Automatic Test		Throughput, Latency, Frame Loss Rate, Back to Back Frame, System Recovery, Reset		
RFC2889 Automatic Test (Option 10)*5		—	[1] Fully Meshed Throughput, Frame Loss and Forwarding Rates, [2] Partially Meshed one-to-Many/Many-to-One, [3] Partially Meshed Multiple Devices, [4] Partially Meshed Unidirectional Traffic, [5] Congestion Control, [6] Forward Pressure and Maximum Forwarding Rate, [7] Address Caching Capacity, [8] Address Learning Rate, [9] Errored Frames Filtering, [10] Broadcast Frame Forwarding and Latency	—
Link Fault Signaling (Option 16)*7		–		LFS pattern transmit function, LFS transmitted counter function, Received counter function, LFS data capture, LFS emulation function

*1: 1000BASE-SX/LX/LH/ZX/T can be selected by changing the GBIC module.
*2: 10GBASE-LR can be selected by changing the XENPAK module.
*3: VLAN tag and MPLS labels cannot both be used simultaneously.
*4: Increment and random of frame length can be used only when choosing None as a protocol.
*5: Main frame option is required.
*6: Unframe BER Test (MU120118A) requires main frame option (Option 13).
*7: Main frame option is required (Option 16).

• Advanced Protocol Ethernet Module

Model		MU120111A	MU120112A
Ports		10BASE-T/100BASE-TX Number of ports: 8 Connector: RJ-45 Link speed: 10 Mbit/s, 100 Mbit/s Duplex mode: Full, Half Auto negotiation: On/Off Flow control: On/Off	1000BASE-SX/LX/LH/ZX[*1], Electrical: 1000BASE-T[*1] Number of ports: 2 Connector: GBIC interface (GBIC: SC, RJ-45) Link speed: 1 Gbit/s Duplex mode: Full Auto negotiation: On/Off Flow control: On/Off
LEDs		Link (10/100M), Tx/Collision, Rx/Error	Link, Tx, Rx, Error
Frame Settings		MAC address: Fixed, Increment, Decrement, Random (changeable portions specified in 4 bits units) VLAN tag[*2]: Fixed, Increment, Decrement, Random MPLS label[*2]: Up to 10 MPLS labels can be appended (fixed setting) Protocol editing: Ethernet, IPv4, IPv6, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPX, ARP, MAC control, IS-IS Option 12[*3, *4]: TCP/IPv6, UDP/IPv6, ICMPv6/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4 Data field Can set any 4 portions of data field: All 1, All 0, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9 Data Field 1 only: Time stamp, Sequence number, User defined, Test frame	
Frame Length		12 to 10000 byte (Settable as auto, Fixed, Increment[*3], or Random[*3])	48 to 65280 byte (Settable as auto, Fixed, Increment[*3], or Random[*3])
Stream Transport Mode		Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count (Loop count: 1 to 16,000,000, Frame count per burst: 1 to 16,777,215, Burst count per stream: 1 to 16,777,215)	
Stream Gap Setting	Inter Frame Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed, Random 100BASE-TX: Resolution of 80 ns 800 ns to 170 s, Settable as fixed, Random	Resolution of 8 ns 64 ns to 120 s, Settable as fixed, Random
	Inter Burst Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed 100BASE-T: Resolution of 80 ns 800 ns to 170 s, Settable as fixed	Resolution of 8 ns 64 ns to 120 s, Settable as fixed
	Inter Stream Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed 100BASE-TX: Resolution 80 ns 800 ns to 170 s, Settable as fixed	Resolution of 8 ns 64 ns to 120 s, Settable as fixed
Number of Streams		256 Streams/Port	
Error Insertion	Frame Error	FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error, Alignment error, Dribble bit error, Collision	FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error
	Packet Error	IPv4 header checksum error, TCP/UDP checksum error	
	Packet BER Test (Option 11)[*4]	PRBS error	
Counter	Common	Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate	
	Ethernet	Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Dribble bit error, Line error, Fragments, Undersize, Oversize, Oversize & FCS error, FCS error, Alignment error, Collision	Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Line error, Fragments, Undersize, Oversize, Oversize & FCS error, FCS error, Byte alignment error
	IP/TCP/UDP	Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, QoS 0 to 7 frame count/rate, Received TCP packet count/rate, Received UDP packet count/rate, IPv4 header checksum error, TCP checksum error, UDP checksum error	
	Unframe[*5]	Bit error count/rate, Pattern sync loss count/second	
	Packet BER Test (Option 11)[*4]	Transmitted test frame, Received test frame, Sequence error, PRBS bit error count/rate, PRBS frame error count/rate	
	IPv6 Expansion (Option 12)[*4]	Transmitted IPv6 packet count/rate, Received IPv6 packet count/rate, Transmitted ICMPv6 echo request, Received ICMPv6 echo request, Transmitted ICMPv6 echo reply, Received ICMPv6 echo reply, Transmitted ICMPv6 (NA), Received ICMPv6 (NA), Transmitted ICMPv6 (NS), Received ICMPv6 (NS)	
Latency		Maximum, Minimum, Average	
Frame Arrival Time Variation Measurement		Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s	
QoS Counter Setting		Using QoS described below, 8-level priority frame count: IEEE802.1D VLAN tag user priority field, 3 LSB of RFC2474 DSCP field	
Unframe BER Test[*5]		Test pattern: All 0, All 1, User-defined 16-bit pattern, PRBS23, PRBS31 Error insertion: Bit unit Error insertion timing: Single error, Single rate (1E-3,4, 5, 6, 7, 8, 9), Programmable rate (9.9 E-3 to 1.0 E-10)	Test pattern: All 0, All 1, User-defined 16-bit pattern, PRBS23, PRBS31, CJPAT, CRPAT Error insertion: Bit unit Error insertion timing: Single error, Single rate (1E-3, 4, 5, 6, 7, 8, 9), Programmable rate (9.9 E-3 to 1.0 E-10)
Capture Buffer		8 Mbyte/port	32 Mbyte/port
Capture Filter		At following conditions for each port, capture filter condition settings: Destination MAC address, Source MAC address, 128-bit pattern (settable bit length and offset) x 2, Error conditions	
Capture Trigger		At following conditions for each port, capture trigger condition settings: Destination MAC address, Source MAC address, 128-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input	

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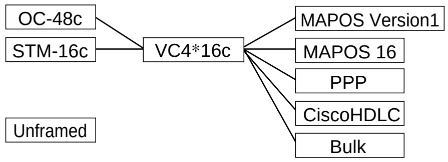
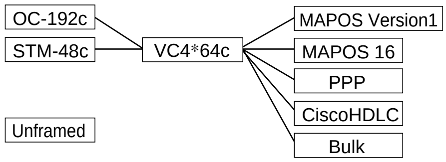
Model	MU120111A	MU120112A
Protocol Decode	ARP, BGP-4, DHCP, DVMRP, Ethernet, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LCP, LDP, MAC Control Frame, MPLS, MPLSCP, OSPFv2, RIP, RSVP, SNAP, TCP, UDP, VLAN, MD1230A Test Frame	
Protocol Emulation	ARP, ICMP for IPv4, IGMP, BGP-4, OSPF (Option 07), MPLS LDP/CR-LDP (Option 08), MPLS RSVP (Option 09), ICMP for IPv6 (Option 12), IGAP (Option 14)	
Traffic Monitor	Ethernet frame count for up to 64 flows, IP packet count for up to 64 flows, Frame count for up to 64 protocols	
Traffic Map	Ethernet data flow for up to 256 flows, IP data flow for up to 256 flows	
Service Disruption Time	Time of frame disruption	
RFC2544 Automatic Test	Throughput, Latency, Frame Loss Rate, Back-to-Back Frame, System Recovery, Reset	
RFC2889 Automatic Test (Option 10)[*4]	[1] Fully Meshed Throughput and Frame Loss, Forwarding Rate, [2] Partially Meshed one-to-Many/Many-to-One, [3] Partially Meshed Multiple Devices, [4] Partially Meshed Unidirectional Traffic, [5] Congestion Control, [6] Forward Pressure and Maximum Forwarding Rate, [7] Address Caching Capacity, [8] Address Learning Rate, [9] Errored Frames Filtering, [10] Broadcast Frame Forwarding and Latency	
Auto Negotiation Analysis (Option 15)[*4]	—	Code data transmitted function, Auto negotiation sequence capture function, Link timer value variable function

[*1] : 1000BASE-SX/LX/LH/ZX/T can be selected by changing the GBIC module.
[*2] : VLAN tag and MPLS labels cannot both be used simultaneously.
[*3] : Increment and random of frame length can be used only when choosing None as a protocol.
[*4] : Main frame option is required.
[*5] : Unframe BER Test (MU120111A) requires port 1 or port 5.

• POS Module

	Model	MU120103A	MU120104A	MU120105A	MU120106A
	Ports	OC-48/STM-16 Wavelength: 1260 to 1360 nm Number of ports: 1 Connector: SC Bit rate: 2488.320 Mbit/s (NRZ) Output level: –5 to 0 dBm Input sensitivity: –18 to 0 dBm	OC-48/STM-16 Wavelength: 1500 to 1580 nm Number of ports: 1 Connector: SC Bit rate: 2488.320 Mbit/s (NRZ) Output level: –2 to +3 dBm Input sensitivity: –28 to –9 dBm	OC-192/STM-64 Wavelength: 1290 to 1330 nm Number of ports: 1 Connector: SC Bit rate: 9953.280 Mbit/s (NRZ) Output level: –4 to +0 dBm Input sensitivity: –12 to 0 dBm	OC-192/STM-64 Wavelength: 1530 to 1565 nm Number of ports: 1 Connector: SC Bit rate: 9953.280 Mbit/s (NRZ) Output level: –1 to +2 dBm Input sensitivity: –14 to –3 dBm
	LEDs	Link, Tx, Rx, Error, Optical send			
	Clocks	Internal (±50 ppm variable), Receive signal, Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)		Internal (±100 ppm variable), Receive signal, Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)	
	Power Meter	Standard			
	SDH/SONET Setting	Frame select: SONET/SDH Scramble: On/Off Alarm addition: LOS, LOF, MS-AIS, MS-RDI, MS-TIM, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ Alarm addition timing: Single, Single burst frame (1 to 64000), Alternative [Alarm frame (0 to 8000), Normal frame (1 to 8000)], All Error insertion: FAS, Bit all, B1, B2, B3, MS-REI, HP-REI, HP-IEC Error insertion timing: Single, Single burst bit (1 to 64000), Rate (1E-3, 1E-4, 1E-5, 1E-6, 1E-7, 1E-8, 1E-9), Programmed rate [AE-B *A: 1.0 to 9.9 (step 0.1), B: 3 to 10], All APS (K1/K2) sequence generation: 2 to 64 words, Repeat (8000 frames)			
	Mapping				
	Frame Settings	FCS: CRC32 MPLS label: Up to 10 MPLS labels can be appended (fixed setting) Protocol editing: PPP, IPv4, IPv6, TCP/IP, UDP/IP, IGMP/IP, ICMP/IP, RIP/UDP/IP, DHCP, IS-IS Data field Can set any 4 parts in data field: All 1, All 0, Alternate 1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9 Data field 1 only: Time stamp, Sequence number, User defined, Test frame			
	Frame Length	8 to 65536 byte (Settable as auto, Fixed, Increment[*1], or Random[*1])			
	Stream Transport Mode	Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count (Loop count: 1 to 16,000,000, Frame count per burst: 1 to 1,099,551,627,775, Burst count per stream: 1 to 1,099,551,627,775)			
Stream Gap Setting	Inter Frame Gap	Resolution of 3.3 ns 3.3 ns to 120 s, Settable as fixed, Random		Resolution of 0.8 ns 0.8 ns to 120 s, Settable as fixed, Random	
	Inter Burst Gap	Resolution of 3.3 ns 3.3 ns to 120 s, Settable as fixed		Resolution of 0.8 ns 13.4 ns to 120 s, Settable as fixed	
	Inter Stream Gap	Resolution of 3.3 ns 427.4 ns to 120 s, Settable as fixed		Resolution of 0.8 ns 106.8 ns to 120 s, Settable as fixed	
	Number of Streams	256 Streams/Port			
Error Insertion	Frame Error	FCS error, Abort frame, Fragment, Undersize, Oversize, Oversize & FCS error			
	Packet Error	IPv4 header checksum error, TCP/UDP checksum error			
	Packet BER Test (Option 11)[*2]	PRBS bit error			

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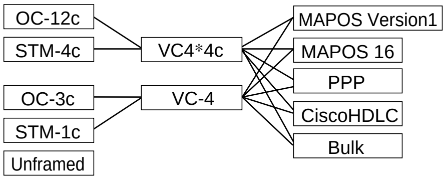
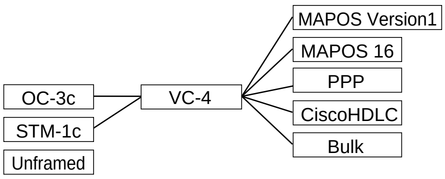
Model		MU120103A	MU120104A	MU120105A	MU120106A
Counter	SONET/SDH/ Bulk	B1 count/rate, B2 count/rate, B3 count/rate, HP-IEC count/rate, MS-REI count/rate, HP-REI count/rate, LOS count/second, LOF count/second, OOF count/second, MS-AIS count/second, MS-RDI count/second, AU-AIS count/second, AU-LOP count/second, HP-SLM count/second, HP-RDI count/second, HP-UNEQ count/second, Bit Info count/rate, Pattern Sync Loss count/second, Abort frame, Sequence error count			
	Justification	NDF count/rate, +PJC count/rate, –PJC count/rate, Consecutive count/rate, PPM			
	Common	Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate			
	PPP/IP/TCP/UDP	Transmitted bytes (after stuffing), Received bytes (before destufing), Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, QoS 0 to 7 frame/rate, Received TCP packet count/rate, Received UDP packet count/rate, IPv4 header checksum error, TCP checksum error, UDP checksum error			
	Unframe	Bit Info count/rate, Pattern Sync Loss count/second			
	Packet BER Test (Option 11)*2	Transmitted test frame, Received test frame, Sequence error, Received PRBS frame error count/rate, Received PRBS bit error count/rate			
Latency		Maximum, Minimum, Average			
Alarm Arrival Time Variation Measurement		Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s			
QoS Counter Settings		Using QoS described below, 8-level priority frame count: 3 LSB of RFC2474 DSCP field			
Unframe BER Setting		Test pattern: PRBS23, PRBS31 Error insertion: Bit unit Error insertion timing: Single error, Single rate (1E-3, 4, 5, 6, 7, 8, 9), Programmable rate (9.9 E-3 to 1.0 E-10)			
Capture Buffer		256 Mbyte/port			
Capture Filter		At following conditions for each port, capture filter condition settings: Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions			
Capture Trigger		At following conditions for each port, capture trigger condition settings: Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input			
Protocol Decode		BGP-4, Cisco HDLC, DHCP, DVMRP, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LCP, LDP, MAPOS, MPLS, MPLSCP, OSPFv2, PPP, RIP, RSVP, SNAP, TCP, UDP, MD1230A Test Frame			
Protocol Emulation		PPP, PING, IGMP, BGP-4			
Traffic Monitor		IP packet count for up to 64 flows, Frame count for up to 64 protocols			
Traffic Map		IP data flow for up to 256 flows			
Service Disruption Time		Time of frame disruption			
RFC2544 Automatic Test		Throughput, Latency, Frame Loss Rate, Back-to-Back Frame, System Recovery, Reset			

*1: Increment and random of frame length can be used only when choosing None as a protocol.
*2: Main frame option is required.

Model	MU120119A	MU120120A
Ports	OC-3/12 STM-1/4 Wavelength: 1300 nm band Number of ports: 2 Connector: SC Bit rate: 155.52/622.08 Mbit/s (NRZ) Output level: –15 to –8 dBm Input sensitivity: –28 to –8 dBm	OC-3 STM-1 Wavelength: 1300 nm band Number of ports: 2 Connector: SC Bit rate: 155.52 Mbit/s (NRZ) Output level: –15 to –8 dBm Input sensitivity: –28 to –8 dBm
LEDs	Link, Tx, Rx, Error	
Clocks	Internal (±50 ppm variable), Receive signal, Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)	
Power Meter	Option	
SDH/SONET Setting	Frame select: SONET/SDH Scramble: On/Off Alarm addition: LOS, LOF, MS-AIS, MS-RDI, MS-TIM, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ Alarm addition timing: Single, Single burst frame (1 to 64000), Alternative [Alarm frame (0 to 8000), Normal frame (1 to 8000)], All Error insertion: FAS, Bit all, B1, B2, B3, MS-REI, HP-REI, HP-IEC Error insertion timing: Single, Single burst bit (1 to 64000), Rate (1E-3, 1E-4, 1E-5, 1E-6, 1E-7, 1E-8, 1E-9), Programmed rate [AE-B *A: 1.0 to 9.9 (step 0.1), B: 3 to 10], All APS (K1/K2) Sequence generation: 2 to 64 words, Repeat (8000 frames)	
Mapping		

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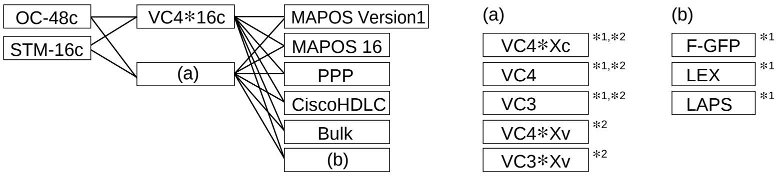
Model		MU120119A	MU120120A
Frame Settings		FCS: CRC32 MPLS label: Up to 10 MPLS labels can be appended (fixed setting) Protocol editing: PPP, IPv4, IPv6, TCP/IP, UDP/IP, IGMP/IP, ICMP/IP, RIP/UDP/IP, DHCP, IS-IS Data field Can set any 4 parts in data field: All 1, All 0, Alternate 1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9 Data field 1 only: Time stamp, Sequence number, User defined, Test frame	
Frame Length		8 to 65536 byte (Settable as auto, Fixed, Increment[*1], or Random[*1])	
Stream Transport Mode		Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count (Loop count: 1 to 16,000,000, Frame count per burst: 1 to 16,000,000, Burst count per stream: 1 to 16,000,000)	
Stream Gap Setting	Inter Frame Gap	156M: 53.4 ns to 120 s, Resolution of 53.4 ns, Settable as fixed, Random 622M:13.4 ns to 120 s, Resolution of 13.4 ns, Settable as fixed, Random	
	Inter Burst Gap	156M: 53.4ns to 120 s, Resolution of 53.4 ns, Settable as fixed 622M:13.4 ns to 120 s, Resolution of 13.4 ns, Settable as fixed	
	Inter Stream Gap	156M: 427.4 ns to 120 s, Resolution of 53.4 ns, Settable as fixed 622M:106.8 ns to 120 s, Resolution of 13.4 ns, Settable as fixed	
Number of Streams		256 streams/port	
Error Insertion	Frame Error	FCS error, Abort frame, Fragment, Undersize, Oversize, Oversize & FCS error	
	Packet Error	IPv4 header checksum error, TCP/UDP checksum error	
	Packet BER Test (Option 11)[*2]	PRBS bit error	
Counter	SONET/SDH/Bulk	B1 count/rate, B2 count/rate, B3 count/rate, HP-IEC count/rate, MS-REI count/rate, HP-REI count/rate, LOS count/second, LOF count/second, OOF count/second, MS-AIS count/second, MS-RDI count/second, AU-AIS count/second, AU-LOP count/second, HP-SLM count/second, HP-RDI count/second, HP-UNEQ count/second, Bit Info count/rate, Pattern Sync Loss count/second, Abort frame, Sequence error count	
	Justification	NDF count/rate, +PJC count/rate, –PJC count/rate, Consecutive count/rate, PPM	
	Common	Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate	
	PPP/IP/TCP/UDP	Transmitted bytes (after stuffing), Received bytes (before destufing), Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, QoS 0 to 7 frame/rate, Received TCP packet count/rate, Received UDP packet count/rate, IPv4 header checksum error, TCP checksum error, UDP checksum error	
	Unframe	Bit Info count/rate, Pattern Sync Loss count/second	
	Packet BER test (Option 11)[*2]	Transmitted test frame, Received test frame, Sequence error, Received PRBS frame error count/rate, Received PRBS bit error count/rate	
Latency		Maximum, Minimum, Average	
Frame Arrival Time Variation Measurement		Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s	
QoS Counter Settings		Using QoS described below, 8-level priority frame count: 3 LSB of RFC2474 DSCP field	
Unframe BER Setting		Test pattern: PRBS11, PRBS15, PRBS20, PRBS23, PRBS31 Error insertion: Bit unit Error insertion timing: Single error, Single rate (1E-3,4, 5, 6, 7, 8, 9), Programmable rate (9.9 E-3, 1.0 E-10)	
Capture Buffer		32 Mbyte/port	
Capture Filter		At following conditions for each port, capture filter condition settings: Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions	
Capture Trigger		At following conditions for each port, capture trigger condition settings: Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input	
Protocol Decode		BGP-4, Cisco HDLC, DHCP, DVMRP, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LCP, LDP, MAPOS, MPLS, MPLSCP, OSPFv2, PPP, RIP, RSVP, SNAP, TCP, UDP, MD1230A Test Frame	
Protocol Emulation		PPP, PING, IGMP, BGP-4	
Traffic Monitor		IP packet count for up to 64 flows, Frame count for up to 64 protocols	
Traffic Map		IP data flow for up to 256 flows	
Service Disruption Time		Time of frame disruption	
RFC2544 Automatic Test		Throughput, Latency, Frame Loss Rate, Back-to-Back Frame, System Recovery, Reset	
Module Options		MU120119A-01/MU120120A-01 Maximum input level: +10 dBm Optical power measurement range: –40 to +5 dBm Optical power measurement accuracy: ±0.5 dBm	

*1: Increment and random of frame length can be used only when choosing None as a protocol.
*2: Main frame option is required.

- **EOS Module**

Model		MU120103B	MU120104B
Ports		OC-48/STM-16 Wavelength: 1260 to 1360 nm Number of ports: 1 Connector: SC Bit rate: 2488.320 Mbit/s (NRZ) Output level: –5 to 0 dBm Input sensitivity: –18 to 0 dBm	OC-48/STM-16 Wavelength: 1500 to 1580 nm Number of ports: 1 Connector: SC Bit rate: 2488.320 Mbit/s (NRZ) Output level: –2 to +3 dBm Input sensitivity: –28 to –9 dBm
LEDs		Link, Tx, Rx, Error, Optical send	
Clocks		Internal (±50 ppm variable), Receive signal, Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)	
Power Meter		Standard	
SDH/SONET Setting		Frame select: SONET/SDH Scramble: On/Off Alarm addition: LOS, LOF, MS-AIS, MS-RDI, MS-TIM, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ Alarm addition timing: Single, Single burst frame (1 to 64000), Alternative [Alarm frame (0 to 8000), Normal frame (1 to 8000)], All Error insertion: FAS, Bit all, B1, B2, B3, MS-REI, HP-REI, HP-IEC Error insertion timing: Single, Single burst bit (1 to 64000), Rate (1E-3, 1E-4, 1E-5, 1E-6, 1E-7, 1E-8, 1E-9), Programmed rate [AE-B ∗A: 1.0 to 9.9 (step 0.1), B: 3 to 10], All APS (K1/K2) sequence generation: 2 to 64 words, Repeat (8000 frames)	
Mapping			
Frame Settings		FCS: CRC32, CRC16 MAC address: Fixed, Increment, Decrement, Random (changeable portions specified in 4 bits units) VLAN tag^{*3}: Fixed, Increment, Decrement, Random MPLS label^{*3}: Up to 10 MPLS labels can be appended. Fixed setting Protocol editing: Ethernet, IPv4, IPv6, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPX, ARP, MAC control, IS-IS, LEX Control Packet^{*4}, GFP, PPP Data field Can set any 4 parts in data field: All 1, All 0, Alternate 1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment, Decrement, Random, Single PRBS9 Data field 1 only: Time stamp, Sequence number, User defined, Test frame	
Frame Length		8 to 65536 byte (Settable as auto, Fixed, Increment^{*5}, or Random^{*5})	
Stream Transport Mode		Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count (Loop count: 1 to 16,000,000, Frame count per burst: 1 to 16,000,000, Burst count per stream: 1 to 16,000,000)	
Stream Gap Setting	Inter Frame Gap	GFP: 0 ns to 120 s, Resolution of 13.4 ns, Settable as fixed, Random^{*6} PPP/LEX/LAPS: 3.3 ns to 120 s, Resolution of 3.2 ns, Settable as fixed, Random^{*6}	
	Inter Burst Gap	51.4 ns to 120 s, Resolution of 3.2 ns, Settable as fixed (IFG <51.4 ns or Frame length <63 bytes) IFG + 51.4ns to 120 s	
	Inter Stream Gap	427.4 ns to 120 s, Resolution of 3.2 ns, Settable as fixed (IFG <51.4 ns or Frame length <63 bytes) IFG + 427.4 ns to 120 s	
Number of Streams		256 streams/port	
Error Insertion	GFP^{*7}	cHEC error, Correctable cHEC error, tHEC error, Correctable tHEC error, eHEC error, Correctable eHEC error, FCS error	
	LAPS^{*7}	FCS error, Abort sequence	
	LEX^{*7}	FCS error, Fragment error, Undersize error, Oversize, Oversize & FCS error, Abort sequence	
	Frame Error	FCS error, Abort frame, Fragment, Undersize, Oversize, Oversize & FCS error	
	Packet Error	IPv4 header checksum error, TCP/UDP checksum error	
	Packet BER Test (Option 11)^{*8}	PRBS bit error	
Counter	SONET/SDH/Bulk	B1 count/rate, B2 count/rate, B3 count/rate, HP-IEC count/rate, MS-REI count/rate, HP-REI count/rate, LOS count/second, LOF count/second, OOF count/second, MS-AIS count/second, MS-RDI count/second, AU-AIS count/second, AU-LOP count/second, HP-SLM count/second, HP-RDI count/second, HP-UNEQ count/second, Bit Info count/rate, Pattern Sync Loss count/second, Sequence error count	
	Justification	NDF count/rate, +PJC count/rate, –PJC count/rate, Consecutive count/rate, PPM	
	Common	Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate	
	GFP/LEX/LAPS^{*7}	Transmitted bytes (after stuffing), Transmitted bytes (after adaptation), cHEC error, Correctable cHEC error, tHEC error, Correctable tHEC error, eHEC error, GFP FCS error, Server signal fail interval, Client loss of sync frame, Client loss of sync interval, Client loss of signal frame, Client loss of signal interval, Fragment, Undersize, Oversize, Oversize & FCS error, Abort frame	
	Ethernet^{*7}	Transmitted Ethernet frame, Received Ethernet frame, Transmitted Ethernet byte, Received Ethernet byte, Ethernet FCS error, Flow control, Ethernet fragment error, Ethernet undersize error, Ethernet oversize error, Ethernet oversize & FCS error, Transmitted ARP request, Received ARP request, Transmitted ARP reply, Received ARP reply	
	PPP/IP/TCP/UDP	Transmitted bytes (after stuffing), Received bytes (before destufing), Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, QoS 0 to 7 frame/rate, Received TCP packet count/rate, Received UDP packet count/rate, IPv4 header checksum error, TCP checksum error, UDP checksum error	

Continued on next page

Model		MU120103B	MU120104B
Counter	Unframe	Bit info count/rate, Pattern Sync Loss count/second	
	Packet BER Test (Option 11)	Transmitted test frame, Received test frame, Sequence error, Received PRBS frame error count/rate, Received PRBS bit error count/rate	
Latency		Maximum, Minimum, Average	
Frame Arrival Time Variation Measurement		Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s	
QoS Counter Settings		Using QoS described below, 8-level priority frame count: IEEE802.1D VLAN tag user priority field, 3 LSB of RFC2474 DSCP field	
Unframe BER Setting		Test pattern: PRBS23, PRBS31 Error insertion: Bit unit Error insertion timing: Single error, Single rate (1E-3, 4, 5, 6, 7, 8, 9), Programmable rate (9.9 E-3, 1.0 E-10)	
Capture Buffer		256 Mbyte/port	
Capture Filter		At following conditions for each port, capture filter condition settings: Destination MAC address[*9], Source MAC address[*9], Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions	
Capture Trigger		At following conditions for each port, capture trigger condition settings: Destination MAC address[*9], Source MAC address[*9], Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input	
Protocol Decode		ARP, BGP-4, Cisco HDLC, DHCP, DVMRP, Ethernet, GFP, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LAPS (X.86), LCP, LDP, LEX, LLC, MAC Control Frame, MAPOS, MPLS, MPLSCP, OSPFv2, PPP, PPP-LEX, RIP, RSVP, SNAP, TCP, UDP, VLAN, MD1230A Test Frame	
Protocol Emulation		ARP, PPP, ICMP(PING), IGMP, BGP-4	
Traffic Monitor		IP packet count for up to 64 flows, Frame count for up to 64 protocols	
Traffic Map		IP data flow for up to 256 flows	
Service Disruption Time		Time of frame disruption	
RFC2544 Automatic Test		Throughput, Latency, Frame Loss Rate, Back-to-Back Frame, System Recovery, Reset	
Module Options		MU120103B-01/MU120104B-01 Mapping: T-GFP, LAPS, LEX Concatenation: [SDH] VC-4-Xc (X = 16, 8, 4, 3, 2), VC-4, VC-3 [SONET] STS-Xc (X = 48, 24, 12, 9, 6, 3), STS-1 MU120103B-02/MU120104B-02 Virtual concatenation: [SDH] VC-4-Xv (X = 8, 7, 6, 5, 4, 3, 2), VC-3-Xv (X = 24, 21, 18, 15, 12, 9, 6, 3) [SONET] STS3c-Xv (X = 8, 7, 6, 5, 4, 3, 2), STS1-Xv (X = 24, 21, 18, 15, 12, 9, 6, 3)	

*1: Settable while using the Option 01.
*2: Settable while using the Option 02.
*3: VLAN tag and MPLS labels cannot be used simultaneously.
*4: LEX Control Packet can be chosen only when choosing LEX mapping.
*5: Increment and random of frame length can be used only when choosing None as a protocol.
*6: Random setting is effective only when frame length is more than 64 bytes.
*7: Settable only while using the Option 01.
*8: Main frame option is required.
*9: Settable as only GFP/LAPS/LEX mapping.

• MU740701A IP Tester Control Module

Control Slot Number[*1]	7
Interface	RS-232C
Automatic Test	Standard: RFC2544 Test (Throughput, Latency, Frame Loss Rate, Back-to-Back Frame, System Recovery, Reset) Option: RFC2889 Benchmarking Test ([1] Fully Meshed Throughput, Frame Loss and Forwarding Rates, [2] Partially Meshed One-to-Many/Many-to-One, [3] Partially Meshed Multiple Devices, [4] Partially Meshed Unidirectional Traffic, [5] Congestion Control, [6] Forward Pressure and Maximum Forwarding Rate, [7] Address Caching Capacity, [8] Address Learning Rate, [9] Errored Frames Filtering, [10] Broadcast Frame Forwarding and Latency)
LED	For configuration check
Operating Temperature	0˚ to +40 ˚C
Storage Temperature	–20˚ to +60 ˚C
Corresponding Options	MU740701A-04: MU740701A Decode Module[*2], MU740701A-05: GPS Module[*3], MU740701A-07: OSPF Protocol[*4], MU740701A-08: MPLS (LDP/CR-LDP) Protocol[*4], MU740701A-09: MPLS (RSVP) Protocol[*4], MU740701A-10: RFC2889 Benchmarking Test[*4], MU740701A-11: Packet BER Test[*4], MU740701A-12: IPv6 Expansion[*4], MU740701A-13: XENPAK Test[*5], MU740701A-14: IGAP Protocol[*4], MU740701A-15: Auto Negotiation Analysis[*6], MU740701A-16: Link Fault Signalling[*5], MU740701A-30: MU740701A Expert Analysis Module[*7], MT7407A-40: Annual Software Upgrade Service for MT7407A[*8]

*1: MU740701A is controllable a maximum of 7 modules.
*2: Purchase MU740701A-04 on FD. The Decode Module function doesn’t operate with only MU740701A-04. MX123001A-01 (sold separately) is required.
*3: When using MU740701A-05, MT7407A-01 (sold separately) is required. With one MU740701A-05 can support an entire MT7407A chassis with one MU740701A module installed.
*4: Some of these interface modules may not work in certain combinations depending on the modules and software versions.
Please see the selection guide (Pages 8, 9)
*5: MU740701A-13 and MU740701A-16 support only MU120118A.
*6: MU740701A-15 supports only MU120112A.
*7: Purchase MU740701A-30 on FD. The Expert Analysis module function doesn't operate with only MU740701A-30. MU740701A-04 MU740701A Decode Module, MX123001A-01 Remote Control Software for MD1230A-04, and MX123003A Remote Control Software for MX123002A are required.
*8: MT7407A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase. One license supports two MU740701A.

- **MT7407A-01 IP Tester Interface**[1]

SONET/SDH sync Clock Input	Frequency: 64 kHz + 8 kHz ± 50 ppm, 2.048 MHz ± 50 ppm, 1.544 MHz ± 50 ppm, 2.048 Mbit/s ± 50 ppm,1.544 Mbit/s ± 50 ppm Interface 2M: ITU-T G.703 Table 10, HDB3 1.5M: B8ZS, AMI ANSI T1.403 Level (64k): 0.63 to 1.1 Vo-p Code (64k): AMI 8 kHz violation Connector BNC (75 Ω): 2 MHz, 2 Mbit/s Siemens (120 Ω balanced): 2 MHz, 2 Mbit/s, 64 kHz + 8 kHz Bantam (100 Ω balanced): 1.5 MHz, 1.5 Mbit/s
Sync I/O	MD1230A/1231A time sync signal, Impedance: 75 Ω (BNC)
External Interface Connector[2]	GPS Antenna

*1: This option is required when synchronizing SONET/SDH with MT7407A, or when synchronizing two or more sets of MT7407A, MD1230A, and MD1231A.
*2: When using MU740701A-05, MT7407A-01 (sold separately) is required.

Ordering information

Please specify model/order number, name and quantity when ordering.

- **MD1230A**

Model/Order No.	Name
	Main frame
MD1230A	Data Quality Analyzer
	Standard accessories
	Power cord, 2.5 m: 1 pc
F0079	Fuse, 10 A: 1 pc
B0329G	Front cover (for 3/4MW4U): 1 pc
B0500A	Side cover: 1 pc
W2306AE	MD1230A Family operation manual CD-ROM[1]: 1 pc
	Main frame options
MD1230A-01	RS-232C Control[2]
MD1230A-02	GPIB Control[2]
MD1230A-03	Ethernet Control[2,3]
MD1230A-04	MD1230A Decode Module[4]
MD1230A-05	GPS Module
MD1230A-06	Tcl Interface[3]
MD1230A-07	OSPF Protocol[5]
MD1230A-08	MPLS (LDP/CR-LDP) Protocol[5]
MD1230A-09	MPLS (RSVP) Protocol[5]
MD1230A-10	RFC2889 Benchmarking Test[5]
MD1230A-11	Packet BER Test[5]
MD1230A-12	IPv6 Expansion[5]
MD1230A-13	XENPAK Test[6]
MD1230A-14	IGAP Protocol[5]
MD1230A-15	Auto Negotiation Analysis[7]
MD1230A-16	Link Fault Signaling[6]
MD1230A-20	Application Traffic Monitor[7,8]
MX123002A	MD1230A Expert Analysis Module[14]
	Plug-in modules
MU120101A	10M/100M Ethernet Module
MU120102A	Gigabit Ethernet Module[9]
MU120103A	2.5G (1.31) Module[10]
MU120103B	2.5G (1.31) Module[10]
MU120104A	2.5G (1.55) Module[10]
MU120104B	2.5G (1.55) Module[10]
MU120105A	10G (1.31) Module
MU120106A	10G (1.55) Module
MU120111A	10/100M Ethernet Module
MU120112A	Gigabit Ethernet Module[9]
MU120118A	10 Gigabit Ethernet Module[11]
MU120119A	OC-3/12 STM-1/4 Module (1310 nm)
MU120120A	OC-3/STM-1 Module (1310 nm)
	Plug-in module options
MU120103B-01	EOS Mapping
MU120103B-02	Virtual Concatenation
MU120104B-01	EOS Mapping
MU120104B-02	Virtual Concatenation
MU120119A-01	Optical Power Meter
MU120120A-01	Optical Power Meter
	Softwares
MX123001A	Data Quality Analyzer Control Software
MX123001A-05	Data Quality Analyzer Control Software (5 licenses)
MX123001A-08	Data Quality Analyzer Control Software (8 licenses)
MX123001A-01	Remote Control Software for MD1230A-04[12]
MX123001A-15	Remote Control Software for MD1230A-04 (5 licenses)[12]
MX123001A-18	Remote Control Software for MD1230A-04 (8 licenses)[12]

Model/Order No.	Name
MX123001A-20	Application Traffic Monitor Option[13]
MX123003A	Remote Control Software for MX123002A[15]
MX123003A-05	Remote Control Software for MX123002A (5 licenses)[15]
MX123003A-08	Remote Control Software for MX123002A (8 licenses)[15]
	Software options
MX123001A-06	Tcl Interface[3]
MX123001A-07	RS-232C Control[2]
MX123001A-09	GPIB Control[2]
MX123001A-10	Ethernet Control[2, 3]
	Software upgrade service
MD1230A-40	Annual Software Upgrade Service for MD1230A[16]
MD1230A-41	Annual Software Maintenance for MD1230A-04[17]
MD1230A-42	Annual Software Maintenance for MX123002A[17]
	Maintenance service
MD1230A-90	Extended Three Year Warranty Service
MU120101A-90	Extended Three Year Warranty Service
MU120102A-90	Extended Three Year Warranty Service
MU120103A-90	Extended Three Year Warranty Service
MU120103B-90	Extended Three Year Warranty Service
MU120104A-90	Extended Three Year Warranty Service
MU120104B-90	Extended Three Year Warranty Service
MU120105A-90	Extended Three Year Warranty Service
MU120106A-90	Extended Three Year Warranty Service
MU120111A-90	Extended Three Year Warranty Service
MU120112A-90	Extended Three Year Warranty Service
MU120118A-90	Extended Three Year Warranty Service
MU120119A-90	Extended Three Year Warranty Service
MU120120A-90	Extended Three Year Warranty Service
	Optional accessories
G0105A	GBIC SX 850 nm[19]
G0106A	GBIC LX 1310 nm[19]
G0107A	GBIC LH 1310 nm[19]
G0108A	GBIC ZX 1550 nm[19]
G0124A	GBIC T (1000BASE-T)[20]
G0126A	XENPAK (10GBASE-LR)[21]
J1049A	Fixed Optical Attenuator (SC, 5 dB)[22]
J1049B	Fixed Optical Attenuator (SC, 10 dB)[22]
J1049C	Fixed Optical Attenuator (SC, 15 dB)[22]
MZ1221A	XAUI Extender
MZ1222A	XENPAK Interface
J1163A	XAUI cable, 0.5 m
J1164A	MDIO cable, 0.5 m
J0660B	Optical fiber cord (SM, SC-SC connector both ends), 2 m
J0773B	Optical fiber cord (GI, SC-SC connector both ends), 2 m
J1119B	Optical fiber cable (Duplex, MM), 2 m
J0775D	Coaxial cord (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J1165A	Coaxial cord (27CP-P-1.5-BNC-P-1.5C-CR10)[23]
J0845A	Balanced cable (BANTAM 3P/BANTAM 3P), 6 ft
J0162B	Balanced cable (Siemens 3p-Siemens 3p), 2 m
J0008	GPIB cable, 2 m
J1109B	LAN cable (Cross), 5 m
J1110B	LAN cable (Straight), 5 m
Z0321A	Keyboard (PS/2)

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Model/Order No.	Name
Z0541A	USB mouse
B0448	Soft case
B0336C	Carrying case (for 3/4MW4U, 350D)[*24]
B0530	Carrying case caster for B0336C (only for B0336C, 4 pcs/set)
B0533	Carrying case (for 3/4MW4U, 350D)[*25]
B0501B	Blank panel
W1927AE	MD1230A Data Quality Analyzer operation manual
W1928AE	MX123001A Data Quality Analyzer Control Software operation manual
W1929AE	MD1230A-01/02/03 Remote Control operation manual
W2107AE	MD1230A-04 MD1230A Decode Module MX123001A-01 Remote Control Software for MD1230A-04 operation manual
W2122AE	MD1230A-06 Tcl Interface operation manual
W2134AE	MD1230A-20/MD1231A-20/MX123001A-20 Application Traffic Monitor operation manual
W2108AE	MX123002A MD1230A Expert Analysis Module MX123003A Remote Control Software for MX123002A operation manual
W1931AE	MU120101A/11A 10M/100M Ethernet Module MU120102A/12A Gigabit Ethernet Module MU120118A 10 Gigabit Ethernet Module operation manual
W1932AE	MU120103A/B 2.5G (1.31) Module MU120104A/B 2.5G (1.55) Module MU120105A 10G (1.31) Module MU120106A 10G (1.55) Module operation manual
W2121AE	MU120119A OC-3/12 STM-1/4 Module (1310 nm) MU120120A OC-3/STM-1 Module (1310 nm) operation manual

• MD1231A

Model/Order No.	Name
	Main frame
MD1231A	IP Network Analyzer
	Standard accessories
J0134	Power cord, 2.5 m: 1 pc
F0101	Fuse, 2 A: 1 pc
B0489	Front cover: 1 pc
W2306AE	MD1230A Family operation manual CD-ROM[*1]: 1 pc
	Main frame options
MD1231A-02	GPIB Control[*2]
MD1231A-03	Ethernet Control[*2,*3]
MD1231A-04	MD1231A Decode Module[*4]
MD1231A-05	GPS Module
MD1231A-06	Tcl Interface[*3]
MD1231A-07	OSPF Protocol[*5]
MD1231A-08	MPLS (LDP/CR-LDP) Protocol[*5]
MD1231A-09	MPLS (RSVP) Protocol[*5]
MD1231A-10	RFC2889 Benchmarking Test[*5]
MD1231A-11	Packet BER Test[*5]
MD1231A-12	IPv6 Expansion[*5]
MD1231A-14	IGAP Protocol[*5]
MD1231A-15	Auto Negotiation Analysis[*6]
MD1231A-20	Application Traffic Monitor[*6,*7]
MX123002A	MD1230A Expert Analysis Module[*11]
	Plug-in modules
MU120101A	10M/100M Ethernet Module
MU120102A	Gigabit Ethernet Module[*8]
MU120111A	10/100M Ethernet Module
MU120112A	Gigabit Ethernet Module[*8]
MU120119A	OC-3/12 STM-1/4 Module (1310 nm)
MU120120A	OC-3/STM-1 Module (1310 nm)
	Plug-in module options
MU120119A-01	Optical Power Meter
MU120120A-01	Optical Power Meter
	Softwares
MX123001A	Data Quality Analyzer Control Software
MX123001A-05	Data Quality Analyzer Control Software (5 licenses)
MX123001A-08	Data Quality Analyzer Control Software (8 licenses)
MX123001A-01	Remote Control Software for MD1230A-04[*9]
MX123001A-15	Remote Control Software for MD1230A-04 (5 licenses)[*9]
MX123001A-18	Remote Control Software for MD1230A-04 (8 licenses)[*9]
MX123001A-20	Application Traffic Monitor Option[*10]
MX123003A	Remote Control Software for MX123002A[*12]
MX123003A-05	Remote Control Software for MX123002A (5 licenses)[*12]
MX123003A-08	Remote Control Software for MX123002A (8 licenses)[*12]
	Software options
MX123001A-06	Tcl Interface[*3]
MX123001A-07	RS-232C Control[*2]
MX123001A-09	GPIB Control[*2]
MX123001A-10	Ethernet Control[*2,*3]
	Software upgrade service
MD1231A-40	Annual Software Upgrade Service for MD1231A[*13]
MD1231A-41	Annual Software Maintenance for MD1231A-04[*14]
MD1231A-42	Annual Software Maintenance for MX123002A[*15]
	Maintenance service
MD1231A-90	Extended Three Year Warranty Service
MU120101A-90	Extended Three Year Warranty Service
MU120102A-90	Extended Three Year Warranty Service
MU120111A-90	Extended Three Year Warranty Service
MU120112A-90	Extended Three Year Warranty Service
MU120119A-90	Extended Three Year Warranty Service
MU120120A-90	Extended Three Year Warranty Service
	Optional accessories
G0105A	GBIC SX 850 nm[*16]
G0106A	GBIC LX 1310 nm[*16]
G0107A	GBIC LH 1310 nm[*16]
G0108A	GBIC ZX 1550 nm[*16]
G0124A	GBIC T (1000BASE-T)[*17]
J1049A	Fixed Optical Attenuator (SC, 5 dB)[*18]
J1049B	Fixed Optical Attenuator (SC, 10 dB)[*18]
J1049C	Fixed Optical Attenuator (SC, 15 dB)[*18]
J0660B	Optical fiber cord (SM, SC-SC connector both ends), 2 m
J0773B	Optical fiber cord (GI, SC-SC connector both ends), 2 m
J1119B	Optical fiber cable (Duplex, MM), 2 m

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*1: Includes W1927AE, W1928AE, W1929AE and W2122AE operation manuals. Printed versions sold separately.

*2: The MD1230A-01/02/03 options and MX123001A-07/09/10 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.

*3: MD1230A-03 and MD1230A-06, MX123001A-06 and MX123001A-10 may be installed together, although only one of them can be used at a time.

*4: Purchase MD1230A-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.

*5: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide (Pages 8, 9)

*6: MD1230A-13 and MD1230A-16 support only MU120118A.

*7: MD1230A-15 and MD1230A-20 support only MU120112A.

*8: Purchase MD1230A-20 and the operation manuals (W2134AE) on CD-ROM. Printed versions sold separately. MD1230A-20 supports only two MU120112A.

*9: MU120102A/12A require GBIC modules (sold separately).

*10: MU120103A/04A support POS mapping. MU120103B/04B support POS mapping and EOS mapping.
However, EOS mapping is an option.

*11: MU120118A requires XENPAK modules (sold separately).

*12: MX123001A Data Quality Analyzer Control Software and MD1230A-04 MD1230A Decode Module are required.

*13: Software for external control of MD1230A-20 and MD1231A-20. It can be used even if there is no MX123001A.

*14: MD1230A-04 MD1230A Decode Module is required.

*15: MX123001A Data Quality Analyzer Control Software, MX123001A-01 Remote Control Software for MD1230A-04,
MD1230A-04 MD1230A Decode Module and MX123002A MD1230A Expert Analysis Module are required.

*16: MD1230A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase.

*17: Annual Maintenance Service for MD1230A-04 and MX123001A-01.
You have to purchase this software maintenance simultaneously with MD1230A-04 and MX123001A-01. Moreover, when continuing this software maintenance, annual renewal is required each year.

*18: Annual Maintenance Service for MX123002A and MX123003A. You have to purchase a this software maintenance simultaneously with and MX123002A and MX123003A. Moreover, when continuing this software maintenance, annual renewal is required each year.

*19: The GBIC module is sold on a per-unit basis. MU120102A/12A has two GBIC interfaces slots.

*20: The GBIC-T module is sold on a per-unit basis. MU120112A has two GBIC interfaces slots.

*21: The XENPAK module is sold on a per-unit basis. MU120118A has two XENPAK interfaces slots.

*22: Please check the optical power level.

*23: For connecting MD1231A Unit Sync (SMB connector).

*24: Dimensions and mass: 600 (W) x 805 (H) x 365 (D) mm, 8 kg

*25: Dimensions and mass: 413 (W) x 605 (H) x 420 (D) mm, 13 kg
Two spaces which contain the box of standard accessories are provided.

Model/Order No.	Name
J0775D	Coaxial cord (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J1165A	Coaxial cord (27CP-P-1.5-BNC-P-1.5C-CR10)[*19]
J1166A	Coaxial cord (27CP-P-1.5)[*20]
J0845A	Balanced cable (BANTAM 3P/BANTAM 3P), 6 ft
J0162B	Balanced cable (Siemens 3p-Siemens 3p), 2 m
J0008	GPIB cable, 2 m
J1109B	LAN cable (Cross), 5 m
J1110B	LAN cable (Straight), 5 m
Z0321A	Keyboard (PS/2)
Z0541A	USB mouse
B0510	Soft case
B0501B	Blank panel
W2096AE	MD1231A Data Quality Analyzer operation manual
W1928AE	MX123001A Data Quality Analyzer Control Software operation manual
W1929AE	MD1230A-01/02/03 Remote Control operation manual
W2107AE	MD1230A-04 MD1230A Decode Module, MX123001A-01 Remote Control Software for MD1230A-04 operation manual
W2122AE	MD1230A-06 Tcl Interface operation manual
W2134AE	MD1230A-20/MD1231A-20/MX123001A-20 Application Traffic Monitor operation manual
W2108AE	MX123002A MD1230A Expert Analysis Module, MX123003A Remote Control Software for MX123002A operation manual
W1931AE	MU120101A/11A 10M/100M Ethernet Module, MU120102A/12A Gigabit Ethernet Module, MU120118A 10 Gigabit Ethernet Module operation manual
W2121AE	MU120119A OC-3/12 STM-1/4 Module (1310 nm), MU120120A OC-3/STM-1 Module (1310 nm) operation manual

*1: Includes W2096AE, W1928AE, W1929AE and W2122AE operation manuals. Printed versions sold separately.

*2: The MD1231A-02/03 options and MX123001A-07/09/10 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.

*3: MD1231A-03 and MD1231A-06, MX123001A-06 and MX123001A-10 may be installed together, although only one of them can be used at a time.

*4: Purchase MD1231A-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.

*5: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide (Pages 8, 9).

*6: MD1231A-15 and MD1231A-20 support only MU120112A.

*7: Purchase MD1231A-20 and the operation manuals (W2134AE) on CD-ROM. Printed versions sold separately. MD1231A-20 supports only two sets MU120112A.

*8: MU120102A/12A require GBIC modules (sold separately).

*9: MX123001A Data Quality Analyzer Control Software and MD1231A-04 MD1231A Decode Module are required.

*10: Software for external control of MD1230A-20 and MD1231A-20. It can be used even if there is no MX123001A.

*11: MD1231A-04 MD1231A Decode Module is required.

*12: MX123001A Data Quality Analyzer Control Software, MX123001A-01 Remote Control Software for MD1230A-04, MD1231A-04 MD1231A Decode Module and MX123002A MD1230A Expert Analysis Module are required.

*13: MD1231A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase.

*14: Annual Maintenance Service for MD1231A-04 and MX123001A-01. You have to purchase this software maintenance simultaneously with MD1230A-04 and MX123001A-01. Moreover, when continuing this software maintenance, annual renewal is required each year.

*15: Annual Maintenance Service for MX123002A and MX123003A. You have to purchase this software maintenance simultaneously with MX123002A and MX123003A. Moreover, when continuing this software maintenance, annual renewal is required each year.

*16: The GBIC module is sold on a per-unit basis. MU120102A/12A has two GBIC interfaces slots.

*17: The GBIC-T module is sold on a per-unit basis. MU120112A has two GBIC interfaces slots.

*18: Please check the optical power level.

*19: For connecting MD1230A main frames or MT7407A.

*20: For connecting MD1231A main frames.

- **MT7407A**

Model/Order No.	Name
	Main frame
MT7407A	Multislot Chassis
	Standard accessories for MT7407A
J1211	Power Cord, 3 m: 1 pc
F0108	Fuse, 20 A: 1 pc
J1109B	LAN cable (cross), 5 m: 1 pc
W2306AE	MD1230A Family operation manual CD-ROM[*1]: 1 pc
	Option for MT7407A
MT7407A-01	Interface Board for IP Tester[*2]
	Standard accessories for MT7407A-01
J0775I	Coaxial cable, 0.1 m: 1 pc
	Plug-in modules for MT7407A
MU740701A	IP Tester Control Module[*2]
MU740702A	Power Unit for IP Tester[*2, *3]
	Standard accessories for MU740701A
J1221B	RS-232C cross cable: 1 pc
	Control module options
MU740701A-04	MU740701A Decode Module[*4]
MU740701A-05	GPS Module[*5]
MU740701A-07	OSPF Protocol[*6]
MU740701A-08	MPLS (LDP/CR-LDP) Protocol[*6]
MU740701A-09	MPLS (RSVP) Protocol[*6]
MU740701A-10	RFC2889 Benchmarking Test[*6]
MU740701A-11	Packet BER Test[*6]
MU740701A-12	IPv6 Expansion[*6]
MU740701A-13	XENPAK Test[*7]
MU740701A-14	IGAP Protocol[*6]
MU740701A-15	Auto Negotiation Analysis[*8]
MU740701A-16	Link Fault Signaling[*7]
MU740701A-30	MU740701A Expert Analysis Module[*9]
	Plug-in modules
MU120101A	10M/100M Ethernet Module
MU120102A	Gigabit Ethernet Module[*10]
MU120103A	2.5G (1.31) Module[*11]
MU120103B	2.5G (1.31) Module[*11]
MU120104A	2.5G (1.55) Module[*11]
MU120104B	2.5G (1.55) Module[*11]
MU120105A	10G (1.31) Module
MU120106A	10G (1.55) Module
MU120111A	10/100M Ethernet Module
MU120112A	Gigabit Ethernet Module[*10]
MU120118A	10 Gigabit Ethernet Module[*12]
MU120119A	OC-3/12 STM-1/4 Module (1310 nm)
MU120120A	OC-3/STM-1 Module (1310 nm)
	Plug-in module options
MU120103B-01	EOS Mapping
MU120103B-02	Virtual Concatenation
MU120104B-01	EOS Mapping
MU120104B-02	Virtual Concatenation
MU120119A-01	Optical Power Meter
MU120120A-01	Optical Power Meter
	Softwares
MX123001A	Data Quality Analyzer Control Software
MX123001A-05	Data Quality Analyzer Control Software (5 licenses)
MX123001A-08	Data Quality Analyzer Control Software (8 licenses)
MX123001A-01	Remote Control Software for MD1230A-04[*13]
MX123001A-15	Remote Control Software for MD1230A-04 (5 licenses)[*13]
MX123001A-18	Remote Control Software for MD1230A-04 (8 licenses)[*13]
MX123003A	Remote Control Software for MX123002A[*14]
MX123003A-05	Remote Control Software for MX123002A (5 licenses)[*14]
MX123003A-08	Remote Control Software for MX123002A (8 licenses)[*14]
	Software options
MX123001A-06	Tcl Interface[*15]
MX123001A-07	RS-232C Control[*16]
MX123001A-09	GPIB Control[*16]
MX123001A-10	Ethernet Control[*15,*16]
	Software upgrade service
MT7407A-40	Annual Software Upgrade Service for MT7407A[*17]
MU740701A-41	Annual Software Maintenance for MU740701A-04[*18]
MU740701A-42	Annual Software Maintenance for MU740701A-30[*19]

Continued on next page

Model/Order No.	Name
	Maintenance service
MT7407A-90	Extended Three Year Warranty Service[*20]
MU740701A-90	Extended Three Year Warranty Service[*20]
MU740702A-90	Extended Three Year Warranty Service[*20]
MU120101A-90	Extended Three Year Warranty Service
MU120102A-90	Extended Three Year Warranty Service
MU120103A-90	Extended Three Year Warranty Service
MU120103B-90	Extended Three Year Warranty Service
MU120104A-90	Extended Three Year Warranty Service
MU120104B-90	Extended Three Year Warranty Service
MU120105A-90	Extended Three Year Warranty Service
MU120106A-90	Extended Three Year Warranty Service
MU120111A-90	Extended Three Year Warranty Service
MU120112A-90	Extended Three Year Warranty Service
MU120118A-90	Extended Three Year Warranty Service
MU120119A-90	Extended Three Year Warranty Service
MU120120A-90	Extended Three Year Warranty Service
	Optional accessories
G0105A	GBIC SX 850 nm[*21]
G0106A	GBIC LX 1310 nm[*21]
G0107A	GBIC LH 1310 nm[*21]
G0108A	GBIC ZX 1550 nm[*21]
G0124A	GBIC T (1000BASE-T)[*22]
G0126A	XENPAK (10GBASE-LR)[*23]
J1049A	Fixed Optical Attenuator (SC, 5 dB)[*24]
J1049B	Fixed Optical Attenuator (SC, 10 dB)[*24]
J1049C	Fixed Optical Attenuator (SC, 15 dB)[*24]
MZ1221A	XAUI Extender
MZ1222A	XENPAK Interface
J1163A	XAUI cable, 0.5 m
J1164A	MDIO cable, 0.5 m
B0532	Rack flange
B0531	Blank panel[*25]
B0501B	Blank panel
J0660B	Optical fiber cord (SM, SC-SC connector both ends), 2 m
J0773B	Optical fiber cord (GI, SC-SC connector both ends), 2 m
J1119B	Optical fiber cable (duplex, MM), 2 m
J0775D	Coaxial cord (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J1165A	Coaxial cord (27CP-P-1.5-BNC-P-1.5C-CR10)[*26]
J0845A	Balanced cable (BANTAM 3P/BANTAM 3P), 6 ft
J0162B	Balanced cable (Siemens 3p-Siemens 3p), 2 m
J0008	GPIB cable
J1109B	LAN cable (Cross), 5 m
J1110B	LAN cable (Straight), 5 m
W2238AE	MT7407A operation manual
W1928AE	MX123001A Data Quality Analyzer Control Software operation manual
W1929AE	MD1230A-01/02/03 Remote Control operation manual
W2107AE	MD1230A-04 MD1230A Decode Module MX123001A-01 Remote Control Software for MD1230A-04 operation manual
W2122AE	MD1230A-06 Tcl Interface operation manual
W1931AE	MU120101A/11A 10M/100M Ethernet Module MU120102A/12A Gigabit Ethernet Module MU120118A 10 Gigabit Ethernet Module operation manual
W1932AE	MU120103A/B 2.5G (1.31) Module MU120104A/B 2.5G (1.55) Module MU120105A 10G (1.31) Module MU120106A 10G (1.55) Module operation manual
W2121AE	MU120119A OC-3/12 STM-1/4 Module (1310 nm) MU120120A OC-3/STM-1 Module (1310 nm) operation manual

∗1: Includes W2238AE, W1928AE, W1929AE and W2122AE operation manuals. Printed versions sold separately.

∗2: Maximum two sets for one MT7407A. When two MU740701A modules are used, MT7407A requires two MU740702A units. Each MU740701A supports 7 slots.

∗3: One MU740702A supports one MU740701A. When adding MU740702A, chassis hardware modification is required.

∗4: The Decode Module function doesn’t operate with only MU740701A-04. MX123001A-01 (sold separately) is required.

∗5: When using GPS module with MT7407A, it is required MT7407A-01. However two MU740701A-05 can be inserted to MT7407A, it is enough only one MU740701A-05 for one MT7407A.

∗6: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide (Pages 8, 9).

∗7: MU740701A-13 and MU740701A-16 supports only MU120118A.

∗8: MU740701A-15 supports only MU120112A.

∗9: The Expert Analysis module function doesn't operate with only MU740701A-30. MU740701A-04 MU740701A Decode Module, MX123001A Data Quality Analyzer Control Software, and MX123001A-01 Remote Control Software for MD1230A-04 are required.

∗10: MU120102A/12A require GBIC modules (sold separately).

∗11: MU120103A/04A support POS mapping. MU120103B/04B support POS mapping and EOS mapping. However, EOS mapping is an option.

∗12: MU120118A requires XENPAK modules (sold separately).

∗13: MX123001A Data Quality Analyzer Control Software and MU740701A-04 MU740701A Decode Module are required.

∗14: MX123001A Data Quality Analyzer Control Software, MX123001A-01 Remote Control Software for MD1230A-04, MU740701A-04 MU740701A Decode Module and MU740701A-30 MU740701A Expert Analysis Module are required.

∗15: MX123001A-06 and MX123001A-10 may be installed together, although only one of them can be used at a time.

∗16: MX123001A-07/09/10 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.

∗17: MT7407A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase. One license supports two MU740701A.

∗18: Annual Maintenance Service for MU740701A-04 and MX123001A-01. You have to purchase software maintenance simultaneously with MU740701A-04 and MX123001A-01. Moreover, when continuing this software maintenance, annual renewal is required each year.

∗19: Annual Maintenance Service for MU740701A-30 and MX123003A. You have to purchase this software maintenance simultaneously with MU740701A-30 and MX123003A. Moreover, when continuing this software maintenance, annual renewal is required each year.

∗20: Extended Three Year Warranty Service is divided into three order for main frame, CPU module and Power Unit. Please choose your need order among them.

∗21: The GBIC module is sold on a per-unit basis. MU120102A/12A has two GBIC interfaces slots.

∗22: The GBIC-T module is sold on a per-unit basis. MU120112A has two GBIC interfaces slots.

∗23: The XENPAK module is sold on a per-unit basis. MU120118A has two XENPAK interfaces slots.

∗24: Please check the optical power level.

∗25: For CPU module slot.

∗26: For connecting MD1231A Unit Sync (SMB connector).

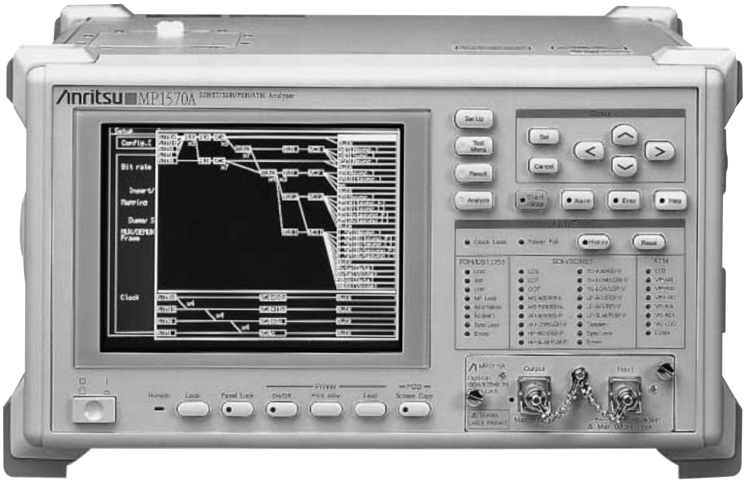
SONET/SDH/PDH/ATM ANALYZER

MP1570A

1.5 Mbit/s to 10 Gbit/s

CE GPIB OPTION

Comprehensive Testing of Core Networks from One Compact Portable Analyzer

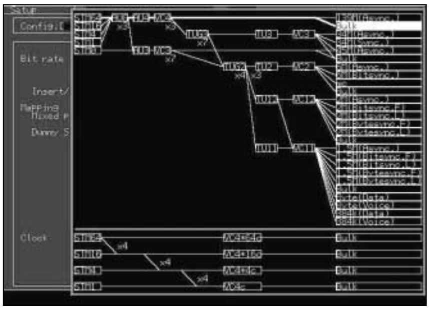


The MP1570A analyzer is designed for development, manufacturing, construction, maintenance, and inspection of SDH, SONET, PDH, and ATM equipment and networks.
A variety of plug-in units and options are available that offer the flexibility to the users to configure various analysis systems for different applications.
The MP1570A is scalable from 1.5 Mbit/s to 10 Gbit/s, and has six slots to install the plug-in units required for SDH, SONET and PDH tests at bit different rates. Installing the appropriate combinations of plug-in units can also perform ATM, jitter and wander tests conform to ITU-T O.171/O.172.
The MP1570A conforms to the ITU-T recommendations and Bellcore standards, and supports concatenation mapping, tandem connection, APS measurement, CID measurement and POS measurement.
The user can measure 1.5 Mbit/s to 10 Gbit/s signals using a single MP1570A; previously, this required several measuring instruments.
The MP1570A has a built-in printer and a 3.5-inch floppy disk drive as standard output devices to print measurement results, and to save and read measurement data to and from the floppy disk (FD), which can also be read on an external PC. The user can also save screen data to the FD. The MP1570A has a "HELP" key function that explains operations, functions and connections.

SDH, SONET and PDH measurement

- **Measurement at bit rates from 1.5 Mbit/s to 10 Gbit/s**

A mapping route to a bit rate of up to 10 Gbit/s can be set.
The MP1570A mainly supports SDH, SONET, and Japanese mapping, European PDH and North American DSn for digital communications. For concatenation mapping, a route can be set from STM-1c/STS-3c up to STM-64c/STS-192c. Furthermore, the MP1570A supports a combination of channels. For example, 64 channels of VC4c/STS3c, 16 channels of VC4-4c/STS-12c, and four channels of VC4-16c/STS-48c (See Figure 1 or Figure 2 in page 165 and 166).



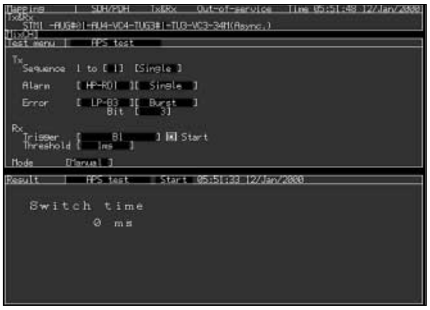
Mapping

- **Overhead setting and testing**

The user can modify and capture the overhead, and test the overhead portion with overhead change, pointer 64 frames, overhead add/drop and overhead bit errors.

- **APS function**

The user can test the automatic protection switch (APS) by measuring the equipment switching time accurately in milliseconds. The MP1570A also conforms to ITU-T Rec. G.783 and G.841.



```
Mapping    |   SDH/PDH    Tx&Rx    Out-of-service    Time 05:51:48 12/Jan/2000
Tx&Rx
   STM1 -AUG#01-AU4-VC4-TUG3#1-TU3-VC3-34M(Async.)
Tx/CH
Test menu  |     APS test
 Tx
  Sequence  1 to [ 1]  [Single ]
  Alarm     [ HP-RDI  ][  Single  ]
  Error     [  LP-B3  ][  Burst   ]
                 Bit  [      3]
 Rx
  Trigger   [        B1        ] ▣ Start
  Threshold [    1ms    ]
 Mode      [Manual ]
Result     |     APS test      Start  05:51:33 12/Jan/2000

    Switch time
          0  ms
```

APS test sub-screen

- **Mixed payload**

At mapping measurement in TUG-3 and AU3, the user can set different mapping for three additional channels other than the target measurement channel.

- **Tandem connection**

The N1/Z5 and N2/Z6 bytes can be set and measured.

- **Various analysis functions**

The internal optical power meter and frequency counter allows the user to measure optical power and frequency during error and alarm measurement without changing the connections of the signal cables. The MP1570A can capture any SOH/TOH or POH (1 byte), K1/ K2 byte, or H1/H2 byte in 1023 frames to analyze errors and alarms, and check APS operation.

Measured errors and alarms can be displayed as a graph with a time scale in 1 second, 1 minute, 15 minutes, or 60 minutes.

- **Pointer value monitoring**

Changes in pointer value can be displayed as a graph with values updated in real time.

- **MUX/DEMUX function (option)**

When the MUX/DEMUX option is added, the multiplexing structure including the frame alignment signal can be generated, and multiplexer/demultiplexer measurement can be performed.

- **Non frame pattern/CID pattern**

Frames can be set on/off at all bit rates. CID pattern can generate or analysis at SONET/SDH measurements.

- **Through modes**

One of the three through modes can be selected: (1) Transparent, (2) Overhead/Overwrite, and (3) Payload/Overwrite. The external DS1/DS3/PDH signal can be added/dropped to/from payload by payload overwrite.

- **Enhanced error/alarm simulation**

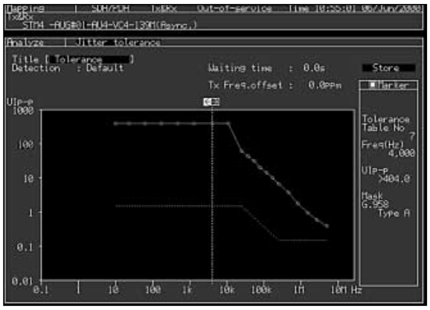
The MP1570A can generate normal and abnormal frames alternately to test the frame synchronization function of terminal equipment. (This is an SDH/SONET FAS error addition function.)

- **Easily operated pointer sequence test (combined jitter measurement)**

Able to generate the justification pattern conforming to ITU-T G.783 from the transmission equipment side, and simultaneously make the tributary signal offset variable. This makes the combined jitter test possible.

Jitter, wander measurements

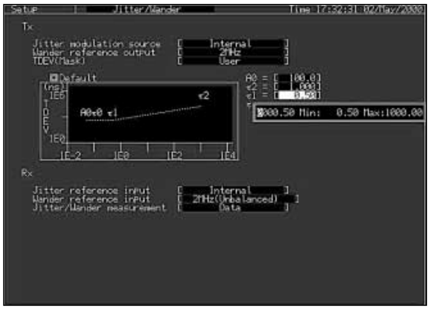
The jitter/wander measurement conforming to ITU-T O.171/O.172 exceeds these standards in performance evaluation. Automatic measurements, such as jitter tolerance, jitter transfer, and jitter vs. frequency offset are performed in a short time. Various automatic measurements can be achieved with just one unit.



Title [Tolerance]
Detection : Default
Waiting time : 0.0s
Tx Freq.offset : 0.0ppm
Tolerance Table No 7
Freq(Hz) 4,000
UIp-p >404.0
Mask G.958 Type A

- **Various wander generation functions (option)**

Various wander generations for evaluation are available: such as TDEV wander tolerance measurement and TDEV wander transfer characteristics measurement that were regulated by ITU-T, ANSI, Bellcore, and ETSI.



Jitter modulation source [Internal]
Wander reference output [2MHz]
TDEV(Mask) [User]
A0 = [100.0]
τ2 = [1000]
τ1 = [0.50]
000.50 Min: 0.50 Max:1000.00
Jitter reference input [Internal]
Wander reference input [2MHz(Unbalanced)]
Jitter/Wander measurement [Data]

- **Wander measurement (option)**

Subdivides the bandwidth of the wander measurement into three ranges, and can analyze the wander factor caused by temperature change, pointer, etc. It can also perform measurements conforming to ITU-T O.172.

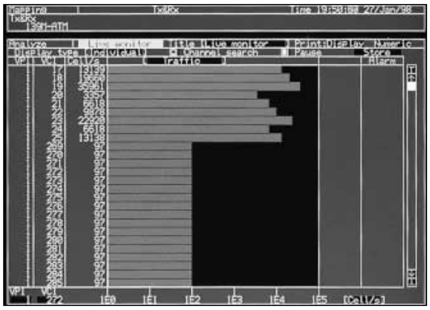
- **Through jitter function (only SONET/SDH)**

Able to generate the jitter by through, while monitoring the input jitter quality.

ATM

- **Supports ATM from 1.5M to 622M rates**

TC layer mappings of 622M, 156M, 52M, 139M, 45M, 34M, 2M and 1.5M are supported along with ATM mappings of O.191, AAL1, AAL2, AAL3/4, and AAL5, which makes the MP1570A ideal for various combinations of layers. The VPI/VCI for 1023 channels can be detected automatically, and the presence/absence of alarms, cell count, and non-conforming cell count can be displayed graphically, for easy comparison of line channel traffic.



- **1- and 2-point CDV in conformance with I.356**

When measuring delay in cell traffic, either 1-point CDV or 2-point CDV conforming to ITU-T Rec. I.356 can be selected according to the conditions.

- **Simultaneous display of error cells, inserted error cells and lost cells**

The error/alarm generation conditions can be displayed both numerically and graphically to give a visual impression of the traffic conditions.

- **Traffic monitoring**

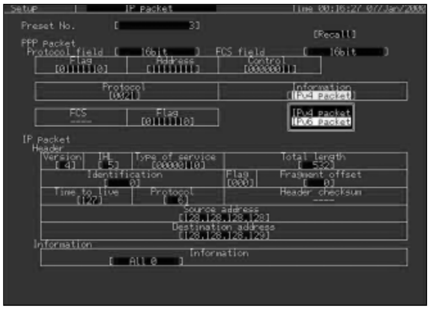
The constantly changing traffic can be displayed as a graph for the selected-one-channel VPI/VCI.

IP-over-SONET/SDH, IP-over-ATM (option)

Programs IP/PPP at will transmits it, picks PPP packet from capture memory (option), displays it and supports high-speed POS router evaluation. Programs IP in the AAL5 payload at will transmits it, picks the IP packet from the cell capture memory, and displays it. And evaluate router ATM function.

- **IP/PPP header setting**

Able to set the value of each header optionally when selecting IPv4 or IPv6. Calculates FCS or header checksum automatically.



Preset No. [3]
Protocol field [16bit] FCS field [16bit]
Flag [01111110] Address [11111111] Control [00000011]
Protocol [0021] Information [IPv4 Packet]
FCS ---- Flag [01111110]
Version [4] IHL [5] Type of service [00000110] Total length [532]
Identification [0] Flag [000] Fragment offset [0]
Time to live [127] Protocol [6] Header checksum ----
Source address [128.128.128.128]
Destination address [128.128.128.129]
Information [All 0]

- **PPP packet transmission and real time count**

Transmits the three types of packets (can be set separately) by optional sequence (the idle length between each packet can be set simultaneously.). Displays the number of Tx packets and Rx PPP packets at real time.

- **PPP packet capture and display**

Samples PPP packet from the capture memory, and displays IP header. Detects FCS error and displays it in red.

Specifications

• MP0121A 2/8/34/139/156M*1 Unit

Bit rate	2.048, 8.448, 34.368, 139.264 Mbit/s
Level/waveform	Conforms to ITU-T G.703 (with 20 dB monitoring point)
Connectors	BNC (75 Ω, unbalanced), 3-pin Siemens (120 Ω, balanced) 2.048 Mbit/s: HDB3 (balanced/unbalanced) 8.448, 34.368 Mbit/s: HDB3 (unbalanced) 139.264 Mbit/s: CMI (unbalanced)
Clock	Internal (accuracy: ±7 ppm, jitter unit not installed), external (ECL [AC] 50 Ω), received signal
Frame format	Unframed: 2, 8, 34, 139 Mbit/s Framed: 2 Mbit/s (with/without CRC-4 at channels 30/31, G.704), 8 Mbit/s (G.742), 34 Mbit/s (G.751), 139 Mbit/s (G.751), MUX/DEMUX (Option 06)
Test patterns	PRBS: $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$, $2^{23} – 1$ (O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit (all, test pattern), code, E-bit Timing: Single, rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7) FAS: n in 16 (n: 1 to 4), all
Alarm addition	LOS, LOF, AIS, RDI, RDI (MF) Timing: All
Measurements	Mode: Single, repeat, manual In-service Errors: Frame, code, CRC-4, E-bit Alarms: Power-fail, LOS, AIS, LOF, MF loss, RDI, RDI (MF) Error performance: G.821 (inc. Annex D), M.2100, G.826 Out-of-service Errors: Frame, code, CRC-4, E-bit, bit Alarms: Power-fail, LOS, AIS, LOF, MF loss, RDI, RDI (MF), sync loss Error performance: G.821 (inc. Annex D), M.2100, G.826
Delay	Measurement cycle: 0.5, 1 s Measurement range: 0 to 1.00 s, timeout Display accuracy: Within ±5 µs, 0 to 999 µs, 1.0 to 999.9 ms, 1.0 s, timeout
LEDs	LOS, AIS, LOF, MF loss, RDI, RDI (MF), sync loss, errors
Monitor	Frame word
Trouble search	Auto search for errors/alarms in all measured channels
Auxiliary interface	Clock sync output, frame sync output, error output

*1: Built-in 156M CMI (electrical) interface

• MP0122A 1.5/45/52M*1 Unit, MP0122B 1.5/45/52/52M*2 (1.31) Unit

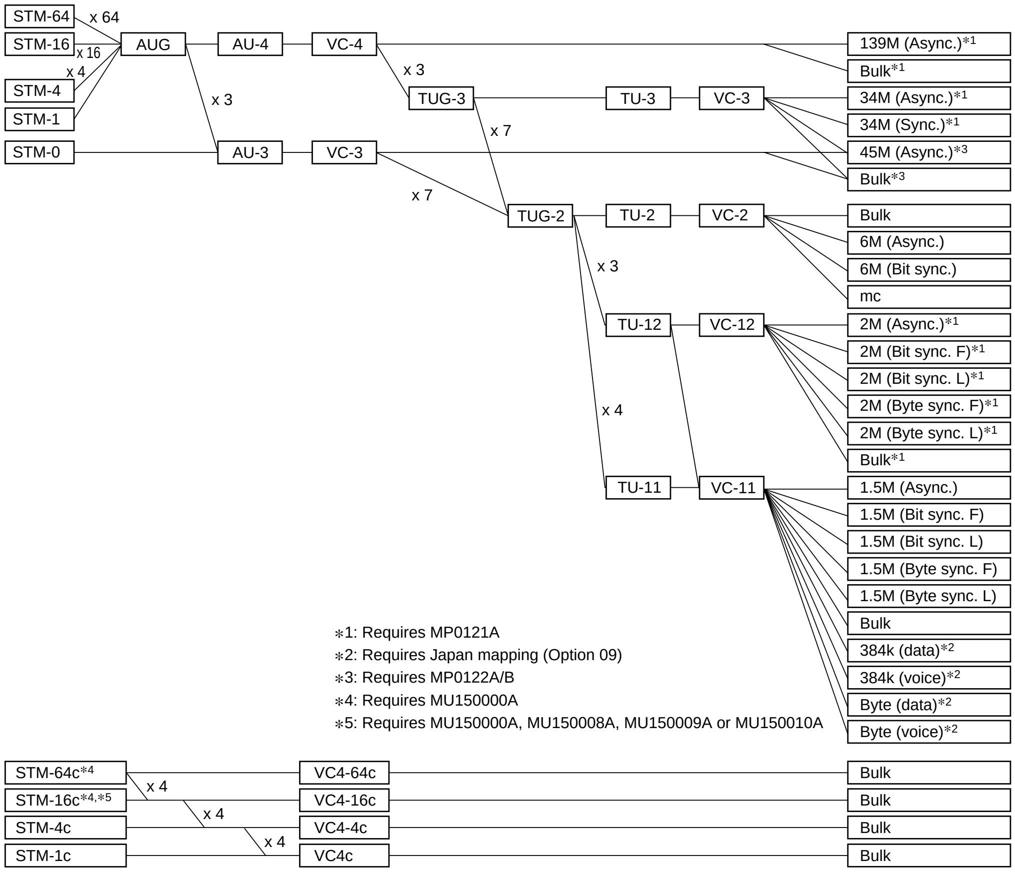
Bit rate	1.544, 44.736 Mbit/s
Level/waveform	1.544 Mbit/s: ANSI T1.102 (with 20 dB monitoring point), 0/655 ft 44.736 Mbit/s: ANSI T1.102 (with 20 dB monitoring point), 0/450/900 ft
Connectors	BNC (75 Ω, unbalanced), BANTAM (100 Ω, balanced) 1.544 Mbit/s: AMI/B8ZS (balanced), 44.736 Mbit/s: B3ZS (unbalanced)
Clock	Internal (accuracy: ±7 ppm, jitter unit not installed), external (ECL [AC] 50 Ω) received signal
Frame format	Unframed: 1.5, 45 Mbit/s Framed: 1.5 Mbit/s (D4, ESF, Japan ESF*3), 45 Mbit/s (M13, C-bit), MUX/DEMUX (Option 07)
Test patterns	PRBS: $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$ (zero suppress), $2^{20} – 1$, $2^{23} – 1$ (O.151) Invert: On/off Word: 16-bit program, all 0, all 1, 3 in 24 (1.5 Mbit/s)
Error addition	Bit (all, test pattern), code, parity, CRC-6, C-bit, REI Timing: Single, rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7) FAS (45 Mbit/s): n in 16 (n: 1 to 4), all
X-bit setting	00, 01, 10, 11
Alarm addition	LOS, LOF, AIS, RDI Timing: All
Measurements	Mode: Single, repeat, manual In-service Errors: FAS, code, parity, CRC-6, C-bit, REI Alarms: Power-fail, LOS, AIS, LOF, RDI Error performance: G.821 (inc. Annex D), M.2100, G.826 Out-of-service Errors: FAS, code, parity, CRC-6, C-bit, REI, bit Alarms: Power-fail, LOS, AIS, LOF, RDI, sync loss Error performance: G.821 (inc. Annex D), M.2100, G.826
Delay	Measurement cycle: 0.5, 1 s Measurement range: 0 to 1.00 s, timeout Display accuracy: Within ±5 µs, 0 to 999 µs, 1.0 to 999.9 ms, 1.0 s, timeout
LEDs	LOS, LOF, AIS, RDI, sync loss, errors
Trouble search	Auto search for errors/alarms in all measured channels
Auxiliary interface	Clock sync output, frame sync output, error output

*1: Built-in 52M B3ZS (electrical) interface
*2: Built-in 52M B3ZS (electrical) and optical interfaces
*3: Mounted Option 09 (Japan mapping)

- **52/156/622/2488/9953M (SDH)**

Bit rate	51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s
Level/waveform	52M (electrical: B3ZS)[*1]: ANSI T1.102, 0/450 ft 52M (optical): As per MP0122B unit optical interface specifications 156M (electrical: CMI)[*2]: ITU-T G.703 156M (optical): As per optical 156M/622M unit specifications 622M (electrical/optical): As per optical 156M/622M unit and NRZ unit specifications 2488M (electrical/optical): As per 2.5G unit and 2.5G/10G unit specifications 9953M (electrical/optical): As per 2.5G/10G unit specifications
Clock	Internal (accuracy: ±3.5 ppm, jitter unit not installed), Lock (2 MHz, 1.5 MHz, 64 kHz + 8 kHz, 2 Mbit/s, 1.5 Mbit/s), external (ECL [AC] 50 Ω, 9953M: 1.02 to 0.58 Vp-p, 50 Ω), received signal
Frame	SDH/SONET, CID pattern, non-frame
Mapping	See Fig. 1
Through	Trance parent, over head overwrite, payload overwrite
Test patterns	PRBS: $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$ (zero suppress, MP0122A/B installed), $2^{20} – 1$, $2^{23} – 1$, $2^{31} – 1$ (only concatenation mapping 16c/64c, conform to O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit all (all, test pattern), FAS, B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI Timing: Single, single (burst) bit (1 to 64000), rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7, 1E–8, 1E–9) User program AE-B [A: 1.0 to 9.9 (step: 0.1), B: 2 to 10] Alternative: Error frame (0 to 8000), normal frame (1 to 8000)
Alarm addition	LOS, LOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ, TU-AIS, TU-LOP, TU-LOM, LP-SLM, LP-TIM, LP-RDI, LP-UNEQ, LP-RFI Timing: Single, single (burst) frame Alternative: Alarm frame (0 to 8000), normal frame (1 to 8000), all
Measurements	Mode: Single, repeat, manual In-service/Out-of-service Errors: B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI Alarms: Power-fail, LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ, TU-AIS, TU-LOP, TU-LOM, LP-SLM, LP-TIM, LP-RDI, LP-UNEQ, LP-RFI Error performance: G.826, M2101, M2110, M2120 Preset: Alarm measurement condition
LEDs	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-SLM, TU-AIS, TU-LOM, TU-LOP, LP-RDI, LP-RFI, LP-SLM, Tandem, sync. loss, errors
Tandem connection	N1 byte (Type 1, Type 2), N2 byte Errors: N2 BIP-2, TC-REI, OEI, IEC Alarms: VC-AIS, ISF, FAS, HP-Incoming-AIS, HP-TC-RDI, HP-ODI, LP-Incoming-AIS, LP-TC-RDI, LP-ODI
Justification	AU pointer, TU pointer, C, C1/C2 Measurement: NDF, +PJC, –PJC, Cons, C, C1/C2
Monitor	SOH, POH, K1/K2, pointer, path trace (TIM alarms detectable), Tandem, payload
Pointer sequence	Signal of opposites polarity, regular with double, regular with missing, double of opposites polarity, 87-3/26-1 (normal, add, cancel), continuous pattern (normal, add, cancel), single pointer adjustment, maximum rate pointer burst, phase transient pointer burst, initialize period polarity, cooldown period
Over head capture	SOH/POH (any 1 byte), H1/H2, K1/K2
Dummy channel setting	Payload: Dummy, copy, mixed payload Setting: POH, pathtrace, SS bit, Tandem
Simultaneous measurement	VC2, VC12, VC11
Trouble search	Auto search for errors/alarms in all measured channels
Delay	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, time out Display accuracy: ±5 µs (0.5, 1 s), ±50 µs (2, 5, 10 s)
APS (K1/K2)	Switching time measurement Measurement range: 1 to 2000 ms, >2000 ms Trigger Internal: B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI, MS-AIS, AU-AIS, AU-LOP, HP-RDI, TU-AIS, TU-LOM, TU-LOP, LP-RDI, LP-RFI, Bit External: Measures trigger input signal (active high) Threshold: Specify non-error alarm between 1 ms, 10 ms, 100 ms Sequence generation: 2 to 64 word, repeat (8000 frame) Sequence capture: 2 to 64 word, repeat (8000 frame)
Frequency measurement	Range: ±100 ppm, Accuracy: ±3.5 ppm (jitter unit not installed)
Over head test	OH change: SOH/POH 1 byte, K1/K2, RSOH, MSOH, SOH, POH (except B1, B2, B3, BIP-2) PTR 64 frame: AU pointer, TU pointer Timing: Single, repeat (2 to 64) Setting: PTR, NDF, +PJC, –PJC OH BERT: SOH/POH 1 byte (exclude B1, B2, B3, BIP-2), D1-D3, D4-D12 Test pattern: $2^{11} – 1$, $2^{15} – 1$ OH add/drop: SOH/POH 1 byte, D1-D3, D4-D12 (exclude B1, B2, B3, BIP-2 additional type)
Japan mapping (option 09)	VC11 Signaling (8-multiframe, 64-multiframe setting)
Frame memory/capture	Memory size: 64 frame (156M, 622M, Option 13), 64 frame (MU150008A-01/150009A-01/150010A-01, 2.5G), 26 frame (MU150000A-01, 2.5G/10G)
Insert/extract	Bit rate: 10G (52M, 156M), 2.5G (52M, 156M)
Payload offset	±100 ppm/0.1 ppm step
Auxiliary interface	Clock sync output, trigger input, trigger output, DCC interface (V.11), orderwire, receive clock output

*1: Mounted MP0122A/B, *2: Mounted MP0121A



*1: Requires MP0121A
*2: Requires Japan mapping (Option 09)
*3: Requires MP0122A/B
*4: Requires MU150000A
*5: Requires MU150000A, MU150008A, MU150009A or MU150010A

Fig. 1 Mapping structure (SDH)

- **52/156/622/2488/9953M (SONET)**

Bit rate	51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s
Level/waveform	52M (electrical: B3ZS)*1: ANSI T1.102, 0/450 ft 52M (optical): As per MP0122B unit optical interface specifications 156M (electrical: CMI)*2: ITU-T G.703 156M (optical): As per optical 156M/622M unit specifications 622M (electrical/optical): As per optical 156M/622M unit and NRZ unit specifications 2488M (electrical/optical): As per 2.5G unit and 2.5G/10G unit specifications 9953M (electrical/optical): As per 2.5G/10G unit specifications
Clock	Internal (accuracy: ±3.5 ppm, jitter unit not installed), Lock (2 MHz, 1.5 MHz, 64 kHz + 8 kHz, 2 Mbit/s, 1.5 Mbit/s), External (ECL [AC] 50 Ω, 9953M: 1.02 to 0.58 Vp-p, 50 Ω), received signal
Frame	SDH/SONET, CID pattern, non-frame
Mapping	See Fig. 2
Through	Trance parent, over head overwrite, payload overwrite
Test patterns	PRBS: $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$ (zero suppress, MP0122A/B installed), $2^{20} – 1$, $2^{23} – 1$, $2^{31} – 1$ (only concatenation mapping 16c/64c, conform to O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit all (all, test pattern), FAS, B1, B2, B3, BIP-2, REI-L, REI-P, REI-V Timing: Single, single (burst) bit (1 to 64000), rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7, 1E–8, 1E–9) User program AE-B [A: 1.0 to 9.9 (step: 0.1), B: 2 to 10] Alternative: Error frame (0 to 8000), normal frame (1 to 8000)
Alarm addition	LOS, LOF, AIS-L, RDI-L, AIS-P, LOP-P, PLM-P, HP-TIM, RDI-P, UNEQ-P, AIS-V, LOP-V, LOM-V, PLM-V, LP-TIM, RDI-V, UNEQ-V, RFI-V Timing: Single, single (burst) frame Alternative: alarm frame (0 to 8000), normal frame (1 to 8000), all
Measurements	Mode: Single, repeat, manual In-service/Out-of-service Errors: B1, B2, B3, BIP-2, REI-L, REI-P, REI-V Alarms: Power-fail, LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, LOP-P, PLM-P, HP-TIM, RDI-P, UNEQ-P, AIS-V, LOP-V, LOM-V, PLM-V, LP-TIM, RDI-V, UNEQ-V, RFI-V Error performance: G.826, M2101, M2110, M2120 Preset: Alarm measurement condition
LEDs	LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, LOP-P, RDI-P, PLM-P, AIS-V, LOM-V, LOP-V, RDI-V, RFI-V, PLM-V, Tandem, sync. loss, errors
Tandem connection	Z5 byte (Type 1, Type 2), Z6 byte Errors: Z6 BIP-2, TC-REI, OEI, IEC Alarms: VC-AIS, ISF, FAS, HP-Incoming-AIS, HP-TC-RDI, HP-ODI, LP-Incoming-AIS, LP-TC-RDI, LP-ODI

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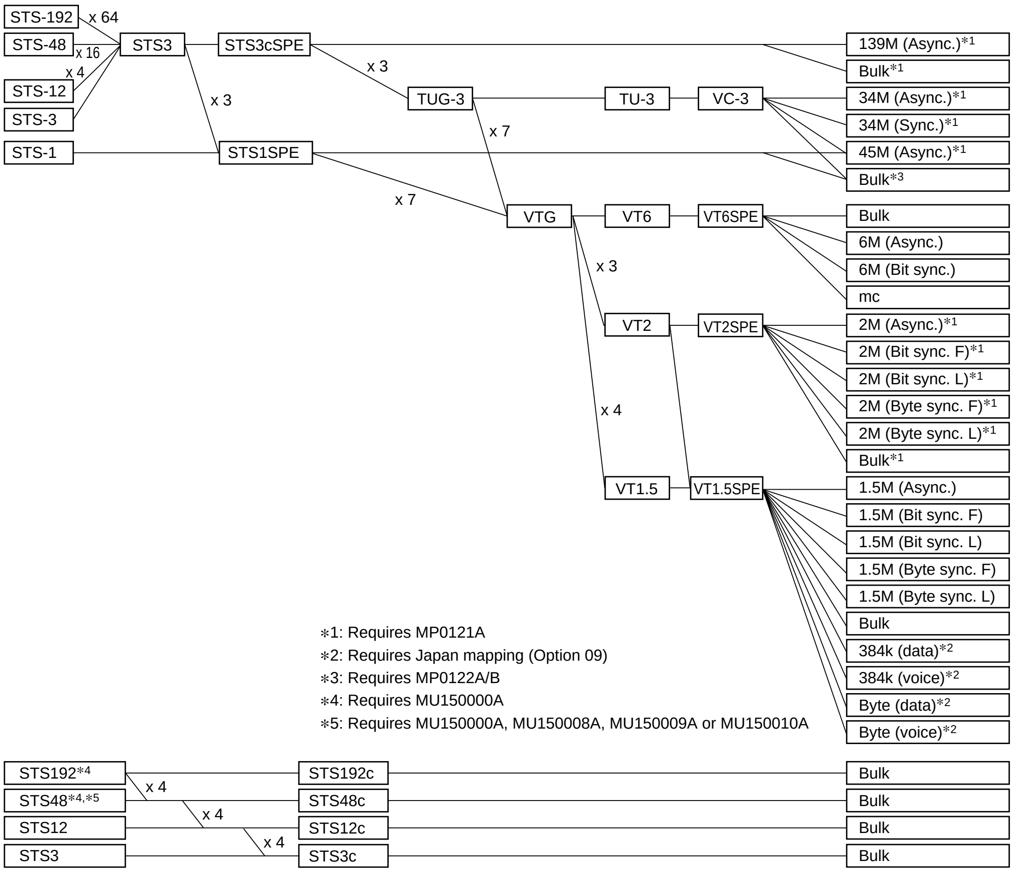
Justification	STS pointer, VT pointer, C, C1/C2 Measurement: NDF, +PJC, –PJC, Cons, C, C1/C2
Monitor	TOH, POH, K1/K2, pointer, path trace (TIM alarms detectable), Tandem, payload
Pointer sequence	Signal of opposites polarity, regular with double, regular with missing, double of opposites polarity, 87-3/26-1 (normal, add, cancel), continuous pattern (normal, add, cancel), single pointer adjustment, maximum rate pointer burst, phase transient pointer burst, initialize period polarity, cooldown period
Over head capture	TOH/POH (any 1 byte), H1/H2, K1/K2
Dummy channel setting	Payload: Dummy, copy, mixed payload Setting: POH, pathtrace, SS bit, Tandem
Simultaneous measurement	VT6SPE, VT2SPE, VT1.5SPE
Trouble search	Auto search for errors/alarms in all measured channels
Delay	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, time out Display accuracy: ±5 µs (0.5, 1 s), ±50 µs (2, 5, 10 s)
APS (K1/K2)	Switching time measurement Measurement range: 1 to 2000 ms, >2000 ms Trigger Internal: B1, B2, B3, BIP-2, REI-L, REI-P, REI-V, AIS-L, AIS-P, LOP-P, RDI-P, AIS-V, LOM-V, LOP-V, RDI-V, RFI-V, Bit External: Measures trigger input signal (active high) Threshold: Specify non-error alarm between 1 ms, 10 ms, 100 ms Sequence generation: 2 to 64 word, repeat (8000 frame) Sequence capture: 2 to 64 word, repeat (8000 frame)
Frequency measurement	Range: ±100 ppm, Accuracy: ±3.5 ppm (jitter unit not installed)
Over head test	OH change: TOH/POH 1 byte, K1/K2, LOH, SOH, TOH, POH (except B1, B2, B3, BIP-2) PTR 64 frame: STS pointer, VT pointer Timing: Single, repeat (2 to 64) Setting: PTR, NDF, +PJC, –PJC OH BERT: TOH/POH 1 byte (exclude B1, B2, B3, BIP-2), D1-D3, D4-D12 Test pattern: $2^{11} – 1$, $2^{15} – 1$ OH add/drop: TOH/POH 1 byte, D1-D3, D4-D12 (exclude B1, B2, B3, BIP-2 additional type)
Japan mapping (option 09)	VT1.5SPE Signaling (8-multiframe, 64-multiframe setting)
Frame memory/capture	Memory size: 64 frame (156M, 622M, Option 13), 64 frame (MU150008A-01/150009A-01/150010A-01, 2.5G), 26 frame (MU150000A-01, 2.5G/10G)
Insert/extract	Bit rate: 10G (52M, 156M), 2.5G (52M, 156M)
Payload offset	±100 ppm/0.1 ppm step
Auxiliary interface	Clock sync output, trigger input, trigger output, DCC interface (V.11), orderwire, receive clock output

*1: Mounted MP0122A/B, *2: Mounted MP0121A



*1: Requires MP0121A
*2: Requires Japan mapping (Option 09)
*3: Requires MP0122A/B
*4: Requires MU150000A
*5: Requires MU150000A, MU150008A, MU150009A or MU150010A

Fig. 2 Mapping structure (SONET)

• IP-over-SONET/SDH (Option)*1

Bit rate	155.52, 622.08, 2488.32, 9953.28 Mbit/s
PPP setting (RFC1662)	Flag, address, control: Any settable Protocol: 8/16 bit selectable and any settable FCS: 16/32 bit selectable and auto calculate Information: IPv4/IPv6 selectable and any settable
IPv4 setting (RFC791)	Any setting: Version, IHL, TOS, total length, ID, flags, flagment offset, TTL, protocol, address (source, destination) Header checksum: Auto calculate Data byte: All 0, all 1, 8 bits program, single PRBS 7, user program (max. 65535 byte)
IPv6 setting (RFC1883)	Any setting: Version, priority, flow label, payload length, next header, hop limit, address (source, destination) Data byte: All 0, all 1, 8 bits program, single PRBS 7, user program (max. 65535 byte)
Packet transmission setting	1 to 3 in IP/PPP (independently), IP/PPP sending pattern, packet sending interval (max. 100000 bytes), single/repeat, sending on/off, scramble (X^{43} + 1) on/off, control escape auto insertion, FCS error insertion (single), number of packet count display
Packet receiving/analysis	PPP frame calculation (count), scramble (X^{43} + 1) on/off setting, automatic analysis of control escape. Frame/capture memory (option) required data captured into the capture memory (max. 64 frames*2), IPv4/IPv6 select, IP address filter set

*1: The frame/capture memory (option) is required.
*2: Maximum 26 frames at 2488/9953 Mbits when MU150000A is inserted.

• IP-over-ATM (Option)*1

Bit rate	155.52, 622.08 Mbit/s
AAL5 edit pattern	IPv4/IPv6 selectable
IPv4 setting (RFC791)	Any setting: Version, IHL, TOS, total length, ID, flags, flagment offset, TTL, protocol, address (source, destination) Header checksum: Auto calculate Data byte: All 0, all 1, 8 bit program, single PRBS 7, user program (max. 65535 bytes)
IPv6 setting (RFC1883)	Any setting: Version, priority, flow label, payload length, next header, hop limit, address (source, destination) Data byte: All 0, all 1, 8 bits program, single PRBS 7, user program (max. 65535 bytes)
Packet sending	Follow with AAL5 distribution setting
Packet receiving/analysis	Displays the IP packet from the data captured into cell capture memory (maximum 2016 cells), IPv4/IPv6 selectable

*1: MP0123A ATM Unit is required.

• General

Printer	Internal, external
Internal memory	Measurement settings memory: 10, Graphics memory: 15
Others	FDD, RS-232C (Option 01)*1, GPIB (Option 02)*1, Ethernet (Option 03)*1, video output (Option 04)*1, buzzer, clock, help, screen copy
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, 10 kg approx. (excluding plug-in units and options)
Power	100 to 240 Vac, 47.5 to 63 Hz, ≤500 VA
Temperature	0˚ to +40˚C

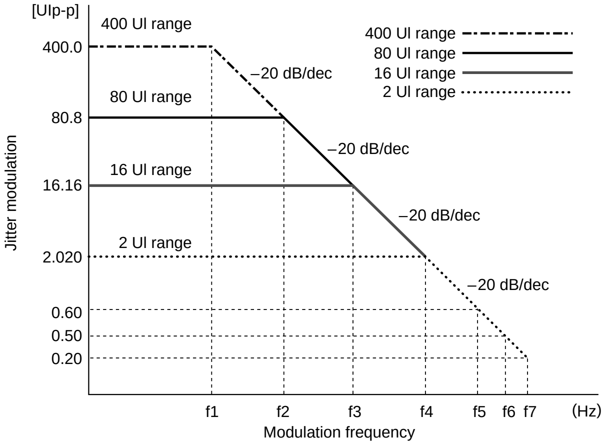
*1: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously.
Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

• MU150005A/150006A/150007A Jitter Units

Bit rate	MU150005A: 2.048, 8.448, 34.368, 139.264, 155.52, 622.08 Mbit/s MU150006A: 1.544, 44.736, 51.84, 155.52, 622.08 Mbit/s MU150007A: 1.544, 2.048, 8.448, 34.368, 44.736, 139.264, 51.84, 155.52, 622.08 Mbit/s

Jitter generation

Conform to ITU-T O.171/O.172
Modulation frequency: 0.1 Hz to 6 MHz
Amplitude: 0 to 404.0 UIp-p
Resolution:0.001 UIp-p (2 UI range), 0.01 UIp-p (16 UI range), 0.1 UIp-p (80 UI range), 0.2 UIp-p (400 UI range)



Bit rate (Mbit/s)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (kHz)	f6 (kHz)	f7 (kHz)
1.544	130	630	3.2	25	—	100	—
2.048	300	1.5k	7.5	60	—	240	—
8.448	1.1k	5.5k	28	220	—	880	—
34.368	2.5k	13k	63	500	—	—	5000
44.736	2.5k	13k	63	500	—	—	5000
139.264	9k	45k	230	1800	6000	—	—
51.84	2.5k	13k	63	500	—	—	5000
155.52	7.5k	38k	190	1500	—	6000	—
622.08	3k	15k	75	600	—	—	6000

Accuracy

2 UI range: (±Q% of setting) ±0.02 UIp-p, 16 UI range: (±Q% of setting) ±0.2 UIp-p, 80 UI range: (±Q% of setting) ±1.2 UIp-p, 400 UI range: (±Q% of setting) ±6 UIp-p

Bit rate (Mbit/s)	Error Q	Frequency range
1.544	±12%	0.1 to 2 Hz
	±8%	2 Hz to 100 kHz
2.048	±12%	0.1 to 10 Hz
	±8%	10 Hz to 240 kHz
8.448	±12%	0.1 to 20 Hz
	±8%	20 Hz to 880 kHz
34.368	±12%	0.1 to 100 Hz
	±8%	0.1 to 500 kHz
	±12%	500 kHz to 5 MHz
44.736	±12%	0.1 to 2 Hz
	±8%	2 Hz to 5 MHz
139.264	±12%	0.1 to 100 Hz
	±8%	0.1 to 500 kHz
	±12%	0.5 to 2 MHz
	±15%	2 to 6 MHz
51.84	±12%	0.1 to 300 Hz
	±8%	300 Hz to 5 MHz
155.52	±12%	0.1 to 500 Hz
	±8%	0.5 to 500 kHz
	±12%	0.5 to 6 MHz
622.08	±12%	0.1 Hz to 1 kHz
	±8%	1 to 500 kHz
	±12%	0.5 to 2 MHz
	±15%	2 to 6 MHz

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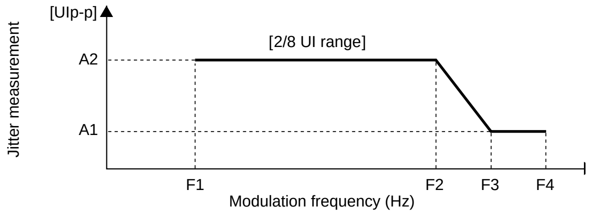
Frequency offset	Range: ±999.9 ppm/0.1 ppm steps (jitter off), ±100 ppm/0.1 ppm steps (jitter on/off) Accuracy: ±0.1 ppm after power-on, calibrates after 60 min warm-up, 23˚ ±5˚C
Auxiliary interface	External modulation input, External 5/10 MHz reference input, Jitter clock/Jitter reference output, Wander reference output

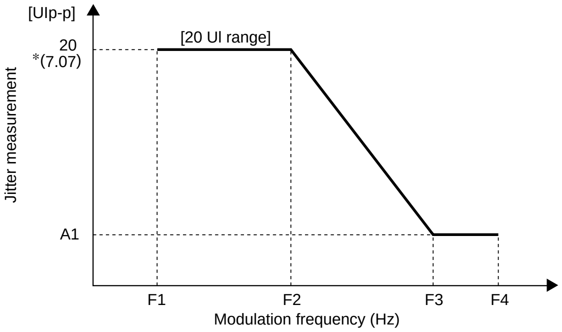
Jitter measurement

Conform to ITU-T O.171/O.172
Modulation frequency: 0.1 Hz to 5 MHz
Amplitude: 0.0 to 400 UI (800 UI: at 622M)
Resolution:
0.001 UIp-p/0.001 UIrms (2 UI range), 0.01 UIp-p/0.01 UIrms (8 UI/20 UI range), 0.2 UIp-p (400 UI range), 0.5 UIp-p (800 UI range)



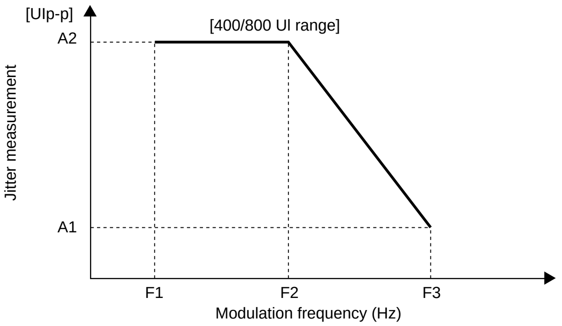
Bit rate (Mbit/s)	A1 (UIp-p)	A2 (UIp-p)		F1* (Hz)		F2 (Hz)		F3 (Hz)	F4 (Hz)
	—	Full	Wide	Full	Wide	Full	Wide	—	—
1.544	0.5	8	2	0.1	10	1.25k	5k	20k	40k
2.048	0.5	8	2	0.1	10	3.75k	15k	60k	100k
8.448	0.5	—	2	—	10	—	50k	200k	400k
34.368	0.5	8	2	0.1	10	18.75k	75k	300k	800k
44.736	0.5	8	2	0.1	10	25k	100k	400k	400k
139.264	0.5	8	2	0.1	10	50k	200k	800k	3.5M
51.84	0.5	8	2	1	10	25k	100k	400k	400k
155.52	0.4	8	2	1	10	25k	100k	500k	1.3M
622.08	0.3	8	2	1	10	75k	300k	2M	5M

∗F1 = 100 Hz at RMS



Bit rate (Mbit/s)	A1 (UIp-p)	F1* (Hz)		F2 (Hz)	F3 (Hz)	F4 (Hz)
	—	Full	Wide	—	—	—
1.544	0.67	0.1	1	600	15k	15k
2.048	1.67	0.1	1	1.5k	18k	18k
8.448	1.43	0.1	1	5k	70k	70k
34.368	0.5	0.1	1	8k	300k	300k
44.736	0.5	0.1	1	10k	400k	400k
139.264	0.5	0.1	1	20k	800k	1.2M
51.84	0.5	1	1	10k	400k	400k
155.52	0.4	1	1	10k	500k	1.3M
622.08	0.3	1	1	30k	2M	5M

*F1 = 100 Hz at RMS



Bit rate (Mbit/s)	A1 (UIp-p)	A2 (UIp-p)	F1** (Hz)	F2 (Hz)	F3 (Hz)
1.544	20	400	0.1	10	200
2.048	20	400	0.1	10	200
8.448	20	400	0.1	10	200
34.368	20	400	0.1	10	200
44.736	20	400	0.1	10	200
139.264	20	400	0.1	10	200
51.84	20	400	0.1	10	200
155.52	4	400	0.1	10	1k
622.08	4	800	0.1	10	2k

**: Full band only

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Jitter measurement

Filter:
Conform to O.171/O.172, LP, HP0 + LP, HP1 + LP, HP2 + LP, HP + LP, user

Bit rate (Mbit/s)	HP0 (Hz)	HP1 (Hz)	HP2 (Hz)	HP2' (Hz)	HP (Hz)	LP (Hz)
1.544	10	10	8k	—	12k	40k
2.048	10	20	18k	700	12k	100k
8.448	10	20	3k	80k	12k	400k
34.368	10	100	10k	—	12k	800k
44.736	10	10	30k	—	12k	400k
139.264	10	200	10k	—	12k	3.5M
51.84	10	100	20k	—	12k	400k
155.52	10	500	65k	—	12k	1.3M
622.08	10	1k	250k	—	12k	5M

Accuracy (UIp-p, UI+p, UI-p)
2 UI range: ±R% of reading ±W UIp-p, 20 UI range: ±R% of reading ±W UIp-p, 400 UI range: ±R% of reading ±W UIp-p, 800 UI range: ±R% of reading ±W UIp-p

Fixed error [W]
UIp-p

Bit rate (Mbit/s)	Pseudo-random signal							
	HP1 + LP				HP2 + LP			Bit length
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI	
1.544	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{20} – 1$
2.048	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{15} – 1$
8.448	0.040	—	0.22	3.5	0.025	—	0.15	$2^{15} – 1$
34.368	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{23} – 1$
44.736	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{15} – 1$
139.264	0.040	0.08	0.30	5.0	0.025	0.05	0.15	$2^{23} – 1$

Bit rate (Mbit/s)	Clock signal						
	HP1 + LP				HP2 + LP		
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI
1.544	0.015	0.03	0.10	1.6	0.010	0.02	0.08
2.048	0.015	0.03	0.10	1.6	0.010	0.02	0.08
8.448	0.015	—	0.10	1.6	0.010	—	0.08
34.368	0.030	0.06	0.18	2.8	0.020	0.04	0.15
44.736	0.030	0.06	0.18	2.8	0.020	0.04	0.15
139.264	0.030	0.06	0.22	3.8	0.020	0.04	0.20

Bit rate (Mbit/s)	SONET/SDH signal							
	HP1 + LP				HP2 + LP			Container
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI	
51.84e	0.070	0.14	0.30	5.0	0.050	0.10	0.20	VC3
51.84o	0.070	0.14	0.30	5.0	0.050	0.10	0.20	VC3
155.52e	0.070	0.14	0.30	5.0	0.025	0.05	0.20	VC4
155.52o	0.070	0.14	0.30	5.0	0.050	0.10	0.20	VC4
622.08	0.100	0.20	0.30	10.0	0.050	0.10	0.20	VC4-4c

At PRBS $2^{23} – 1$

Bit rate (Mbit/s)	Clock signal						
	HP1 + LP				HP2 + LP		
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI
51.84e	0.050	0.10	0.22	3.8	0.030	0.06	0.20
155.52e	0.050	0.10	0.22	3.8	0.030	0.06	0.20
622.08	0.050	0.10	0.22	5.0	0.030	0.06	0.20

Frequency error [R]

Frequency error	Frequency range
±10%	0.1 to 20 Hz
±7%	20 Hz to 300 kHz
±8%	300 kHz to 1 MHz
±10%	1 to 3 MHz
±15%	3 to 5 MHz

Continued on next page

Jitter measurement

UIrms
2 UI range: ±R% ±Y UIrms, 20 UI range: ±R% ±Y UIrms

Fixed error [Y]
UIrms

Bit rate (Mbit/s)	Pseudo-random signal			
	HP + LP			Bit length
	2 UI	8 UI	20 UI	
1.544	0.006	0.02	0.04	$2^{20} – 1$
2.048	0.006	0.02	0.04	$2^{15} – 1$
8.448	0.006	—	0.04	$2^{15} – 1$
34.368	0.008	0.02	0.05	$2^{23} – 1$
44.736	0.008	0.02	0.05	$2^{15} – 1$
139.264	0.008	0.02	0.05	$2^{23} – 1$

Bit rate (Mbit/s)	Clock signal		
	HP + LP		
	2 UI	8 UI	20 UI
1.544	0.004	0.02	0.03
2.048	0.004	0.02	0.03
8.448	0.004	—	0.03
34.368	0.006	0.02	0.04
44.736	0.006	0.02	0.04
139.264	0.006	0.02	0.04

Bit rate (Mbit/s)	SONET/SDH signal			
	HP + LP			Container
	2 UI	8 UI	20 UI	
51.84e	0.010	0.02	0.06	VC3
51.84o	0.010	0.02	0.06	VC3
155.52e	0.010	0.02	0.06	VC4
155.52o	0.010	0.02	0.06	VC4
622.08	0.012	0.03	0.08	VC4-4c

At PRBS $2^{23} – 1$

Bit rate (Mbit/s)	Clock signal		
	HP + LP		
	2 UI	8 UI	20 UI
51.84e	0.008	0.02	0.05
155.52e	0.008	0.02	0.05
622.08	0.010	0.02	0.06

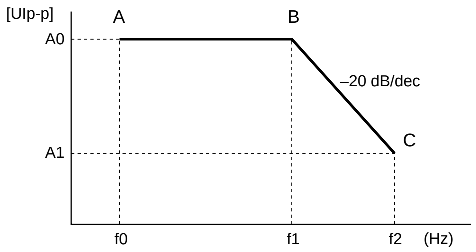
Frequency error [R]

Frequency error	Frequency range
±10%	0.1 to 20 Hz
±7%	20 Hz to 300 kHz
±8%	300 kHz to 1 MHz
±10%	1 to 3 MHz
±15%	3 to 5 MHz

Hit measurement	Count, seconds, % free Seconds
Frequency measurement	Resolution: 0.1 ppm, Display: Hz or ppm (After power-on, calibrates after 60 min warm-up, 23˚ ±5˚C)
Auxiliary interface	Demodulation output, Clock/Reference input
Jitter auto measurement	Jitter tolerance measurement: Evaluates jitter tolerance point automatically Jitter sweep measurement: Conforms to high-speed jitter tolerance evaluation for mass production, etc. Jitter transfer measurement: High dynamic range measurement by selective level method (variable) Jitter frequency measurement: Measures the mapping jitter automatically Frequency sweep measurement: Measures the jitter tolerance automatically while changing the offset

Line wander generation

Modulation frequency: 10 µHz to 10 Hz (sine wave)
Amplitude: 0 to 400,000 UI (10 UIp-p steps)



Bit rate (Mbit/s)	f0 (µHz)	f1 (mHz)	f2 (Hz)	A0 (UIp-p)	A1 (UIp-p)
1.544	10	20	10	400,000	800
2.048	10	20	10	400,000	800
8.448	10	200	10	400,000	8,000
34.368	10	400	10	400,000	16,000
44.736	10	400	10	400,000	16,000
139.264	10	2,000	10	400,000	80,000
51.84	10	400	10	400,000	16,000
155.52	10	2,000	10	400,000	80,000
622.08	10	400	10	400,000	16,000

Accuracy: ±Q% of setting ±100 UIp-p

Error Q	Frequency range
±8%	10 µHz to 0.125 Hz
±12%	0.125 Hz to 1 Hz
±15%	1 to 10 Hz

Wander auto measurement	Automatically evaluates the wander of the sine wave by the wander sweep measurement

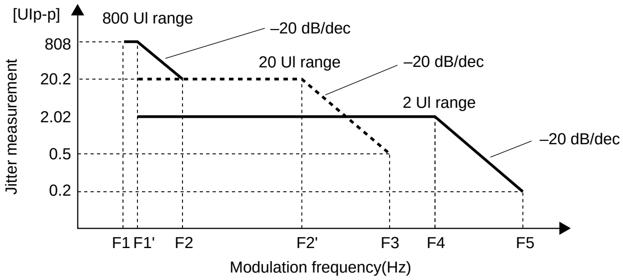
Continued on next page

Reference wander generation (Option 03)	Off: Able to set non-modulated status TDEV mask: The 37 types of TDEV masks that are regulated by ITU-T, ETSI, ANSI, and Bellcore standards are available as default. It is possible to add the wander modulation on the user specified TDEV mask. Transient: It is possible to change the A (1 – e $^{-63.7t}$) phase by the timing of the start. Signal off: It is possible to disconnect the standard signal.
Wander measurement (Option 02)	Conform to ITU-T O.172 Reference input: 2.048M (HDB3, Clock), 1.544M (AMI/B8ZS, Clock), 64k + 8 kHz, 5 MHz, 10 MHz Sampling frequency: 40 Hz, 1 Hz, 0.1 Hz, 5 mHz (select by MX150001B) Measurement range P-P: 0.0 to 2E10 ns, +P/–P: 0.0 to 1E10 ns, TIE: 0.0 to ±1E10 ns Accuracy: Conform to ITU-T O.172 Measurement time: 10 to 1 x 10^8 s (max. 120, 000 s; MP1570A only) Wander application (requires MX150001B Wander Application Software) TIE: Max. 1 x 10^8 s, MTIE: Max. 1 x 10^8 s, TDEV: Max. 1 x 10^6 s Frequency offset: Measurement conforms to ANSI TI.105.09 Frequency drift rate: Measurement conforms to ANSI TI.105.09 MRTIE: The evaluation separated from the wander by a frequency offset Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations Wander transfer (TDEV) measurement: Calibration method by simulation,outputting results by the one measurement

- **MU150011A 2.5G Jitter Unit**

Jitter generation

Conforms to ITU-T O.172
Frequency: 2488.32 MHz
Modulation frequency: 0.1 Hz to 20 MHz
Amplitude: 0 to 808.0 UIp-p
Resolution: 0.001 UIp-p (2 UI range), 0.01 UIp-p (20 UI range), 0.4 UIp-p (800 UI range)



Bit rate (Mbit/s)	F1 (Hz)	F1' (Hz)	F2* (kHz)	F2'* (kHz)	F3* (MHz)	F4* (MHz)	F5* (MHz)
2488.32	0.1	60	2.5	30	1.2	2	20

*Typical value

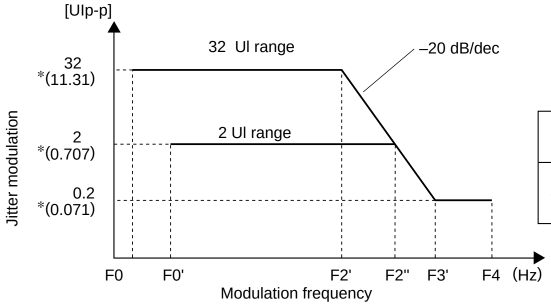
Accuracy
2 UI range: (±Q% of setting) ±0.02 UIp-p, 20 UI range: (±Q% of setting) ±0.3 UIp-p, 800 UI range: (±Q% of setting) ±12.5 UIp-p

Bit rate (Mbit/s)	Error Q	Frequency range
2488.32	±12%	0.1 Hz to 5 kHz
	±8%	5 to 500 kHz
	±12%	0.5 to 2 MHz
	±15%	2 to 20 MHz

Frequency offset	Range: ±100 ppm/0.1 ppm steps (jitter on/off) Accuracy: ±0.1 ppm (after power-on, calibrate after 60 min warm-up, 23˚±5 ˚C)
Auxiliary interface	External clock input, Jitter reference output

Jitter measurement

Conforms to ITU-T O.172
Frequency: 2488.32 MHz ±100 ppm
Modulation frequency: 10 Hz to 20 MHz
Amplitude: 0.0 to 32 UI
Resolution: 0.001 UIp-p/0.001 UIrms (2 UI range), 0.01 UIp-p/0.01 UIrms (32 UI range)



Bit rate (Mbit/s)		F0 (Hz)	F0' (Hz)	F2' (kHz)	F2" (kHz)	F3' (MHz)	F4 (MHz)
2488.32	2 UI	–	100	–	100	1	20
	32 UI	10	–	6.25	–	1	20

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Jitter measurement

Conforms to ITU-T O.172
LP, HP0 + LP, HP1 + LP, HP2 + LP, HP + LP

Bit rate (Mbit/s)	HP0 (Hz)	HP1 (Hz)	HP2 (Hz)	HP (Hz)	LP (Hz)
2488.32	10	5k	1M	12k	20M

Accuracy (UIp-p, UI+p, UI–p)
2 UI range: Measurement value ±R% ±W UIp-p, 32 UI range: Measurement value ±R% ±W UIp-p
[MU150008A/150009A/150010A are simultaneously installed, conform to ITU-T O.172]

Fixed error [W]
Input level: –12 to –10 dBm (adds to 0.01 UIp-p/dB at <–12 dBm)

Bit rate (Mbit/s)	SONET/SDH signal				
	HP1 + LP		HP2 + LP		Container
	2 UI	32 UI	2 UI	32 UI	
2488.32	0.100	2.2	0.050	1.40	VC4-16c

Bit rate (Mbit/s)	Clock signal			
	HP1 + LP		HP2 + LP	
	2 UI	32 UI	2 UI	32 UI
2488.32	0.050	0.60	0.030	0.50

At PRBS $2^{23} – 1$

Accuracy (UIrms)
2 UI range: ±R% ±Y UIrms, 32 UI range: ±R% ±Y UIrms

Fixed error [Y]
Input level: –12 to –10 dBm (adds to 0.002 UIrms/dB at <–12 dBm)

Bit rate (Mbit/s)	SONET/SDH signal			Clock signal	
	HP + LP		Container	HP + LP	
	2 UI	32 UI		2 UI	32 UI
2488.32	0.012	0.08	VC4-16c	0.010	0.16

At PRBS $2^{23} – 1$

Frequency error [R]

Frequency error	Frequency range
±7%	5 to 300 kHz
±8%	300 kHz to 1 MHz
±10%	1 to 3 MHz
±15%	3 to 10 MHz
±20%	10 to 20 MHz

Hit measurement

Count, Seconds, % free seconds

Frequency measurement

Resolution: 0.1 ppm, Display: Hz or ppm (after power-on, calibrates after 60 min warm-up, 23˚ ±5˚C)

Auxiliary interface

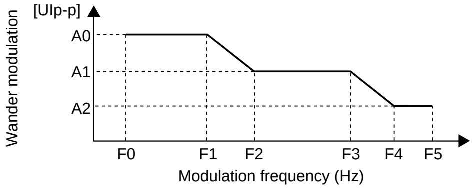
Reference clock input

Auto jitter measurement

Jitter tolerance measurement: Evaluates jitter tolerance point automatically
Jitter sweep measurement: Conforms to high-speed jitter tolerance evaluation for mass production, etc.
Jitter transfer measurement: High dynamic range measurement by selective level method
Frequency sweep measurement: Measures the jitter tolerance automatically while changing the offset

Line wander generation

Modulation frequency: 10 µHz to 0.2 Hz (sine wave)
Amplitude: 0 to 57,600 UIp-p (30 UIp-p steps)



Bit rate (Mbit/s)	Amplitude (UIp-p)			Frequency (Hz)					
	A0	A1	A2	f0	f1	f2	f3	f4	f5
2488.32	57600	6480	810	10µ	180µ	1.6m	16m	0.13	0.2

Accuracy: ±Q% ±160 UIp-p

Frequency error	Frequency range
±8%	10 µHz to 0.1 Hz
±12%	0.1 to 0.2 Hz

Auto wander measurement

Wander sweep measurement

Reference wander generation

Reference wander generation is valid when MU150005A/150006A/150007A Option 03 is mounted.
Off: Able to set non-modulated status
TDEV mask:
The 37 types of TDEV masks that are regulated by ITU-T, ETSI, ANSI, and Bellcore standards are available as default.
It is possible to add the wander modulation to the user specified TDEV mask.
Transient: It is possible to change the A ($1 – e^{-63.7t}$) phase by the timing of the start.
Signal off: It is possible to disconnect the standard signal.

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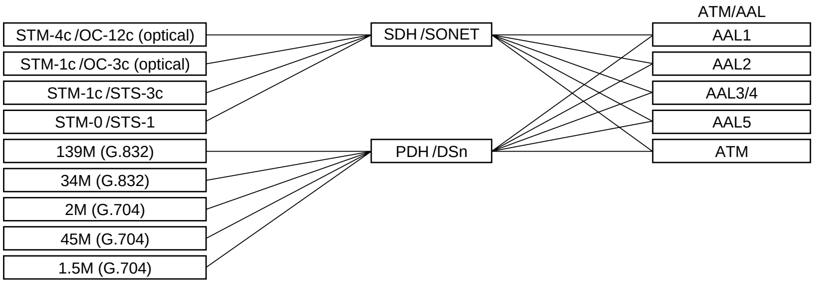
Wander measurement	Wander measurement is valid when MU150005A/150006A/150007A Option 02 is mounted. Conforms to ITU-T O.172 Reference input: 2.048M (HDB3, clock), 1.544M (AMI/B8ZS, clock), 64k + 8 kHz, 5 MHz, 10 MHz Sampling frequency: 320 Hz, 40 Hz, 1 Hz, 0.1 Hz, 5 mHz (select from MX150001B) Measurement range P-P: 0.0 to 2E10 ns, +P/–P: 0.0 to 1E10 ns, TIE: 0.0 to ±1E10 ns Accuracy: Conform to ITU-T O.172 Measurement time: 10 to 1 x 10^8 s (Max. 120,000 s: MP1570A only) Wander application (requires MX150001B Wander Application Software) TIE: Max. 1 x 10^8 s MTIE: Max. 1 x 10^8 s TDEV: Max. 1 x 10^6 s Frequency offset: Measurement with conform to ANSI TI.105.09 Frequency drift rate: Measurement with conform to ANSI TI.105.09 MRTIE: Evaluation separated from the wander by the frequency variation Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations Wander transfer (TDEV) measurement: Calibration method by simulation, outputting results by the one measurement

- **MP0123A ATM Unit**

Bit rate	1.544, 2.048, 34.368, 44.736, 139.264, 51.84, 155.52, 622.08 Mbit/s
Mapping	
Traffic pattern	CBR, burst, sawtooth, CBR/PCR with CDV, Poisson
Test patterns	Cell: Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern, time stamp O.191: Edit pattern AAL1: Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern, time stamp AAL2 (CPS-PDU): Time stamp AAL2 (CPS-PACKET): Single cell PRBS 7, 8-bit word pattern, edit pattern AAL3/4 (SAR-PDU): Time stamp AAL3/4 (CPCS-PDU): Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern AAL5: Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern
Error addition	Cell: HEC, programmable pattern O.191: Lost cell, misinserted cell, errored cell, SECB AAL1: Lost cell, SNP, PRBS, word AAL2 (CPS-PDU): P, SN, OSF AAL2 (CPS-PACKET): HEC, PRBS, word AAL3/4 (SAR-PDU): SN, CRC10, segment type, LI, abort AAL3/4 (CPCS-PDU): CPI, B/E tag mismatch, BA size, AL, length, PRBS, word AAL5: Frame size, length, CRC32, abort, PRBS, word
Alarm addition	LCD, VP/VC AIS, VP/VC RDI, VP/VC CC, VP/VC loopback cell
PM cell	Error insertion: Lost cell, misinserted cell, BIPV, SECB
Cell editing	O.191, AAL1, AAL2, AAL3/4, AAL5, AIS, RDI, CC, loopback, FM, BR, background (10 ch)
Memorized cell	Possible to send after editing receiver's capture data
Measurement	Mode: Single, repeat, manual Error Cell: Cell count, correctable HEC, uncorrectable HEC, non-conforming cell O.191: Errored cell, lost cell, misinserted cell, SECB AAL1: SAR-PDU count, lost cell, SNP, uncorrectable SNP, PRBS, word AAL2: CPS-PDU count, P, OSF, SN, CPS packet count, CID count, HEC, PRBS, word AAL3/4*: SAR-PDU count, CRC10, MID count (SAR-PDU with selected MID value), SN, ST (segment type), LI, abort, discarded PDU (one of SN error, LI error, abort, COM with ST error, or EOM with ST error), CPCS-PDU count, CPI, B/E tag mismatch, BA size, AL, length, undeliverded PDU (one of CPI error, B/E tag mismatch, BA size error, AL error, or length error), PRBS, word *CRC10 is calculated for all SAR-PDU. The others are calculated for SAR-PDU with specified MID. AAL5: CPCS-PDU count, frame size, length, CRC32, abort, discarded PDU (one of frame size error, length error, CRC32 error, or abort), PRBS, word FM: Lost cell, misinserted cell, BIPV, SECB BR: Lost cell, misinserted cell, BIPV, SECB Alarm: LCD, VP/VC segment AIS, VP/VC end-to-end AIS, VP/VC segment RDI, VP/VC end-to-end RDI, VP/VC segment LOC, VP/VC end-to-end LOC
LED	LCD, VP-AIS, VP-RDI, VP-LOC, VC-AIS, VC-RDI, VC-LOC, errors
Monitor	Live monitor (1023 channel monitor), traffic monitor, cell monitor
Delay measurement	1-point CDV, 2-point CDV
Capture	1 to 2016 cells

• MP0131A Add/Drop Unit

Bit rate	1.544, 2.048, 34.368, 44.736, 139.264 Mbit/s
Level/waveform	1.544 Mbit/s: ANSI T1.102, 0/655 ft 44.736 Mbit/s: ANSI T1.102, 0/450/900 ft (0 ft: Drop only) 2.048/34.368/139 Mbit/s: ITU-T G.703
Connector	BANTAM (100 Ω, balanced): 1.544 Mbit/s (AMI/B8ZS) 3-pin Siemens (120 Ω, balanced): 2.048 Mbit/s (HDB3) BNC (75 Ω, unbalanced): 2.048 Mbit/s, 34.368 Mbit/s (HDB3), 139.264 Mbit/s (CMI)
Mapping	See Fig. 3 and 4

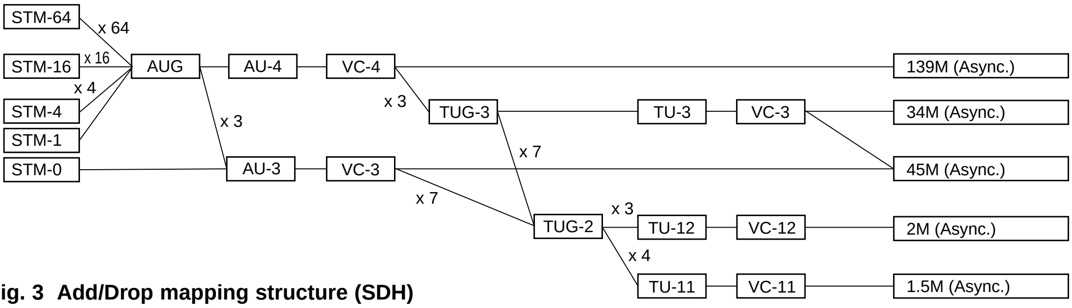


Fig. 3 Add/Drop mapping structure (SDH)

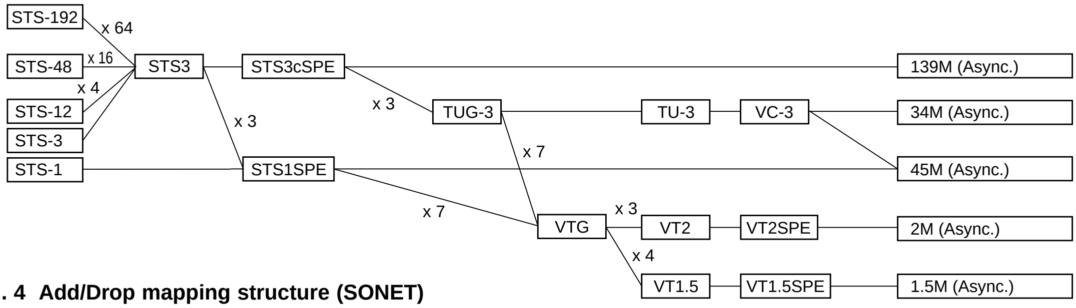


Fig. 4 Add/Drop mapping structure (SONET)

• MP0111A Optical 156M/622M (1.31) Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Wavelength: 1310 nm Output level: –11.5 dBm ±3.5 dB Optical safety: IEC 825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SMF)
Receive	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Sensitivity 156M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) 622M: –28 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm)

• MP0112A Optical 156M/622M (1.55) Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Wavelength: 1550 nm Output level: –5 dBm ±2 dB Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SMF)
Receive	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Sensitivity 156M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) 622M: –28 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm)

• MP0113A Optical 156M/622M (1.31/1.55) Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Wavelength: 1310/1550 nm Output level 1.31 µm: –11.5 dBm ±3.5 dB, 1.55 µm: –5 dBm ±2 dB Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SMF)
Receive	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Sensitivity 156M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) 622M: –28 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm)

• MP0105A CMI Unit

Transmit	Bit rate: 155.52 Mbit/s, Level: 1 ±0.1 V, Connector: BNC (75 Ω)
Receive	Bit rate: 155.52 Mbit/s Level: 1 ±0.1 V (0 to 12 dB, with $\sqrt{f}$ auto correction and monitor function) Connector: BNC (75 Ω)

• MP0108A NRZ Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s Level: ECL Connector (data, clock): SMA (50 Ω)
Receive	Bit rate: 155.52, 622.08 Mbit/s Level: ECL (–2 V) Connector (data, clock): SMA (50 Ω)

• MP0122B 1.5/45/52/52 (1.31) Unit

Optical interface

Transmit	Bit rate: 51.84 Mbit/s (NRZ) Wavelength: 1310 nm Output level: –11.5 dBm ±3.5 dB Optical safety: IEC 825-1 Class 1, 21CFR1040.10 Class Ⅰ Connector: FC-PC (SMF)
Receive	Bit rate: 51.84 Mbit/s (NRZ) Sensitivity 52M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm) Monitor input Level: 0.1 to 1.0 Vp-p (AC), Connector: SMA (50 Ω)

• MU150008A/150009A/150010A 2.5G Unit

Bit rate	2488.32 Mbit/s (NRZ)
Optical output	Wavelength: 1310 nm (MU150008A), 1550 nm (MU150009A), 1310/1550 nm (MU150010A) Output level: –4 dBm ±3 dB Optical safety: IEC825-1 Class 3A, 21CFR1040.10 Class Ⅲb Connector: FC-PC (SMF)
Optical input	Sensitivity Narrow: –28 to –9 dBm (BER 10^{-10}, +10˚ to +30˚C), –27 to –9 dBm (BER 10^{-10}, 0˚ to +30˚C) Wide: –20 to –9 dBm (BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Range: –30 to –9 dBm (peak power) Accuracy: ≤±2 dB (–20 dBm) Linearity: ≤±2 dB (–30 to –9 dBm)
Electrical I/O	Transmit (NRZ) Level: ECL (–2 V), Connector (data, clock): SMA (50 Ω) Receive (NRZ) Level: ECL (–2 V), Connector (data, clock): SMA (50 Ω) Monitor input Level: 0.1 to 1.0 Vp-p (AC), Connector (data): SMA (50 Ω)
Auxiliary interface	External clock input, receive clock output, sync. output

• MU150000A 2.5G/10G Unit

Bit rate	9953.28, 2488.32 Mbit/s (NRZ)
Electrical I/O	Transmit (NRZ) Level Data H: 0 to –0.2 V, Data L: –0.85 to –1.4 V Clock H: 0 to –0.2 V, Clock L: –0.85 to –1.3 V Connector (data, clock): SMA (50 Ω) Receive (NRZ) Level Data: 0.65 to 1.4 Vp-p, Clock: 0.65 to 1.3 Vp-p Connector (data, clock): SMA (50 Ω)
Auxiliary interface	External clock input, internal clock output, receive clock output,156M sync. output

• MU150001A/B Optical 10G Tx (1.55) Unit

Bit rate	9953.28, 2488.32 Mbit/s (Option)
Optical output	Wavelength: 10G: 1550 nm band 2.5G: 1310 nm band (Option 01), 1550 nm band (Option 02), 1310/1550 nm band (Option 03) Output level: –4 dBm ±3 dB Optical safety: IEC825-1 Class 3A, 21CFR1040.10 Class Ⅲb Connector: FC-PC (SMF)
Electrical input	Data input H: 0 to –0.2 V, L: –0.85 to –1.4 V Clock input H: 0 to –0.2 V, L: –0.85 to –1.3 V Connector: SMA 50 Ω

• MU150002A Optical 10G Rx (Narrow) Unit

Bit rate	9953.28, 2488.32 Mbit/s (Option 01)
Optical input	Sensitivity 10G: –13 to –3 dBm (BER 10^{-12}, NRZ, mark ratio: 1/2, PRBS: 2^{31} – 1) 2.5G: –29 to –10 dBm (BER 10^{-11}, NRZ, mark ratio: 1/2, PRBS: 2^{23} – 1) (Option 01) Connector: FC-PC (SMF) Power measurement Range:–16 to 0 dBm (10G, average power), –30 to –10 dBm (2.5G, average power) Accuracy: ≤±2 dB (10G, –10 dBm), ≤±2 dB (2.5G, –20 dBm) Linearity: ≤±2 dB (10G, –16 to 0 dBm), ≤±2 dB (2.5G, –30 to –10 dBm)
Electrical output	Data output: 0.65 to 1.4 Vp-p Clock output: 0.65 to 1.3 Vp-p Connector: SMA 50 Ω

• MU150031A/C Optical 10G Tx (1.55) High Power Unit

Bit rate	MU150031A: 9953.28 Mbit/s MU150031C: 9953.28 Mbit/s, 2488.32 Mbit/s
Optical output	Wavelength: 1525 to 1565 nm Output level: +2 dBm ±2 dB Optical Safety: IEC825-1 (Class 3A), 21CFR1040.10 (Class Ⅲb) Connector: FC-PC (SMF)
Electrical input	Data input H: 0 to –0.2 V, L: –0.85 to –1.4 V Clock input H: 0 to –0.2 V, L: –0.85 to –1.3 V Connector: SMA (50 Ω)

• MU150061A/B Optical 10G Tx (1.31) Unit

Bit rate	MU150061A: 9953.28 Mbit/s MU150061B: 9953.28 Mbit/s, 2488.32 Mbit/s
Optical output	Wavelength: 1290 to 1330 nm Output level: +3 dBm ±2 dB Optical Safety: IEC825-1 (Class 3A), 21CFR1040.10 (Class Ⅲb) Connector: FC-PC (SMF)
Electrical input	Data input H: 0 to –0.2 V, L: –0.85 to –1.4 V Clock input H: 0 to –0.2 V, L: –0.85 to –1.3 V Connector: SMA (50 Ω)

• MU150017A/B Optical 10G Rx (Wide) Unit

Bit rate	MU150017A: 9953.28 Mbit/s ±100 ppm MU150017B: 9953.28 Mbit/s ±100 ppm, 2488.32 Mbit/s ±100 ppm
Optical output	Wavelength 10G: 1550 nm band, 2.5G: 1310/1550 nm band (MU150017B) Sensitivity: –11 to –3 dBm (10G BER10^{-12}, NRZ, VC4-64c, scramble: on, mark ratio: 1/2, PRBS 2^{23} – 1 –15 to –3 dBm (2.5G BER10^{-12}, NRZ, VC4-16c, scramble: on, mark ratio: 1/2, PRBS 2^{23} – 1 Connector: FC-SPC (SMF) Power measurement Range: –16 to –2 dBm (10G, average power), –36 to –2 dBm (2.5G average power) Accuracy: ≤±2 dB
Electrical input	Data output: 0.7 to 1.3 Vp-p Clock output: 0.65 to 1.3 Vp-p Connector: SMA (50 Ω) Output phase: Variable output clock phase according to output data (10G only)

Unit	Slot 1	Slot 2	Slot 3	Slot 4/5	Front
MP0121A 2/8/34/139/156M Unit	√				
MP0122A 1.5/45/52M Unit	√*	√			
MP0122B 1.5/45/52/52M (1.31) Unit	√*	√			
MP0123A ATM Unit			√		
MU150005A 2/8/34/139M, 156/622M Jitter Unit				√	
MU150006A 1.5/45/52M, 156/622M Jitter Unit				√	
MU150007A 2/8/34/139M, 1.5/45/52M, 156M/622M Jitter Unit				√	
MP0111A Optical 156/622M (1.31) Unit					√
MP0112A Optical 156/622M (1.55) Unit					√
MP0113A Optical 156/622M (1.31/1.55) Unit					√
MU150008A 2.5G (1.31) Unit		√			
MU150009A 2.5G (1.55) Unit		√			
MU150010A 2.5G (1.31/1.55) Unit		√			
MU150011A 2.5G Jitter Unit			√		
MP0131A Add/Drop Unit	√	√			
MU150000A 2.5G/10G Unit				√	
MU150001A/B Optical 10G Tx (1.55) Unit			√		
MU150002A Optical 10G Rx (Narrow) Unit		√			
MP0105A CMI Unit					√
MP0108A NRZ Unit					√
MU150031A/C Optical 10G Tx (1.55) High Power Unit			√		
MU150061A/B Optical 10G Tx (1.31) Unit			√		
MU150017A/B Optical 10G Rx (Wide) Unit		√			

Note: The same model name units can not be used simultaneously with inserted them in to the plural slots. Only one unit is usable at a time.

*: MP0122A/B can not insert in to slot 1 when MP0123A is inserted in to Slot 3

Ordering information

Please specify model/order number name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1570A*1	SONET/SDH/PDH/ATM Analyzer	
	Standard accessories	
	AC power cord:	1 pc
Z0169	Printer paper (5 rolls/pack):	1 pack
F0079	Fuse, 10 A:	2 pcs
B0329G	Front cover:	1 pc
Z0486	Side cover:	1 pc
J0907Q	Remote interlock cord (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
J0908	Remote interlock terminator (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
E0008A	Optical output control key (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	2 pcs
J0747A	Fixed optical attenuator (5 dB, for MU150017A/B):	1 pc
J0747B	Fixed optical attenuator (10 dB, for MU150002A):	1 pc
J0900A	Coaxial cable (AA-165-200), 20 cm (for MU150011A):	2 pcs
J0635A	Optical fiber cable (FC · PC-FC · PC), 1 m (for MU150002A, MU150008A, MU150009A, MU150010A, MU150017A/B):	1 pc
MX150001B	Wander (MTIE, TDEV) Measurement Application Software (supplied with MU150005A-02, MU150006A-02, MU150007A-02):	1 pc
W1719AE	MP1570A operation manual (Vol. 1 Basic operation for SDH):	1 copy
W1720AE	MP1570A operation manual (Vol. 1 Basic operation for SONET):	1 copy
W1721AE	MP1570A operation manual (Vol. 2 Remote control):	1 copy
W1722AE	MP1570A operation manual (Vol. 3 ATM measurement):	1 copy
W1723AE	MP1570A operation manual (Vol. 4 2.5G/10G measurement):	1 copy
W1724AE	MP1570A operation manual (Vol. 5 Add/Drop function):	1 copy
W1725AE	MP1570A operation manual (Vol. 6 Jitter/wander measurement, for MU150005A/150006A/150007A):	1 copy
W1726AE	MP1570A operation manual (Vol. 7 2.5G jitter/wander measurement, for MU150011A):	1 copy
W1763AE	Wander (MTIE, TDEV) APPLI SOFT manual (supplied with MX150001B):	1 copy
J1002A	Semi-rigid cable (for MU150001A/B, MU150031A/C, MU150061A/B):	2 pcs
J1002B	Semi-rigid cable (for MU150002A, MU150017A/B):	2 pcs
J1002C	Semi-rigid cable (for MU150000A):	3 pcs
	Plug-in units	
MP0121A	2/8/34/139/156M Unit	
MP0122A	1.5/45/52M Unit	
MP0122B*2	1.5/45/52/52M (1.31) Unit	
MP0123A	ATM Unit	
MU150008A*2	2.5G (1.31) Unit (with optical power meter)	
MU150009A*2	2.5G (1.55) Unit (with optical power meter)	
MU150010A*2	2.5G (1.31/1.55) Unit (with optical power meter)	
MP0131A	Add/Drop Unit	
MU150000A	2.5G/10G Unit	
MU150001A*2	Optical 10G Tx (1.55) Unit (2 km transmission)	
MU150001B*2	Optical 10G Tx (1.55) Unit (40 km transmission)	
MU150002A*2	Optical 10G Rx (Narrow) Unit (with optical power meter)	
MP0111A*2	Optical 156M/622M (1.31) Unit (with optical power meter)	
MP0112A*2	Optical 156M/622M (1.55) Unit (with optical power meter)	
MP0113A*2	Optical 156M/622M (1.31/1.55) Unit (with optical power meter, 1.31/1.55 switchable)	
MU150017A	Optical 10G Rx (Wide) Unit	
MU150017B	Optical 2.5G/10G Rx (Wide) Unit	
MU150031A	Optical 10G Tx (1.55) High Power Unit	
MU150031C	Optical 2.5G/10G Tx (1.55) High Power Unit	
MU150061A	Optical 10G Tx (1.31) Unit	

Continued on next page

Model/Order No.	Name
MU150061B	Optical 2.5G/10G Tx (1.31) Unit
MU150005A	2/8/34/139M, 156/622M Jitter Unit [jitter generation/ measurement only (requires MP0121A)]
MU150006A	1.5/45/52M, 156/622M Jitter Unit [jitter generation/ measurement only (requires MP0122A/B)]
MU150007A	2/8/34/139M, 1.5/45/52M, 156/622M Jitter Unit [jitter generation/measurement only (requires MP0121A or MP0122A/B)]
MU150011A	2.5G Jitter Unit [jitter generation/measurement only (requires MU150008A/150009A or MU150010A)]
MP0105A	CMI Unit
MP0108A	NRZ Unit
	Options
MP1570A-01[*3]	RS-232C
MP1570A-02[*3]	GPIB
MP1570A-03[*3]	Ethernet
MP1570A-04[*3]	VGA output
MP1570A-06	MUX/DEMUX (2/8/34/139 Mbit/s, for MP0121A)
MP1570A-07	MUX/DEMUX (1.5/45 Mbit/s, for MP0122A/B)
MP1570A-08	45M-2M MUX/DEMUX (requires MP0121A and MP0122A/B)
MP1570A-09	Japan mapping (requires MP0122A or MP0122B)
MP1570A-10[*1]	SDH
MP1570A-11[*1]	SONET
MP1570A-13	Frame memory capture (156M/622M, 64 frame)
MP1570A-14	IP-over-SONET/SDH (requires MP1570A-13)
MP1570A-15	IP-over-ATM (requires MP0123A)
MP1570A-22	K1/K2 overwrite through
MU150005A-02	Wander measurement
MU150006A-02	Wander measurement
MU150007A-02	Wander measurement
MU150005A-03	Wander reference output
MU150006A-03	Wander reference output
MU150007A-03	Wander reference output
MU150008A-01	Frame memory capture (2.5G, 64 frame)
MU150009A-01	Frame memory capture (2.5G, 64 frame)
MU150010A-01	Frame memory capture (2.5G, 64 frame)
MU150000A-01	Frame memory capture (2.5G/10G, 26 frame)
MU150001A/B-01	2.5G (1.31)
MU150001A/B-02	2.5G (1.55)
MU150001A/B-03	2.5G (1.31/1.55)
MU150002A-01	2.5G
MU150002A-04	Available for 10G (1.31)
MP0111A/0112A-37	FC connector (replaceable, 2 sets)
MP0111A/0112A-38	ST connector (replaceable, 2 sets
MP0111A/0112A-39	DIN connector (replaceable, 2 sets)
MP0111A/0112A-40	SC connector (replaceable, 2 sets)
MP0111A/0112A-43	HMS-10/A connector (replaceable, 2 sets)
MP0113A-37	FC connector (replaceable, 3 sets)
MP0113A-38	ST connector (replaceable, 3 sets)
MP0113A-39	DIN connector (replaceable, 3 sets)
MP0113A-40	SC connector (replaceable, 3 sets)
MP0113A-43	HMS-10/A connector (replaceable, 3 sets)
MP0122B-37	FC connector (replaceable, 2 sets)
MP0122B-38	ST connector (replaceable, 2 sets)
MP0122B-39	DIN connector (replaceable, 2 sets)
MP0122B-40	SC connector (replaceable, 2 sets)
MP0122B-43	HMS-10/A connector (replaceable, 2 sets)
MU150008A-37	FC connector (replaceable, 2 sets)
MU150008A-38	ST connector (replaceable, 2 sets)
MU150008A-39	DIN connector (replaceable, 2 sets)
MU150008A-40	SC connector (replaceable, 2 sets)

Model/Order No.	Name
MU150008A-43	HMS-10/A connector (replaceable, 2 sets)
MU150009A-37	FC connector (replaceable, 2 sets)
MU150009A-38	ST connector (replaceable, 2 sets)
MU150009A-39	DIN connector (replaceable, 2 sets)
MU150009A-40	SC connector (replaceable, 2 sets)
MU150009A-43	HMS-10/A connector (replaceable, 3 sets)
MU150010A-37	FC connector (replaceable, 3 sets)
MU150010A-38	ST connector (replaceable, 3 sets)
MU150010A-39	DIN connector (replaceable, 3 sets)
MU150010A-40	SC connector (replaceable, 3 sets)
MU150010A-43	HMS-10/A connector (replaceable, 3 sets)
MU150001A/B-37	FC connector (replaceable, 1 set)
MU150001A/B-38	ST connector (replaceable, 1 set)
MU150001A/B-39	DIN connector (replaceable, 1 set)
MU150001A/B-40	SC connector (replaceable, 1 set)
MU150001A/B-43	HMS-10/A connector (replaceable, 1 set)
MU150002A-37	FC connector (replaceable, 1 set)[*4]
MU150002A-38	ST connector (replaceable, 1 set)[*4]
MU150002A-39	DIN connector (replaceable, 1 set)[*4]
MU150002A-40	SC connector (replaceable, 1 set)[*4]
MU150002A-43	HMS-10/A connector (replaceable, 1 set)[*4]
MU150017A/B-37	FC connector (user replaceable, 1 set)
MU150017A/B-38	ST connector (user replaceable, 1 set)
MU150017A/B-39	DIN connector (user replaceable, 1 set)
MU150017A/B-40	SC connector (user replaceable, 1 set)
MU150017A/B-43	HMS-10/A connector (user replaceable, 1 set)
MU150031A/C-37	FC connector (user replaceable, 1 set)
MU150031A/C-38	ST connector (user replaceable, 1 set)
MU150031A/C-39	DIN connector (user replaceable, 1 set)
MU150031A/C-40	SC connector (user replaceable, 1 set)
MU150031A/C-43	HMS-10/A connector (user replaceable, 1 set)
MU150061A/B-37	FC connector (user replaceable, 1 set)
MU150061A/B-38	ST connector (user replaceable, 1 set)
MU150061A/B-39	DIN connector (user replaceable, 1 set)
MU150061A/B-40	SC connector (user replaceable, 1 set)
MU150061A/B-43	HMS-10/A connector (user replaceable, 1 set)
	Maintenance service[*5]
MP1570A-90	Extended three year warranty service
MP0121A-90	Extended three year warranty service
MP0122A-90	Extended three year warranty service
MP0122B-90	Extended three year warranty service
MP0123A-90	Extended three year warranty service
MU150005A-90	Extended three year warranty service
MU150006A-90	Extended three year warranty service
MU150007A-90	Extended three year warranty service
MU150008A-90	Extended three year warranty service
MU150009A-90	Extended three year warranty service
MU150010A-90	Extended three year warranty service
MU150011A-90	Extended three year warranty service
MU150000A-90	Extended three year warranty service
MU150001A-90	Extended three year warranty service
MU150001B-90	Extended three year warranty service
MU150002A-90	Extended three year warranty service
MP0111A-90	Extended three year warranty service
MP0112A-90	Extended three year warranty service
MP0113A-90	Extended three year warranty service
MP0105A-90	Extended three year warranty service
MP0108A-90	Extended three year warranty service
MU150017A/B-90	Extended three year warranty service
MU150031A/C-90	Extended three year warranty service
MU150061A/B-90	Extended three year warranty service

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Model/Order No.	Name
	Application equipment
MP1777A	10 GHz Jitter Analyzer
MP9677B	E/O, O/E Converter
MU967701A	Clock Recovery Unit (9.95328 Gbit/s)
MP1580A	Portable 2.5G/10G Analyzer
MU150018A	2.5G/10G Jitter Unit (for MP1580A)
	Optional accessories
MN9320A	Optical Channel Drop Unit (OCD)
MX150001B	Wander (MTIE, TDEV) Measurement Application Software (supplied with MU150005A-02/150006A-02/150007A-02)
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0162A	Balanced cable, 1 m (Siemens 3p-Siemens 3p)
J0162B	Balanced cable, 2 m (Siemens 3p-Siemens 3p)
J0845A	Balanced cable, 6 ft (BANTAM 3P/BANTAM 3P)
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
J0898A	Conversion cable (M-1PS · BANTAM 3P), 1 m
J0898B	Conversion cable (M-1PS · BANTAM 3P), 2 m
J0635A	Optical fiber cable, 1 m (SM, FC-SPC connector both ends)
J0635B	Optical fiber cable, 2 m (SM, FC-SPC connector both ends)
J0635C	Optical fiber cable, 3 m (SM, FC-SPC connector both ends)
J0660A	Optical fiber cable, 1 m (SM, SC connector, both-ends)
J0660B	Optical fiber cable, 2 m (SM, SC connector, both-ends)
J0660C	Optical fiber cable, 3 m (SM, SC connector, both-ends)
J0756A	Optical fiber cable, 1 m (SM, ST connector, both-ends)
J0756B	Optical fiber cable, 2 m (SM, ST connector, both-ends)
J0756C	Optical fiber cable, 3 m (SM, ST connector, both-ends)
J0747A	Fixed optical attenuator (5 dB)
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J1049A	Fixed optical attenuator, SC (5 dB)
J1049B	Fixed optical attenuator, SC (10 dB)
J1049C	Fixed optical attenuator, SC (15 dB)
J1049D	Fixed optical attenuator, SC (20 dB)
J1050A	Fixed optical attenuator, ST (5 dB)
J1050B	Fixed optical attenuator, ST (10 dB)
J1050C	Fixed optical attenuator, ST (15 dB)
J1050D	Fixed optical attenuator, ST (20 dB)
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0008	GPIB cable, 2 m
A0006	Head set
B0453B	Blank panel (for front slot)
B0454C	Blank panel (for slot 1 to 3)
B0454D	Blank panel (for slot 4/5)
B0448	Soft case
B0336C	Carrying case

∗1: Must specify SDH (Option 10) or SONET (Option 11) when ordering depends on your system. The option price is included in the MP1570A. These two options can be installed simultaneously. But in this case, one option price is charged.
∗2: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified the FC connector (MP0111A/0112A/0113A/0122B-37, MU150008A/150009A/150010A/150001A/150001B/150002A-37) is supplied as standard.
∗3: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously. Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.
∗4: With Option 01, 2 sets
∗5: Please ask your local Anritsu Field Office or Sales. Representative for price and availability.

The units for MP1552A/B and MP1555A/B can be used with MP1570A.

SONET/SDH/PDH/ATM ANALYZER

MP1570A1

1.5 Mbit/s to 10 Gbit/s

CE GPIB OPTION

Supports North American and European Mapping by One Box

MP1570A1 is a SONET/SDH/PDH/ATM Analyzer which has one more slot compared with MP1570A. It can measure bit rate of 2488M (OC-48) or more in North American and European mapping without the DSn and PDH plug-in units exchange.

Specifications

• General

(Other specifications are same as MP1570A. For the specification, refer to page 163.)

Printer	Internal, external
Internal memory	Measurement settings memory: 10 Graphics memory: 15
Others	FDD, RS-232C (Option 01)[*1], GPIB (Option 02)[*1], Ethernet (Option 03)[*1], Video output (Option 04)[*1], buzzer, clock, help, screen copy
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Dimensions and mass	320 (W) x 222 (H) x 350 (D) mm, 12 kg approx. (excluding plug-in units and options)
Power	100 to 240 Vac, 47.5 to 63 Hz, ≤500 VA
Temperature	0° to +40°C

*1: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously. Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1570A1[*1]	SONET/SDH/PDH/ATM Analyzer	
	Standard accessories	
	AC power cord:	1 pc
Z0169	Printer paper (5 rolls/pack):	1 pack
F0079	Fuse, 10 A:	2 pcs
B0482	Front cover:	1 pc
J0907Q	Remote interlock cord (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
J0908	Remote interlock terminator (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
E0008A	Optical output control key (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	2 pc
J0747A	Fixed optical attenuator (5 dB, for MU150017A/B):	1 pc
J0747B	Fixed optical attenuator (10 dB, for MU150002A):	1 pc
J0900A	Coaxial cable (AA-165-200, 20 cm, for MU150011A):	2 pcs
J0635A	Optical fiber cable (FC · PC-FC · PC, 1 m, for MU150002A/150008A/150009A/150010A, MU150017A/B):	1 pc
MX150001B	Wander (MTIE, TDEV) Measurement Application Software (supplied with MU150005A-02/150006A-02/150007A-02):	1 pc
W1882AE	MP1570A1 operation manual:	1 copy
W1719AE	MP1570A operation manual (Vol. 1 Basic operation for SDH):	1 copy
W1720AE	MP1570A operation manual (Vol. 1 Basic operation for SONET):	1 copy
W1721AE	MP1570A operation manual (Vol. 2 Remote control):	1 copy
W1722AE	MP1570A operation manual (Vol. 3 ATM measurement):	1 copy
W1723AE	MP1570A operation manual (Vol. 4 2.5G/10G measurement):	1 copy

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Model/Order No.	Name
W1724AE	MP1570A operation manual (Vol. 5 Add/Drop function): 1 copy
W1725AE	MP1570A operation manual (Vol. 6 Jitter/wander measurement, for MU150005A/150006A/150007A): 1 copy
W1726AE	MP1570A operation manual (Vol. 7 2.5G jitter/wander measurement, for MU150011A): 1 copy
W1763AE	Wander (MTIE, TDEV) Measurement Application Software (supplied with MX150001B): 1 copy
J1002A	Semi-rigid cable (for MU150001A/B, MU150031A/C, MU150061A/B): 2 pcs
J1002B	Semi-rigid cable (for MU150002A, MU150017A/B): 2 pcs
J1002C	Semi-rigid cable (for MU150000A): 3 pcs
	Plug-in units
MP0121A	2/8/34/139/156M Unit
MP0122A	1.5/45/52M Unit
MP0122B*2	1.5/45/52/52M (1.31) Unit
MP0123A	ATM Unit
MU150005A	2/8/34/139M, 156/622M Jitter Unit (only jitter generation/measurement, requires MP0121A)
MU150006A	1.5/45/52M, 156/622M Jitter Unit (only jitter generation/measurement, requires MP0122A/B)
MU150007A	2/8/34/139M, 1.5/45/52M, 156/622M Jitter Unit (only jitter generation/measurement, requires MP0121A or MP0122A/B)
MU150008A*2	2.5G (1.31) Unit (with optical power meter)
MU150009A*2	2.5G (1.55) Unit (with optical power meter)
MU150010A*2	2.5G (1.31/1.55) Unit (with optical power meter)
MU150011A	2.5G Jitter Unit (only jitter generation/measurement, requires MU150008A, MU150009A, or MU150010A)
MP0131A	Add/Drop Unit
MU150000A	2.5G/10G Unit
MU150001A*2	Optical 10G Tx (1.55) Unit (2 km transmission)
MU150001B*2	Optical 10G Tx (1.55) Unit (40 km transmission)
MU150002A*2	Optical 10G Rx (Narrow) Unit (with optical power meter)
MP0111A*2	Optical 156M/622M (1.31) Unit (with optical power meter)
MP0112A*2	Optical 156M/622M (1.55) Unit (with optical power meter)
MP0113A*2	Optical 156M/622M (1.33/1.55) Unit (with optical power meter, 1.31/1.55 switchable)
MU150017A	Optical 10G Rx (Wide) Unit
MU150017B	Optical 2.5G/10G Rx (Wide) Unit
MU150031A	Optical 10G Tx (1.55) High Power Unit
MU150031C	Optical 2.5G/10G Tx (1.55) High Power Unit
MU150061A	Optical 10G Tx (1.31) Unit
MU150061B	Optical 2.5G/10G Tx (1.31) Unit
MP0105A	CMI Unit
MP0108A	NRZ Unit
	Options
MP1570A1-01*3	RS-232C
MP1570A1-02*3	GPIB
MP1570A1-03*3	Ethernet
MP1570A1-04*3	VGA output
MP1570A1-06	MUX/DEMUX (2/8/34/139 Mbit/s, for MP0121A)
MP1570A1-07	MUX/DEMUX (1.5/45 Mbit/s, for MP0122A/B)
MP1570A1-08	45M-2M MUX/DEMUX (requires MP0121A and MP0122A/B)
MP1570A1-09	Japan mapping (requires MP0122A or MP0122B)
MP1570A1-10*1	SDH
MP1570A1-11*1	SONET
MP1570A1-13	Frame memory capture (156M/622M, 64 frame)
MP1570A1-14	IP-over-SONET/SDH (requires option of frame memory/capture)
MP1570A1-15	IP-over-ATM (requires MP0123A)
MP1570A1-22	K1/K2 overwrite through
MU150005A-02	Wander measurement
MU150006A-02	Wander measurement
MU150007A-02	Wander measurement
MU150005A-03	Wander reference output
MU150006A-03	Wander reference output
MU150007A-03	Wander reference output
MU150008A-01	Frame memory capture (2.5G, 64 frame)
MU150009A-01	Frame memory capture (2.5G, 64 frame)
MU150010A-01	Frame memory capture (2.5G, 64 frame)
MU150000A-01	Frame memory capture (2.5G/10G, 26 frame)
MU150001A/B-01	2.5G (1.31)
MU150001A/B-02	2.5G (1.55)
MU150001A/B-03	2.5G (1.31/1.55)
MU150002A-01	2.5G
MU150002A-04	Available for 10G (1.31)
MP0111A/0112A-37	FC connector (replaceable, 2 sets)
MP0111A/0112A-38	ST connector (replaceable, 2 sets)
MP0111A/0112A-39	DIN connector (replaceable, 2 sets)
MP0111A/0112A-40	SC connector (replaceable, 2 sets)
MP0111A/0112A-43	HMS-10/A connector (replaceable, 2 sets)
MP0113A-37	FC connector (replaceable, 3 sets)
MP0113A-38	ST connector (replaceable, 3 sets)
MP0113A-39	DIN connector (replaceable, 3 sets)
MP0113A-40	SC connector (replaceable, 3 sets)
MP0113A-43	HMS-10/A connector (replaceable, 3 sets)
MP0122B-37	FC connector (replaceable, 2 sets)
MP0122B-38	ST connector (replaceable, 2 sets)
MP0122B-39	DIN connector (replaceable, 2 sets)
MP0122B-40	SC connector (replaceable, 2 sets)
MP0122B-43	HMS-10/A connector (replaceable, 2 sets)
MU150008A-37	FC connector (replaceable, 2 sets)
MU150008A-38	ST connector (replaceable, 2 sets)
MU150008A-39	DIN connector (replaceable, 2 sets)
MU150008A-40	SC connector (replaceable, 2 sets)
MU150008A-43	HMS-10/A connector (replaceable, 2 sets)
MU150009A-37	FC connector (replaceable, 2 sets)
MU150009A-38	ST connector (replaceable, 2 sets)
MU150009A-39	DIN connector (replaceable, 2 sets)
MU150009A-40	SC connector (replaceable, 2 sets)
MU150009A-43	HMS-10/A connector (replaceable, 2 sets)
MU150010A-37	FC connector (replaceable, 3 sets)
MU150010A-38	ST connector (replaceable, 3 sets)
MU150010A-39	DIN connector (replaceable, 3 sets)
MU150010A-40	SC connector (replaceable, 3 sets)
MU150010A-43	HMS-10/A connector (replaceable, 3 sets)
MU150001A/B-37	FC connector (replaceable, 1 set)
MU150001A/B-38	ST connector (replaceable, 1 set)
MU150001A/B-39	DIN connector (replaceable, 1 set)
MU150001A/B-40	SC connector (replaceable, 1 set)
MU150001A/B-43	HMS-10/A connector (replaceable, 1 set)
MU150002A-37	FC connector (replaceable, 1 set*4)
MU150002A-38	ST connector (replaceable, 1 set*4)
MU150002A-39	DIN connector (replaceable, 1 set*4)
MU150002A-40	SC connector (replaceable, 1 set*4)
MU150002A-43	HMS-10/A connector (replaceable, 1 set*4)
MU150017A/B-37	FC connector (user replaceable, 1 set)
MU150017A/B-38	ST connector (user replaceable, 1 set)
MU150017A/B-39	DIN connector (user replaceable, 1 set)
MU150017A/B-40	SC connector (user replaceable, 1 set)
MU150017A/B-43	HMS-10/A connector (user replaceable, 1 set)
MU150031A/C-37	FC connector (user replaceable, 1 set)
MU150031A/C-38	ST connector (user replaceable, 1 set)
MU150031A/C-39	DIN connector (user replaceable, 1 set)
MU150031A/C-40	SC connector (user replaceable, 1 set)
MU150031A/C-43	HMS-10/A connector (user replaceable, 1 set)
MU150061A/B-37	FC connector (user replaceable, 1 set)
MU150061A/B-38	ST connector (user replaceable, 1 set)
MU150061A/B-39	DIN connector (user replaceable, 1 set)
MU150061A/B-40	SC connector (user replaceable, 1 set)
MU150061A/B-43	HMS-10/A connector (user replaceable, 1 set)
	Maintenance service*5
MP0121A-90	Extended three year warranty service
MP0122A-90	Extended three year warranty service
MP0122B-90	Extended three year warranty service
MP0123A-90	Extended three year warranty service
MU150005A-90	Extended three year warranty service
MU150006A-90	Extended three year warranty service
MU150007A-90	Extended three year warranty service
MU150008A-90	Extended three year warranty service
MU150009A-90	Extended three year warranty service
MU150010A-90	Extended three year warranty service
MU150011A-90	Extended three year warranty service
MU150000A-90	Extended three year warranty service
MU150001A-90	Extended three year warranty service
MU150001B-90	Extended three year warranty service
MU150002A-90	Extended three year warranty service
MP0111A-90	Extended three year warranty service
MP0112A-90	Extended three year warranty service
MP0113A-90	Extended three year warranty service
MP0105A-90	Extended three year warranty service
MP0108A-90	Extended three year warranty service
MU150017A/B-90	Extended three year warranty service
MU150031A/C-90	Extended three year warranty service
MU150061A/B-90	Extended three year warranty service
	Application equipment
MP1777A	10 GHz Jitter Analyzer
MP9677B	E/O, O/E Converter
MU967701A	Clock Recovery Unit (9.95328 Gbit/s)
MP1580A	Portable 2.5G/10G Analyzer
MU150018A	2.5G/10G Jitter Unit (for MP1580A)

Continued on next page

Model/Order No.	Name
	Optional accessories
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0162A	Balanced cable (Siemens 3P-Siemens 3P), 1 m
J0162B	Balanced cable (Siemens 3P-Siemens 3P), 2 m
J0845A	Balanced cable (BANTAM 3P/BANTAM 3P), 6 ft
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
J0898A	Conversion cable (M-1PS · BANTAM 3P), 1 m
J0898B	Conversion cable (M-1PS · BANTAM 3P), 2 m
J0635A	Optical fiber cable (SM, FC-SPC connector both ends), 1 m
J0635B	Optical fiber cable (SM, FC-SPC connector both ends), 2 m
J0635C	Optical fiber cable (SM, FC-SPC connector both ends), 3 m
J0660A	Optical fiber cable, 1 m (SM, SC connector, both-ends)
J0660B	Optical fiber cable, 2 m (SM, SC connector, both-ends)
J0660C	Optical fiber cable, 3 m (SM, SC connector, both-ends)
J0756A	Optical fiber cable, 1 m (SM, ST connector, both-ends)
J0756B	Optical fiber cable, 2 m (SM, ST connector, both-ends)
J0756C	Optical fiber cable, 3 m (SM, ST connector, both-ends)
J0747A	Fixed optical attenuator (5 dB)
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J1049A	Fixed optical attenuator, SC (5 dB)
J1049B	Fixed optical attenuator, SC (10 dB)
J1049C	Fixed optical attenuator, SC (15 dB)
J1049D	Fixed optical attenuator, SC (20 dB)
J1050A	Fixed optical attenuator, ST (5 dB)
J1050B	Fixed optical attenuator, ST (10 dB)
J1050C	Fixed optical attenuator, ST (15 dB)
J1050D	Fixed optical attenuator, ST (20 dB)
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0008	GPIB cable, 2 m
A0006	Head set
B0453B	Blank panel (for front panel)
B0454C	Blank panel (for Slot 1 to 3)
B0454D	Blank panel (for Slot 4/5)

∗1: Must specify SDH (Option 10) or SONET (Option 11) when ordering depends on your system. The option price is included in the MP1570A1. These two options can be installed simultaneously. But in this case, one option price is charged.

∗2: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified the FC connector MP0111A/0112A/0113A/0122B-37, MU150008A/150009A/150010A/150001A/150001B/150002A-37) is supplied as standard.

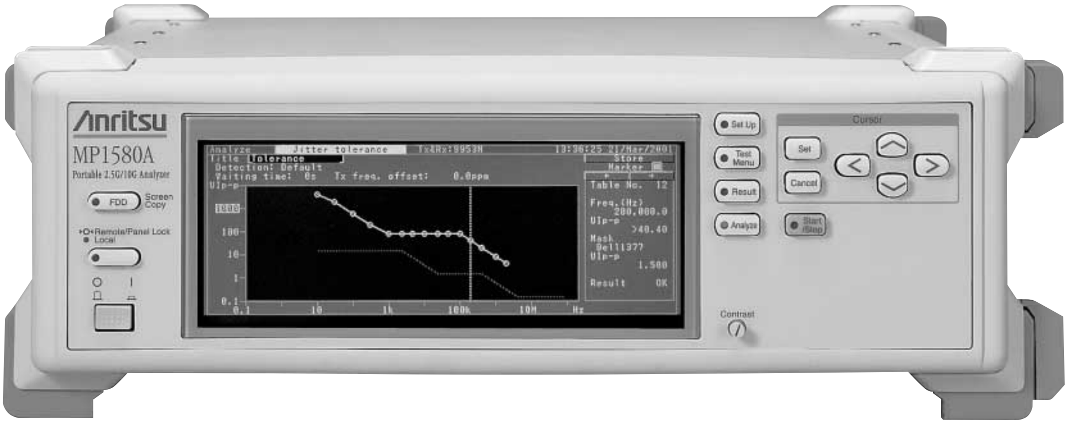
∗3: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously. Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

∗4: With Option 01, 2 sets

∗5: Please ask your local Anritsu Field Office or Sales. Representative for price and availability.

PORTABLE 2.5G/10G ANALYZER
MP1580A

For 2.5G/10G Jitter/Wander Measurements



The MP1580A is a unique and powerful solution for analyzing jitter at the standard OC-48/192 or STM-16/64 bit rates. It can measure jitter of 2.5G/10G electrical interfaces (clock signal) with a simple operation. In addition, when used in combination with the MP1570A SONET/SDH/PDH/ATM Analyzer, evaluation of jitter characteristics in digital transmission lines, systems and devices, such as — jitter tolerance, jitter transfer, jitter generation, etc., can be performed easily.

Functions

- **Complies with the latest ITU-T O.172 and Bellcore GR-1377 standards**

The MP1580A conforms to both the OC-192/STM-64 jitter measurement standards and supports required jitter modulation amplitude of 4000 UIp-p and 80 MHz jitter bandwidth.

- **Supports 10 GHz wander measurement according to the latest ITU-T G.813 standard (option)**

The MP1580A can generate and measure various types of wander. It can generate wander in the frequency range of 10 µHz to 10 Hz at 400,000 UIp-p max. In addition, MTIE/TDEV can be measured in real-time using an external PC and optional application software (MX150002B).

- **Single cabinet support for both 2.5G and 10G jitter/wander measurements**

Just one MP1580A is required for 2.5G and 10G jitter generation and analysis. When combined with the MP1570A and MU150000A, jitter can be added to SONET/SDH signals and measured.

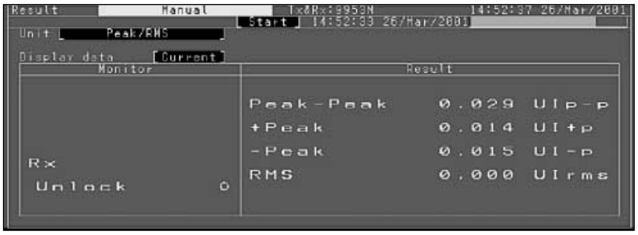
- **Differences from existing instrument (MP1777A)**

Anritsu launched the MP1777A 10 GHz Jitter Analyzer in February of 1998, as a jitter measurement solution for OC-192/STM-64 (9953M). The new MP1580A Portable 2.5G/10G Jitter Analyzer is providing more convenience in measurement without the need for ancillary equipment (network analyzer, external E/O-O/E converter). Anritsu has also developed a Wide Band O/E Converter (MU150017A/B) for the MP1570A to support jitter measurement of 80 MHz at 9953.28 Mbit/s as required by ITU-T standard in conjunction with the MP1580A. Although it uses two cabinets, the compact size makes the system ideal for R&D, manufacturing, installation and maintenance. In addition, the MP1570A can be controlled from the MP1580A for performing automatic measurements, such as Jitter Tolerance and Jitter Transfer.

Application

- **Output jitter measurement**

The MP1580A can easily measure the jitter clock signal (electrical interface only) by just inputting the output clock of DUT directly.



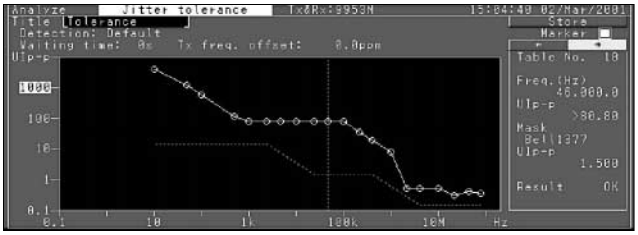
```
Result        Manual         Tx&Rx:9953M          14:52:37 26/Mar/2001
                      Start  14:52:33 26/Mar/2001
 Unit  Peak/RMS
 Display data    Current
        Monitor                          Result

                          Peak-Peak          0.029  UIp-p
                          +Peak              0.014  UI+p
                          -Peak              0.015  UI-p
  Rx                      RMS                0.000  UIrms
   Unlock            0
```

Optical signals can be measured easily by combining the MP1580A with the MP1570A, MU150000A, MU150001A and MU150017A/B.

- **Jitter tolerance measurement**

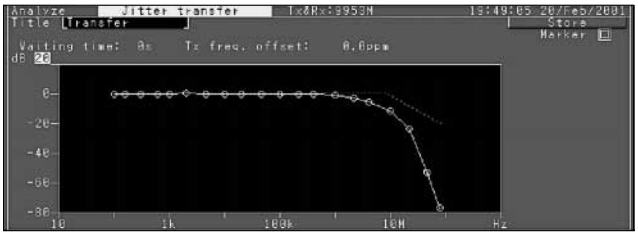
When the MP1580A is used with the MP1570A (send/receive jittered clock), jitter tolerance tests can be performed on OC-192/STM-64 and OC-48/STM-16 signals of electrical and optical interfaces.



```
Analyze       Jitter tolerance       Tx&Rx:9953M        15:04:40 02/Mar/2001
Title  Tolerance                                         Store
 Detection: Default                                      Marker
 Waiting time:  0s    Tx freq. offset:    0.0ppm
                                                        Table No.   18
                                                        Freq.(Hz)
                                                           46,000.0
                                                        UIp-p
                                                            >80.80
                                                        Mask
                                                         Bell1377
                                                        UIp-p
                                                             1.500
                                                        Result      OK
```

• Jitter transfer measurement

When the MP1580A is used with the MP1570A (send/receive jittered clock), jitter transfer tests can be performed on OC-192/STM-64 and OC-48/STM-16 signals of electrical and optical interfaces.



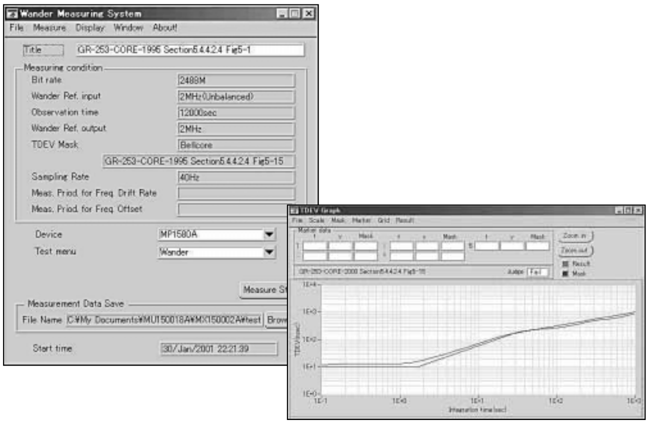
Analyze Jitter transfer Tx&Rx:9953M 19:49:05 20/Feb/2001

Title Transfer

Waiting time: 0s Tx freq. offset: 0.0ppm

• Wander generation and measurement

The MP1580A can generate and measure of wander conforming to ITU-T O.172 and also generation of TDEV conforming to ITU-T G.813. It also can measure TIE (Time Interval Error) by itself and measure MTIE and TDEV by connection of an external PC in which MX150002B is installed.



Wander Measuring System

Title: GR-253-CORE-1995 Section5.4.4.2.4 Fig5-1

Measuring condition
- Bit rate: 2488M
- Wander Ref. input: 2MHz(Unbalanced)
- Observation time: 12000sec
- Wander Ref. output: 2MHz
- TDEV Mask: Bellcore
- GR-253-CORE-1995 Section5.4.4.2.4 Fig5-15
- Sampling Rate: 40Hz
- Meas. Priod for Freq. Drift Rate:
- Meas. Priod for Freq. Offset:

Device: MP1580A

Test menu: Wander

Measurement Data Save
- File Name: C:¥My Documents¥MU150018A¥MX150002A¥test

Start time: 30/Jan/2001 22:21:39

Specifications

Frequency
- Range: 9953.28, 2488.32 MHz
- Offset range: ±100 ppm
- Resolution: 0.1 ppm
- Accuracy: ±0.1 ppm (calibrate after 60 min warm-up, 23 ±5˚C)

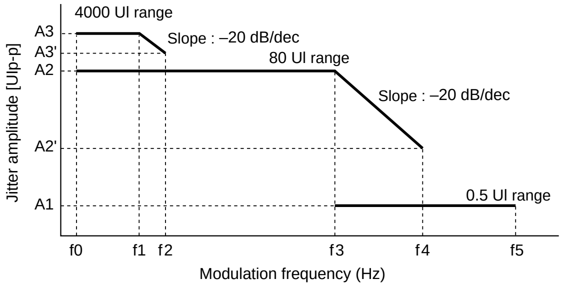
Generation function: Clock signal output, data signal output (with MP1570A), jitter on, wander on/off

Modulation source: Internal (sine wave), external (for jitter generation function only)

Modulation frequency accuracy: fm ±100 ppm (0.1 Hz to 80 MHz)

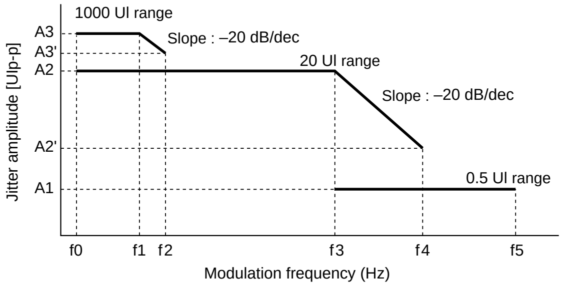
Jitter generation: Conform to ITU-T O.172

Jitter generation



Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (MHz)	f5 (MHz)	A1 (UIp-p)	A2' (UIp-p)	A2 (UIp-p)	A3' (UIp-p)	A3 (UIp-p)
9953.28M	0.1	15	600	100	2	80	0.5	4	80	100	4000

0.5 UI range: 0.000 to 0.505 UIp-p (0.001 UIp-p steps)
80 UI range: 0.00 to 80.80 UIp-p (0.05 UIp-p steps)
4000 UI range: 0 to 4040 UIp-p (2 UIp-p steps)



Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (MHz)	f5 (MHz)	A1 (UIp-p)	A2' (UIp-p)	A2 (UIp-p)	A3' (UIp-p)	A3 (UIp-p)
2488.32M	0.1	15	600	100	2	20	0.5	1	20	25	1000

0.5 UI range: 0.000 to 0.505 UIp-p (0.001 UIp-p steps)
20 UI range: 0.00 to 20.20 UIp-p (0.01 UIp-p steps)
1000 UI range: 0 to 1010 UIp-p (1 UIp-p steps)

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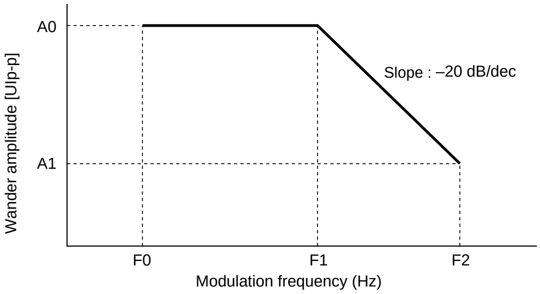
Wander generation

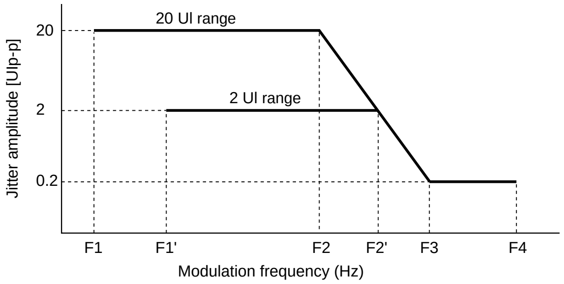
Wander generation: 10 µHz to 10 Hz, 0 to 400,000 UIp-p (1 UIp-p steps), conform to ITU-T O.172



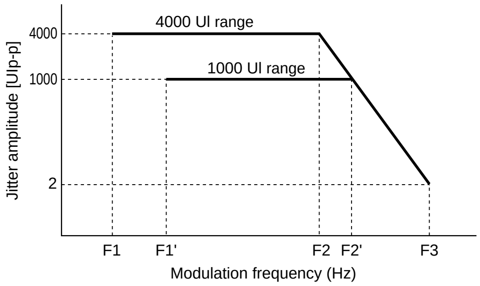
Bit rate (bit/s)	F0 (µHz)	F1 (mHz)	F2 (Hz)	A0 (UIp-p)	A1 (UIp-p)	Steps (UIp-p)
2488.32M	10	400	10	400,000	16,000	1
9953.28M	10	400	10	400,000	16,000	1

Jitter measurement

Measurement functions: UIp-p, UI + peak, UI – peak, UIrms, hit count, hit second, %F second, peak jitter
Measurement mode: Repeat, single, manual
Display: Current, last
Measurement interval: 1 to 99 s, 1 to 99 min, 1 to 99 h, 1 to 99 day
Jitter measurement: Conform to ITU-T O.172



Bit rate (bit/s)	Range (UI)	F1 (Hz)	F1' (Hz)	F2 (kHz)	F2' (kHz)	F3 (MHz)	F4 (MHz)
2488.32M	2	—	100	—	100	1	20
	20	10	—	10	—	1	20
9953.28M	2	—	100	—	400	4	80
	20	10	—	40	—	4	80



Bit rate (bit/s)	Range (UI)	F1 (Hz)	F1' (Hz)	F2 (Hz)	F2' (Hz)	F3 (kHz)
2488.32M	1000	—	1	—	12.1	5
9953.28M	4000	1	—	12.1	—	20

UIp-p measurement
- 2 UI range: 0.000 to 2.020 UIp-p (0.001 UIp-p steps)
- 20 UI range: 0.00 to 20.20 UIp-p (0.01 UIp-p steps)
- 1000 UI range: 0 to 1010 UIp-p (1 UIp-p steps, 2488.32 Mbit/s only)
- 4000 UI range: 0 to 4040 UIp-p (2 UIp-p steps, 9953.28 Mbit/s only)

UI rms measurement
- 2 UI range: 0.000 to 0.714 UIrms (0.001 UIrms steps)
- 20 UI range: 0.00 to 7.17 UIrms (0.01 UIrms steps)

Filters:
- Confirming to ITU-T O.172 and Bellcore GR1377
- LP, HP0 + LP, HP1 + LP, HP1' + LP, HP2 + LP, HP + LP, HP' + LP, LP' (1000/4000 UI range only), HP0 + LP' (1000/4000 UI range only)

Bit rate (bit/s)	HP0 (Hz)	HP1 (kHz)	HP1' (kHz)	HP2 (MHz)	HP' (kHz)	HP (kHz)	LP (MHz)	LP' (kHz)
2488.32M	10	5	—	1	—	12	20	5
9953.28M	10	10	20	4	50	12	80	20

Reference wander generation (Option 03)	Off: Able to set non-modulated status* TDEV mask: The 37 types of TDEV masks that are regulated by ITU-T, ETSI, ANSI, and Bellcore standards are available as default. It is possible to add the wander modulation on the user specified TDEV mask. Transient: It is possible to change the A (1 – e $^{-63.7t}$) phase by the timing of the start. Signal off: It is possible to disconnect the standard signal. Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations
Wander measurement (Option 02)	Conform to ITU-T O.172 Reference input: 2.048M (HDB3, clock), 1.544M (AMI/B8ZS, clock), 64k + 8 kHz, 5 MHz, 10 MHz Sampling frequency: 40 Hz, 1 Hz, 0.1 Hz (select by MX150002B) Measurement range P-P: 0.0 to 2E10 ns, +P/–P: 0.0 to 1E10 ns, TIE: 0.0 to ±1E10 ns Measurement time: 10 to 1 x 10^8 s (max. 120,000 s; MP1570A only) Wander application (requires MX150002B Wander Application Software) TIE: Max. 1 x 10^8 s, MTIE: Max. 1 x 10^8 s, TDEV: Max. 1 x 10^6 s Frequency offset: Measurement conforms to ANSI TI.105.09 Frequency drift rate: Measurement conforms to ANSI TI.105.09 Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations
Other measurement	Jitter transfer, frequency measurement, jitter tolerance, jitter sweep, frequency sweep, wander sweep (with MP1570A)
Dimensions and mass	320 (W) x 100 (H) x 350 (D) mm, ≤10 kg (with MU150018A)
Power	≤250 VA
Temperature range	0° to +40°C (operating), –20° to +60°C (storage)
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*: Only non-modulated status can be set without this option.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1580A	Portable 2.5G/10G Analyzer	
	Standard accessories	
	AC power cord:	1 pc
F0093A	Fuse, 6.3 A:	1 pc
B0489	Front cover:	1 pc
W1889AE	MP1580A operation manual (Vol 1 Jitter/wander):	1 copy
W1890AE	MP1580A operation manual (Vol 2 Remote control):	1 copy
MX150002B	Wander Measurement Application Software (MTIE/TDEV) *Supplied with MU150018A-02:	1 pc
W1892AE	MX150002B operation manual (wander application) *Supplied with MX150002B:	1 copy
J1074	Semirigid cable Tx (for connection to MP1570A):	1 pc
J1075	Semirigid cable Rx (for connection to MP1570A):	1 pc
	Plug-in unit	
MU150018A	2.5G/10G Jitter Unit	
MU150018A-02	Wander measurement	
MU150018A-03	Wander reference output phase modulation	
	Options	
MP1580A-01	RS-232C	
MP1580A-02	GPIB	
MP1580A-03	ETHERNET	
MP1580A-04	VGA	
	Maintenance service	
MP1580A-90	Extended three year warranty service	
MU150018A-90	Extended three year warranty service	
	Peripherals	
MP1570A	SONET/SDH/PDH/ATM Analyzer	
MP1570A-02	GPIB (requires to combine with MP1580A)	
MP1570A-10*	SDH	
MP1570A-11*	SONET	
MU150000A	2.5G/10G Unit (electrical for MP1570A)	
MU150001A	Optical 10G Tx (1.55) Unit *2 km, for MP1570A	
MU150001B	Optical 10G Tx (1.55) Unit *40 km, for MP1570A	
MU150001A/B-01	2.5G (1.31, option for MP1570A)	
MU150001A/B-02	2.5G (1.55, option for MP1570A)	
MU150001A/B-03	2.5G (1.31/1.55, option for MP1570A)	
MU150017A	Optical 10G Rx (Wide) Unit *For MP1570A	
MU150017B	Optical 2.5G/10G Rx (Wide) Unit *For MP1570A	
MP9677B	E/O, O/E Converter	
MU967701A	Clock Recovery Unit (9953.28 MHz) *For MP9677B	
MP35A	Matching Transformer (BNC-J/Siemence, C42334-A282, 75/120 Ω)	

Model/Order No.	Name
	Optical accessories
J0661A	RS232C cable (cross cable with D-sub 9 pin connector at both ends), 2 m
J0006	GPIB cable, 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0322B	Coaxial cord, 1 m
J0696A	Coaxial cord (AA-165-500), 0.5 m
J0696C	Coaxial cord (AA-165-1000), 1 m
J0900E	Coaxial cord (AA-165-1500), 1.5 m
J0162A	Balanced cord (Siemence 3P · Siemence 3P) 1 m
J0162C	Balanced cord (Siemence 3P · Siemence 3P), 2 m
J0845A	Balanced cord, (Bantam 3P · Bantam 3P), 6 ft
J0775D	Coaxial cord (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cord (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
B0490	Joint plate (to mount MP1580A and MP1570A in a stack)
B0491	Soft case
B0492	Hard carrying case
B0495	Side cover
B0330F	Tilt stand

*: Must specify SDH (Option 10) or SONET (Option 11) when ordering depends on your systems. The option price is included in the MP1570A. These two options can be installed simultaneously. But in this case, one option is charged.

NETWORK PERFORMANCE TESTER
MP1590A

GPIB OPTION

PDH/DSn/SDH/SONET/OTN/Jitter Measurement with One Unit

NEW

The MP1590A Network Performance Tester is a measuring instrument capable of testing PDH, DSn, SDH/SONET and OTN equipment as well as making jitter measurements with only one unit.
It also can perform OTN, SDH/SONET testing using the input wavelength from an external Tunable Laser Source. Jitter measurement and external optical input functions are provided by plug-in units that can be used in various combinations as needed.
The MP1590A is equipped with Random error insertion and variable optical output power functions. So it can efficiently evaluate Forward Error Correction (FEC) used with OTN equipment.
For SDH/SONET equipment, the MP1590A can perform Tandem Connection and Automatic Protection Switch (APS) tests. For PDH or DSn equipment, it can perform function tests using multiplexer/demultiplexer (MUX/DEMUX) measurement, error insertion or alarm addition.

- **Supports 1.5 Mbit/s to 10.7 Gbit/s interfaces with only one unit**

The MP1590A supports the following electrical and optical interfaces.
Electrical interfaces: PDH (2.048, 8.448, 34.368, 139.264 Mbit/s), DSn (1.544, 44.736 Mbit/s), STM-0/1/64, STS1/3/192 (51.84, 155.52, 9953.28 Mbit/s), OTU-2 (10.71 Gbit/s)
Optical interfaces: STM-0/1/4/16/64, OC-1/3/12/48/192 (51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s), OTU-1 (2.66 Gbit/s), OTU-2 (10.71 Gbit/s)
Because a plug-in system is employed, units can be used in various combinations as needed.

- **ITU-T G.709 OTN measurement**

Supports setting/monitoring of all overhead for OTU-1 (2.66 Gbit/s) and OTU-2 (10.71 Gbit/s) conforming to ITU-T G.709.
OTN equipment can be tested by error/alarm generation/detection functions. In particular, the Random error insertion function on the MP1590A enables FEC function evaluation. The built-in optical output power adjustable function allows one MP1590A to test the error correction ratio of OTN equipment based on its input power specification.

- **Concatenation mapping**

In addition to traditional concatenation mapping, the MP1590A supports arbitrary concatenation.

Arbitrary concatenation

SONET	STS3-Xc (X = 2 to 16)
SDH	VC-4-Xc (X = 2 to 16)

- **SDH/SONET functions**

The MP1590A is applicable for both SDH and SONET frames. It is easy to switch between SDH and SONET. Transmission/reception with Tandem Connection pattern and “No frame” pattern are possible. Also, APS switching time testing is supported. Moreover, various error/alarm generation functions enable stress testing of SDH/SONET equipment.

- **SDH/SONET overhead setting and monitoring**

SOH/TOH and POH within an SDH/SONET frame can be set and transmitted. Real-time monitoring is supported for K1/K2 bytes within SOH/TOH, K3/K4 bytes within POH, AU/STS pointer, TU/VT pointer, path trace and N1/Z5, N2 of the received signal.

- **Error analysis (error performance)**

Measurements conforming to ITU-T Rec. G.821/G.826/G.828/G.829, M.2100/M.2101/M.2110/M.2120 and GR-820 can be performed.

- **Jitter generation/measurement**

Installing a 10/10.7G jitter unit enables SDH/SONET (52 to 9953 MHz), OTU-1 (2.66 GHz), OTU-2 (10.71 GHz) and 10.3 GHz jitter generation/measurement. Jitter tolerance and jitter transfer characteristic measurements conforming to ITU-T Rec. G.783, G.825, G.8251 and Telcordia GR-253 can be performed. The measured results are displayed in numeric values and graphs, allowing user evaluation and simplifying pass/fail judgment.

- **Through mode**

Through mode operation can be used for all bit rates of PDH/DSn, SDH/SONET and OTU-1/OTU-2.
For SDH/SONET and OTU-1/OTU-2, either transparent through or overhead overwrite modes can be selected. In the overhead overwrite, it is also possible to add an error/alarm to through signals.

• Clock/frame synchronization signal output

Divided-by-16 clock or frame synchronization signals can be output. Connecting this signal output to an external sampling oscilloscope allows the MP1590A to evaluate errors/alarms and the oscilloscope to evaluate the input waveform simultaneously.
The MP1590A can provide both a transmission signal and the synchronized recovered clock from its received signal, making waveform analysis possible for devices that do not have their own synchronized signal output.

• External optical input function

By using the MU150134A 10/10.7G Optical Unit (Transmission External Modulation), OTN and SDH/SONET tests based on a user-provided input wavelength can be performed. This is best suited to provide the reference optical source for jitter measurement because of its very fine waveform quality and low jitter characteristics.

Specifications

• MP1590A (main frame)

Reference Clock input	Frequency Clock: 1.544 MHz, 2.048 MHz, 64 kHz + 8 kHz, 5 MHz, 10 MHz Data: 1.544 Mbit/s (BITS), 2.048 Mbit/s Input range: ±50 ppm Level/Code 1.544 Mbit/s: ANSI T1.403 (B8ZS) 2.048 Mbit/s: ITU-T G.703 Table10 (HDB3) 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz: TTL (Rectangle) 64 kHz + 8 kHz: 0.63 to 1.1 Vo-p (AMI, 8 kHz violation) Interface 1.544 MHz, 2.048 MHz, 2.048 Mbit/s, 5 MHz, 10 MHz: BNC 75 Ω 2.048 MHz, 2.048 Mbit/s, 64 kHz + 8 kHz: SIEMENS 120 Ω 1.544 Mbit/s: BANTAM 100 Ω Effective SDH/SONET/OTN bit rate.
Reference Clock output	Frequency Clock: 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz Data: 1.544 Mbit/s (BITS), 2.048 Mbit/s Level/Code 1.544 Mbit/s: ANSI T1.403 (B8ZS) 2.048 Mbit/s: ITU-T G.703 Table10 (HDB3) 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz: TTL (Rectangle) Interface 1.544 MHz, 2.048 MHz, 2.048 Mbit/s, 5 MHz, 10 MHz: BNC 75 Ω 1.544 Mbit/s: BANTAM 100 Ω ∗5 MHz is possible to use when the MU150125A is installed. Effective SDH/SONET/OTN bit rate.
Trigger	Trigger input: For capture/APS measurement Trigger output: Transmit Error/Alarm, Receive Error/Alarm, Capture trigger Level: TTL (active High) Connector: BNC 75 Ω
DCC/GCC	Data input/output: D1-D3 (192 kbit/s), D4-D12 (576 kbit/s), GCC0-2 (13124 kbit/s, 326.7 kbit/s) Clock output: 192 kHz , 576 kHz, 13124 kHz, 326.7 kHz Level: V.11 Connector: D-sub 9 pin
Remote interface	RS-232C (installed Option 01), GPIB (installed Option 02), Ethernet (10BASE-T/100BASE-TX, installed Option 03)
Peripheral connection	VGA output (SVGA), USB (2 port, Rev. 1.1), keyboard (PS/2)
External memory	Compact flash (2 to 512 MB, recommended by CFA)
Pointing device	By standard pointing device for a main frame, cursor movement in a screen is possible.
Display size	8.4 inch, color TFT (800 x 600)
LED	OTN: Frame, OTU, ODU, OPU SDH/SONET: Frame, MS/Line, AU/Path, TU/VT Standby, HDD, Clock Loss, Power Fail, History, Signal Loss, Errors, Test Pattern, Jitter, PDH/DSn, Event
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Power	85 to 132/170 to 250 Vac (100/200 V system automatic change), 47.5 to 63 Hz
Power consumption	≤500 VA
Operational temperature	0˚ to +40 ˚C
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤13 kg (excluding plug-in units)

• MU150100A 10G/10.7G Unit

Electrical interface (1.544 to 155.52 Mbit/s)	Bit rate PDH/DSn: 1.544 Mbit/s, 2.048 Mbit/s, 8.448 Mbit/s, 34.368 Mbit/s, 44.736 Mbit/s, 139.264 Mbit/s SDH/SONET: 51.84 Mbit/s, 155.52 Mbit/s Code 1.544 Mbit/s: AMI/B8ZS 2.048 Mbit/s, 8.448 Mbit/s, 34.368 Mbit/s: HDB3 44.736 Mbit/s, 51.84 Mbit/s: B3ZS 139.264 Mbit/s, 155.52 Mbit/s: CMI Connector 1.5M: BANTAM 100 Ω Balanced 2M: 3 pin Siemens 120 Ω Balanced 2/8/34/139/45/52/156M: BNC 75 Ω Level ANSI T1.102 (1.5/45M) ITU-T G.703 (2/8/34/139/156M) DSX output (1.5M): 0/655 feet DSX output (45M, 52M): 0/450/900 feet Monitor gain 20 dB, 26 dB: 1.5M/2M/8M/34M/45M/52M 20 dB: 139M/156M
Electrical interface (9953.28 M, 10709.225 Mbit/s)	Bit rate SDH/SONET: 9953.28 Mbit/s OTN: 10709.225 Mbit/s (Installed Option 05) Code: NRZ Connector: SMA 50 Ω Level Clock Output: 1.3 to 0.6 Vp-p Data Output: 0 to –0.2 V (High), –0.85 to –1.5 V (Low) Data Input: 1.5 to 0.3 Vp-p
Optical interface	Bit rate SDH/SONET: 51.84 Mbit/s, 155.52 Mbit/s, 622.08 Mbit/s, 2488.32 Mbit/s OTN: 2666.057 Mbit/s (Installed Option 05) Code: NRZ Connector: FC-PC (SMF), replaceable
Optical output	Level: –1 to +3 dBm (ATT = 0 dB, Option 04) Extinction ratio: ≥10 dB SMSR: ≥30 dB Peak wavelength: 1550 nm ±20 nm (Option 02,03), 1310 nm ±20 nm (Option 01,03) Wavelength stability: ±0.1 nm –20 dB width: ≤1 nm Safety classification: IEC 825-1:CLASS 3A, 21 CFR 1040.10:CLASS Ⅲ B
Optical input	Optical input level: –8 to –33 dBm (52/156M), –8 to –29 dBm (622M/2.5G/2.6G) Wavelength: 1260 to 1610 nm Overload: +3 dBm (Average)
Clock	Internal, External (Reference input, 1/1 input), Receive Internal Accuracy: ±0.1 ppm Offset range: ±100 ppm/0.1 ppm step
Frame	1.544 Mbit/s: D4/ESF/Japan ESF 2.048 Mbit/s: 30, 31ch with or without CRC4 8.448 Mbit/s: G.742 34.368 Mbit/s: G.751 44.736 Mbit/s: M13/C-bit 139.264 Mbit/s: G.751 51.84 Mbit/s: SDH/SONET 155.52 Mbit/s: SDH/SONET 622.08 Mbit/s: SDH/SONET 2488.32 Mbit/s: SDH/SONET 9953.28 Mbit/s: SDH/SONET
No frame	1.544, 2.048, 8.448, 34.368, 44.736, 139.264 Mbit/s 51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s
Test pattern	PRBS, Word, all0, all1, 3 in 24 (only 1.5M) PRBS (SDH/SONET) No Frame: $2^{15} – 1$ (only 52/156M), $2^{23} – 1$, $2^{31} – 1$ Concatenation mapping: $2^{15} – 1$ (1c/4c), $2^{23} – 1$, $2^{31} – 1$ Another mapping: $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$, $2^{20} – 1$z (only 1.5M/45M), $2^{23} – 1$ Invert ON/OFF PRBS (PDH/DSn) $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$, $2^{20} – 1$z (only 1.5M/45M), $2^{23} – 1$ Invert ON/OFF Word: 16-bit programmable Transmit/Receive: An independent setup is possible
Error addition/ measurement	PDH/DSn: Bit all (only addition), Code, Bit info, Bit 1.5M, Bit 2M, Bit 8M, Bit 34M, Bit 45M, Bit 139M, FAS 1.5M, FAS 2M, FAS 8M, FAS 34M, FAS 45M, FAS 139M, EXZ, CRC6, Ebit, Parity, Cbit, REI SDH: FAS, Frame (only measurement), B1, B2, HP-B3, LP-B3, BIP-2, MS-REI (M0/M1), HP-REI, LP-REI, Bitall (Only Addition), Bit info, OH bit, HP-IEC, LP-IEC, N2 BIP-2, HP-TC-REI, LP-TC-REI, HP-OEI, LP-OEI SONET: FAS, Frame (only measurement), B1, B2, HP-B3, LP-B3, BIP-2, REI-L (M0/M1), REI-P, REI-V, Bitall (Only Addition), Bit info, OH bit, HP-IEC, LP-IEC, N2 BIP-2, HP-TC-REI, LP-TC-REI, HP-OEI, LP-OEI

Continued on next page

Error addition timing	Rate, Alternative, Single, Burst, All, Frame Rate Fix rate: $1{*}10^{-n}$ (n: 3 to 9), User program: $A{*}10^{-B}$ (A: 1.0 to 9.9 step 0.1, B: 2 to 10) Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000 Frame (only PDH/DSn) : n in 16 frame (n: 1 to 4 Error Frame) B1, B2, B3, BIP-2 can be set Error bit.
Alarm addition/ measurement	PDH/DSn: LOS, LOF, AIS, RDI, RDI (MF) SDH: LOS, LOF, OOF (only measurement), RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-ERDIP, HP-ERDIS, HP-ERDIC, HP-TIM, HP-UNEQ, HP-SLM, TU-AIS, TU-LOP, TU-LOM, LP-RDI, LP-ERDIP, LP-ERDIS, LP-ERDIC, ISF, LP-RFI, LP-TIM, LP-UNEQ, LP-SLM, Sync. loss, OH Sync., HP-VC-AIS, LP-VC-AIS, HP-FAS, LP-FAS, HP-Incoming AIS, LP-Incoming AIS, HP-TC-RDI, LP-TC-RDI, HP-ODI, LP-ODI, HP-TC-TIM, LP-TC-TIM, HP-LTC, LP-LTC SONET: LOS, LOF, OOF (only measurement), RS-TIM, AIS-L, RDI-L, AIS-P, LOP-P, RDI-P, ERDIP-P, ERDIS-P, ERDIC-P, TIM-P, UNEQ-P, PLM-P, AIS-V, LOP-V, LOM-V, RDI-V, ERDIP-V, ERDIS-V, ERDIC-V, ISF, RFI-V, TIM-V, UNEQ-V, PLM-V, Sync. loss, OH Sync., HP-VC-AIS, LP-VC-AIS, HP-FAS, LP-FAS, HP-Incoming AIS, LP-Incoming AIS, HP-TC-RDI, LP-TC-RDI, HP-ODI, LP-ODI, HP-TC-TIM, LP-TC-TIM, HP-LTC, LP-LTC
Alarm addition timing	Single, Burst, Alternative, All Alternative Error frame = 0 to 64000, Normal frame = 1 to 64000
Monitor	PDH/DSn: FAS 1.5M, FW 2M, NFW 2M, MFW 2M, FAS 8M, FAS 34M, FAS 45M, FAS 139M, Info byte (only 2M) SDH/SONET: SOH/TOH/POH, Path Trace, Tandem byte, K1/K2 byte, AU/STS, TU/VT pointer
Through	Transparent, Overhead overwrite (only SDH/SONET/OTN)
MUX/DEMUX	MUX/DEMUX is possible to 64 k units in PDH and DSn
Add/Drop	PDH/DSn signal can be added to or dropped from the SDH/SONET mapping. Bit rate: 1.5 Mbit/s, 2 Mbit/s, 34 Mbit/s, 45 Mbit/s, 139 Mbit/s
Delay measurement	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0.1 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, >Time out
Dummy channel	Mode: Copy/Dummy Pattern: all 0, all 1, $2^{11}-1$, $2^{15}-1$ (Invert)
Path Trace	J0, J1, J2 byte can be set arbitrarily. 16 byte (CRC On), 32 byte (CRC Off)
Tandem connection	N1/Z5, N2 byte can be set arbitrarily. It can set ON/OFF
Pointer generation	AU/STS, TU/VT pointer Action: NDF, ±Justification Timing: Manual, Burst (2 to 64), NDF
Pointer measurement	AU/STS, TU/VT pointer, C bit Measurement item: NDF, + PJC, –PJC, Cons, C, C1/C2
Payload offset	Offset range: ±100 ppm/0.1 ppm step can set at the Async. mapping.
APS test	Switching time measurement Measurement time: 0.1 to 2000.0 ms, Timeout APS Sequence Generator Generator timing: 2 to 64 word, Max. 8000 frame/word It can be set for each K1/K2, K3, K4.
Overhead sequence capture	Capture byte: K1/K2, K3, K4, AU-Pointer, TU-Pointer Size: 64 sequence Repeat: Max. 8000 frame/sequence
Overhead test	SOH/TOH/POH 1byte, A1/A2, K1/K2, RSOH, MSOH, SOH, POH (except parity byte) Timing: Alternative (A: 1 to 8000 times, B: 1 to 8000 times), A and B can be set up to 256 frames.
OH BERT test	Test byte: SOH/TOH/POH 1 byte, D1-D3, D4-D12 (except parity byte) Pattern: $2^{11}-1$, $2^{15}-1$ (Invert) Error addition: Bit (only Single) Measurement: Bit error, Sync loss
OH add/drop	Test byte: D1-D3, D4-D12
Performance	G.821, G.826, G.828, G.829, M.2100, M.2101, M.2110, M.2120, GR.820
Optical power meter	Wavelength: 1310 nm/1550 nm Measurement range: –7 dBm to –40 dBm Measurement accuracy: ±1 dB (–10 to –30 dBm), ±2 dB (–7 to –9.9 dBm, –30.1 to –40 dBm)
Frequency counter	Measurement frequency (f0): 1.544, 2.048, 8.448, 34.368, 44.736, 139.264 MHz 51.84, 155.52, 622.08, 2488.320, 2666.057 MHz 9953.28, 10709.225 MHz Measurement range: f0 ±100 ppm Accuracy: ±0.1 ppm

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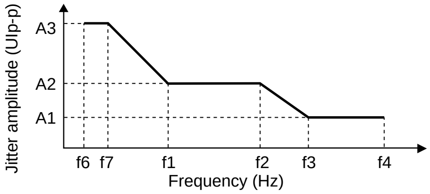
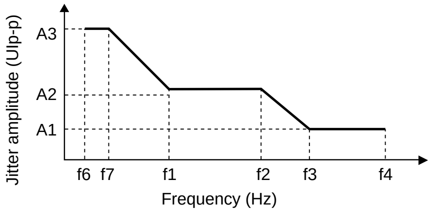
<table>
<tr>
<td>Jitter tolerance</td>
<td>


<table>
<tr><th>Bit rate (Mbit/s)</th><th>A1 (UIp-p)</th><th>A2 (UIp-p)</th><th>A3 (UIp-p)</th><th>f6 (Hz)</th><th>f7 (Hz)</th><th>f1 (Hz)</th><th>f2 (Hz)</th><th>f3 (Hz)</th><th>f4 (Hz)</th></tr>
<tr><td>51.84</td><td>20</td><td>2</td><td>0.2</td><td>10</td><td>30</td><td>300</td><td>2k</td><td>20k</td><td>400k</td></tr>
<tr><td>155.52</td><td>50</td><td>2</td><td>0.2</td><td>10</td><td>19.3</td><td>500</td><td>6.5k</td><td>65k</td><td>1.3M</td></tr>
<tr><td>622.08</td><td>200</td><td>2</td><td>0.2</td><td>10</td><td>10</td><td>1k</td><td>25k</td><td>250k</td><td>5M</td></tr>
<tr><td>2488.32</td><td>800</td><td>2</td><td>0.2</td><td>10</td><td>12.1</td><td>20k</td><td>400k</td><td>4M</td><td>20M</td></tr>
<tr><td>2666.05</td><td>800</td><td>2</td><td>0.2</td><td>10</td><td>12.1</td><td>20k</td><td>400k</td><td>4M</td><td>20M</td></tr>
</table>
Measurement condition: MU150100A loop-back measurement (Built-in MU150125A-05)
  Temperature condition: +10˚ to +40˚C
  Optical input level: –10 to –12 dBm
  Error threshold: 10^{-8} (52M), 10^{-9} (156M, 622M), 10^{-10} (2488M, 2666M)
  Optical input wavelength: 1310 nm/1550 nm
Mapping
  SDH: VC3-Bulk (52M), VC4-nc (n = 1, 4, 16) (156M/622M/2488M)
  SONET: STSnc (n = 1, 3, 12, 48)
  OTU-1: ODU1-OPU1-PRBS
Test pattern: PRBS23 (SDH), PRBS31 (OTU-1), Mark ratio 1/2, Scramble “On”
Clock: internal


<table>
<tr><th>Bit rate (Mbit/s)</th><th>A1 (UIp-p)</th><th>A2 (UIp-p)</th><th>A3 (UIp-p)</th><th>f6 (Hz)</th><th>f7 (Hz)</th><th>f1 (Hz)</th><th>f2 (Hz)</th><th>f3 (Hz)</th><th>f4 (Hz)</th></tr>
<tr><td>9953</td><td>0.2</td><td>2</td><td>3200</td><td>10</td><td>12.1</td><td>20k</td><td>400k</td><td>4M</td><td>80M</td></tr>
<tr><td>10709</td><td>0.2</td><td>2</td><td>3200</td><td>10</td><td>12.1</td><td>20k</td><td>400k</td><td>4M</td><td>80M</td></tr>
</table>
Measurement condition: MU150100A, MU150121A, MU150123A loop-back measurement (Built-in MU150125A-05)
Temperature condition: +10˚ to +40˚C
Optical input level: –10 to –12 dBm
Optical input wavelength: 1310 nm/1550 nm
Mapping
  SDH: VC4-64c (9953M)
  SONET: STS192c (9953M)
  OTU-2: ODU2-OPU2-PRBS
Test pattern: PRBS23 (SDH), PRBS31 (OTU-2), Mark ratio 1/2, Scramble “On”
Clock: internal
</td>
</tr>
<tr><td>Auxiliary interface</td><td>External clock input, Receive clock output, Cock/Frame sync. output</td></tr>
<tr><td>Optical attenuator (Option 04)</td><td>Attenuation: 0 to 30 dB, accuracy: ≤±0.5 dB (0 to 10 dB), ≤±1.0 dB (10.1 to 30 dB) setting resolution: 0.1 dB</td></tr>
</table>

• MU150100A Option 05 (OTU-1/OTU-2)

Bite rate	10709.225 Mbit/s, 2666.057 Mbit/s
Frame	10709.225 Mbit/s: OTU-2, 2666.057 Mbit/s: OTU-1
No frame	10709.225 Mbit/s, 2666.057 Mbit/s
Test pattern	PRBS, Word, all 0, all 1 PRBS No frame: $2^{15}-1$, $2^{23}-1$, $2^{31}-1$ PRBS mapping: $2^{15}-1$, $2^{23}-1$, $2^{31}-1$ SDH/SONET mapping: According to SDH/SONET mapping Invert ON/OFF Word: 16-bit programmable Transmit/Receive: An independent setup is possible
FEC	G.709, RS (255, 239) It can set ON/OFF
Justification	Generation Action: ±Justification Timing: Single, Burst (2 to 64) Measurement item: + JC, –JC
Payload offset	Offset range: ±65.9 ppm/0.1 ppm step can set at the Async. mapping.

Continued on next page

Error addition/measurement	FAS, BIP-8 (SM, PM, TCM1-6), BEI (SM, PM, TCM1-6), Bit all (only addition for OTN frame), Bit
Error addition timing	Single, Rate, All, Alternate, Random (only Bit all) Rate Fix rate: $1*10^{-n}$ (n: 3 to 9), User program: $A*10^{-B}$ (A: 1.0 to 9.9, B: 2 to 10) Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000 Random: Poisson error insertion function (only Bit all) When the Parity error is set, it can be select Error position
Alarm addition/ measurement	LOF, OOF (only measurement), LOM, OOM (only measurement), BDI (SM, PM, TCM1-6), AIS (OTU, ODU), ODU-OCI, ODU-LCK, IAE (SM,TCM1-6), TIM (SM, PM, TCM1-6), LTC (TCM1-6), BIAE (SM, TCM1-6)
Alarm addition timing	Alternative, All, Burst, Single Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000
Monitor	All OH (OTU, ODU, OPU), TTI, FTFL, Payload Multi-frame indicate is possible at the TTI and FTFL.
Overhead sequence capture	Capture byte: FAS, APS/PCC, EXP, FTFL, GCC0-2, PM, PSI, SM, TCMACT, TCM1-6, OPU Size: 64 sequence Repeat: Max. 8000 frame/sequence
Overhead test	OTU/ODU/OPU 1byte, FAS, APS/PCC, TCM1-6, SM, PM, GCC0-2, EXP (except JC,NJC) Timing: Alternative (A: 1 to 8000 times, B: 1 to 8000 times), A and B can be set up to 256 frames.
OH BERT test	GCC0-2, OH 1byte (except Parity byte) Pattern: $2^{11} – 1$, $2^{15} – 1$ (Invert) Error addition: Bit (only Single) Measurement: Bit error, Sync.loss
OH Add/Drop	Test byte: GCC0-2

• MU150100A Option 07 (10G/10.7G Minus option)

Function	This Option removes the 10G/10.7G electrical capability from the MU150100A. This Option must be installed in the factory.

• MU150121A 10/10.7G Optical Unit (Tx)

Bit rate	9953.28 Mbit/s, 10709.225 Mbit/s Depends on frequency accuracy and external input frequency of the MU150100A.
Peak wavelength	1310 ±20 nm (Option 01, 03) 1550 ±20 nm (Option 02, 03)
–20 dB width	≤0.5 nm (@–20 dB)
SMSR	≥30 dB
Extinction ratio	≥10 dB
Optical output power	0 to +3 dBm
Signal code	NRZ
Connector	FC-PC (SMF), replaceable
Electrical input	9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm Input level H: 0 to –0.2 V, L: –0.85 to –1.5 V Impedance: 50 Ω Connector: SMA
Optical output power variable (Option 04)	Variable range: 0 to 20 dB, accuracy: ≤±0.5 dB (0 to 10 dB), ≤±1.0 dB (10.1 to 20 dB), setting resolution: 0.1 dB

• MU150122A 10/10.7G Optical Unit (Rx narrow)

Bit rate	9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm
Optical input wavelength	1260 to 1610 nm
Optical input sensitivity	–14 to 0 dBm
Absolute maximum optical input	+3 dBm (average)
Optical input signal code	NRZ
Optical input return loss	≥27 dB
Optical connector	FC-PC (SMF), replaceable
Electrical output signal	9953.28 Mbit/s, 10709.225 Mbit/s Output level: 0.2 to 1.0 Vp-p Signal code: NRZ Impedance: 50 Ω Connector: SMA
Optical input power measurement	Measurement range: –20 to +2 dBm Measurement accuracy: ≤±0.5 dB (+2 to –10 dBm), ≤±1.0 dB (–10.1 to –20 dBm)

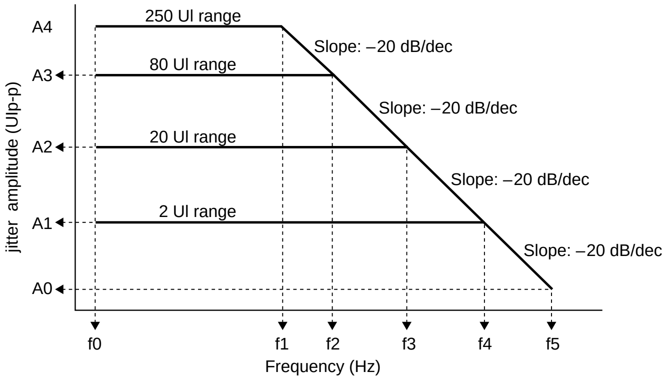
- **MU150123A 10/10.7G Optical Unit (Rx wide)**

Bit rate	9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm (Option 05)
Optical input wavelength	1260 to 1610 nm
Optical input sensitivity	–14 to 0 dBm
Absolute maximum optical input	+3 dBm (average)
Optical input signal code	NRZ
Optical input return loss	≥27 dB
Optical connector	FC-PC (SMF), replaceable
Electrical output signal	Data output 9953.28 Mbit/s, 10709.225 Mbit/s (Option 05) Output level: 1.0 ±0.25 Vp-p Clock output 9953.28 MHz, 10709.225 MHz (Option 05) Output level: 0.8 ±0.25 Vp-p Signal code:NRZ Input impedance: 50 Ω Connector: SMA
Optical input power measurement	Measurement range: –20 to +2 dBm Measurement accuracy: ≤±0.5 dB (+2 to –10 dBm), ≤±1.0 dB (–10.1 to –20 dBm)

- **MU150125A 10/10.7G jitter Unit**

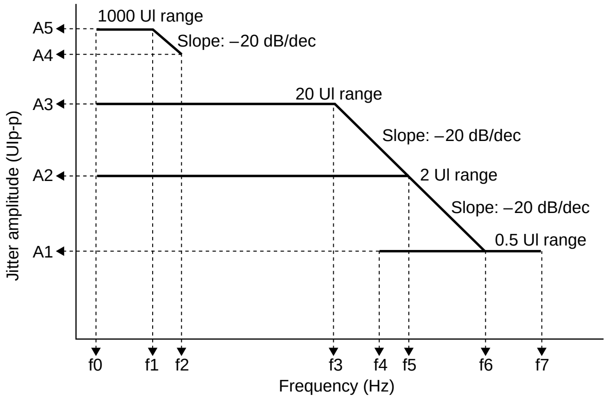
<table>
<tr><td>Frequency</td><td>51.84 MHz, 155.52 MHz, 622.08 MHz, 2488.32 MHz, 9953.28 MHz
2666.06 MHz (Option 05), 10709.225 MHz (Option 05)
10312.5 MHz (Option 06)</td></tr>
<tr><td>Jitter generation</td><td>Frequency:
51.84 MHz ±100 ppm, 155.52 MHz ±100 ppm, 622.08 MHz ±100 ppm, 2488.32 MHz ±100 ppm, 2666.057 MHz ±100 ppm, 9953.28 MHz ±100 ppm, 10312.5 MHz ±100 ppm, 10709.225 MHz ±100 ppm
Level: 0.8 Vp-p ±0.25 V
Interface: SMA, 50 Ω
Modulation frequency: 0.1 to 80 MHz
Amplitude: 0 to 4040 UIp-p

Modulation value:
52M, 156M, 622M



<table>
<tr><th>Bit rate (bit/s)</th><th>f0 (Hz)</th><th>f1 (kHz)</th><th>f2 (kHz)</th><th>f3 (kHz)</th><th>f4 (kHz)</th><th>f5 (MHz)</th><th>A0 (UIp-p)</th><th>A1 (UIp-p)</th><th>A2 (UIp-p)</th><th>A3 (UIp-p)</th><th>A4 (UIp-p)</th></tr>
<tr><td>52M</td><td>0.1</td><td>—</td><td>—</td><td>50</td><td>500</td><td>1.3</td><td>0.776</td><td>2.02</td><td>20.20</td><td>—</td><td>—</td></tr>
<tr><td>155M</td><td>0.1</td><td>—</td><td>38</td><td>150</td><td>1500</td><td>3.8</td><td>0.797</td><td>2.02</td><td>20.20</td><td>80.8</td><td>—</td></tr>
<tr><td>622M</td><td>0.1</td><td>4.8</td><td>15</td><td>60</td><td>600</td><td>5</td><td>0.242</td><td>2.02</td><td>20.20</td><td>80.8</td><td>253.0</td></tr>
</table>

2488M, 2666M


</td></tr>
</table>

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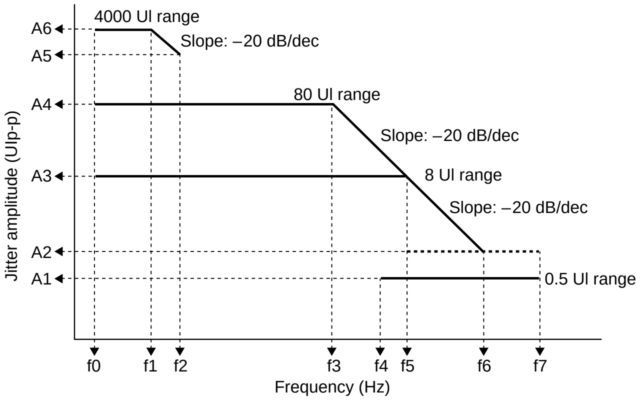
Jitter generation

Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (MHz)	f6 (MHz)	f7 (MHz)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	A4 (UIp-p)	A5 (UIp-p)
2488M 2666M	0.1	15	600	100	500	1	4	20	0.505	2.02	20.2	25	1010

9953M, 10.3G, 10.7G



Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (kHz)	f6 (MHz)	f7 (MHz)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	A4 (UIp-p)	A5 (UIp-p)	A6 (UIp-p)
9953M 10.3G 10.7G	0.1	15	600	100	500	1	4	80	0.505	2.02	8.08	80.8	110	4040

Accuracy:
- 0.5 UI range: ±Q % of setting ±0.02 UIp-p
- 2 UI range: ±Q % of setting ±0.02 UIp-p
- 8 UI range: ±Q % of setting ±0.8 UIp-p
- 20 UI range: ±Q % of setting ±0.2 UIp-p
- 20 UI range: ±Q % of setting ±1.2 UIp-p (2488M, 2666M)
- 80 UI range: ±Q % of setting ±1.2 UIp-p
- 80 UI range: ±Q % of setting ±4.8 UIp-p (9953M, 10.3G, 10.7G)
- 250 UI range: ±Q % of setting ±6 UIp-p
- 1000 UI range: ±Q % of setting ±6 UIp-p
- 4000 UI range: ±Q % of setting ±24 UIp-p

Frequency	Variable error Q	Frequency range
52 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 1.3 MHz
156 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 1.5 MHz
	±15 %	1.5 MHz to 3.8 MHz
622 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 2 MHz
	±15 %	2M to 5 MHz
2488 MHz 2666 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 2 MHz
	±15 %	2M to 20 MHz
9953MHz 10.3 GHz 10.7 GHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 2 MHz
	±15 %	2M to 80 MHz

Jitter measurement

Frequency:
51.84 MHz ±100 ppm, 155.52 MHz ±100 ppm, 622.08 MHz ±100 ppm, 2488.32 MHz ±100 ppm, 2666.057 MHz ±100 ppm, 9953.28 MHz ±100 ppm, 10312.5 MHz ±100 ppm, 10709.225 MHz ±100 ppm

Level: 0.8 Vp-p ±0.3 V (52 MHz to 2.6 GHz), 0.8 Vp-p ±0.25 V (10/10.3/10.7 GHz)

Interface: SMA, 50 Ω

Manual jitter measurement: UIp-p, UI+p, UI-p/UIrms

UIp-p measurement:
- 2 UI range (–1.010 to 1.010 UIp-p/Step 0.001 UIp-p)
- 20 UI range (–10.10 to 10.10 UIp-p/Step 0.01 UIp-p)
- 80 UI range (–40.4 to 40.4 UIp-p/Step 0.25 UIp-p)
- 250 UI range (–123.0 to 123.0 UIp-p/Step 0.5 UIp-p)
- 1000 UI range (–510.0 to 510.0 UIp-p/Step 1 UIp-p)
- 4000 UI range (–2020 to 2020 UIp-p/Step 2 UIp-p)

UIrms measurement:
- 2 UI range (0.000 to 0.714 UIrms/Step 0.001 UIrms)
- 20 UI range (0.00 to 7.14 UIrms/Step 0.01 UIrms)

Continued on next page

Jitter measurement

Filter

Frequency (Hz)	HP0 (Hz)	HP1 (Hz)	HP1’ (Hz)	HP2 (Hz)	HP’ (Hz)	HP (Hz)	LP (Hz)	LP’ (Hz)
52M	10	100	—	20k	—	12k	400k	—
156M	10	500	—	65k	—	12k	1.3M	500
622M	10	1k	—	250k	—	12k	5M	1k
2488M 2666M	10	5k	—	1M	—	12k	20M	5k
9953M 10.3G 10.7G	10	20k	10k	4M	50k	12k	80M	20k

Accuracy (UIp-p, UI+p, UI-p):
2 UI range: ±R% ±W UIp-p
20 UI range: ±R% ±W UIp-p
80 UI range: ±R% ±W UIp-p
250 UI range: ±R% ±W UIp-p
1000 UI range: ±R% ±W UIp-p
4000 UI range: ±R% ±W UIp-p

Frequency (Hz)	W Clock signal						
	HP1+LP		HP2+LP		HP+LP*		HP0+LP’
	2 UI	20 UI	2 UI	20 UI	2 UI	20 UI	80/250/1000/4000 UI
52M	0.035	0.5	0.03	0.3	0.03	0.3	—
156M	0.035	0.5	0.02	0.2	0.03	0.3	2
622M	0.035	0.5	0.03	0.3	0.03	0.3	8
2488M 2.6G	0.035	0.5	0.03	0.3	0.03	0.3	20
9953M 10.3G 10.7G	0.05	0.5	0.03	0.3	0.03	0.3	80

*: Apply HP+LP' at 9953M, 10.3G, 10.7G

UIrms
2 UI range: ±R% ±Y UIp-p
20 UI range: ±R% ±Y UIp-p

Bit rate (bit/s)/ frequency (Hz)	Y clock signal	
	HP+LP*	
	2 UI	20 UI
52M	0.008	0.04
156M	0.008	0.04
622M	0.008	0.04
2488M 2666M	0.008	0.04
9953M 10.3G 10.7G	0.008	0.05

*: Apply HP'+LP at 9953M, 10.3G, 10.7G

MU150100A loop back measurement

Bit rate (Mbit/s)	W data signal			
	UIp-p			UIrms
	HP1+LP	HP+LP	HP2+LP	HP+LP
	2 UI	2 UI	2 UI	2 UI
51.84 (Optical)	0.070	0.070	0.035	0.010
51.84 (Electrical)	0.070	0.070	0.035	0.010
155.52 (Optical)	0.070	0.070	0.035	0.010
155.52 (Electrical)	0.070	0.070	0.035	0.010
622.08 (Optical)	0.070	0.070	0.035	0.010
2488.32 (Optical)	0.080	0.080	0.060	0.010
2666.05* (Optical)	0.080	0.080	0.060	0.010

*: Built-in MU150125A-05

Continued on next page

Jitter measurement

MU150100A with MU150125A Receiver only

Bit rate (Mbit/s)	W data signal (Typical)			
	UIp-p			UIrms
	HP1+LP	HP+LP	HP2+LP	HP+LP
	2 UI	2 UI	2 UI	2 UI
51.84 (Optical)	0.035	0.035	0.035	0.009
51.84 (Electrical)	0.035	0.035	0.035	0.009
155.52 (Optical)	0.035	0.035	0.035	0.009
155.52 (Electrical)	0.035	0.035	0.025	0.009
622.08	0.035	0.035	0.035	0.009
2488.32	0.035	0.035	0.035	0.009
2666.05*	0.035	0.035	0.035	0.009

*: Built-in MU150125A-05

Measurement condition
  Temperature condition: +10˚ to +40˚C
  Optical input level: –10 to –12 dBm
  Measurement time: 1 min
  Optical input wavelength: 1310 nm/1550 nm
Mapping
  SDH: VC3-Bulk (52M), VC4-nc (n = 1, 4, 16) (156M/622M/2488M)
  SONET: STSnc (n = 1, 3, 12, 48)
  OTU-1: ODU1-OPU1-PRBS
Test pattern: PRBS23 (SDH), PRBS31 (OTU-1), Mark ratio 1/2, Scramble “On”
Clock: internal

MU150100A, MU150121A, MU150123A loop back measurement

Bit rate (Mbit/s)	W data signal			
	UIp-p			UIrms
	HP1+LP	HP’+LP	HP2+LP	HP’+LP
	2 UI	2 UI	2 UI	2 UI
9953.280	0.080	0.080	0.060	0.010
10709.225	0.080	0.080	0.060	0.010

Measurement condition: MU150100A, MU150121A, MU150123A loop-back measurement (Built-in MU150125A-05)
Temperature condition: +10˚ to +40˚C
Optical input level: –10 to –12 dBm
Measurement time: 1 min
Optical input wavelength: 1310 nm/1550 nm
Mapping
  SDH: VC4-64c (9953M)
  SONET: STS192c (9953M)
  OTU-2: ODU2-OPU2-PRBS
Test pattern: PRBS23 (SDH), PRBS31 (OTU-2), Mark ratio 1/2, Scramble “On”
Clock: internal

MU150100A, MU150134A, MU150123A loop back measurement

Bit rate (Mbit/s)	W data signal			
	UIp-p			UIrms
	HP1+LP	HP’+LP	HP2+LP	HP’+LP
	2 UI	2 UI	2 UI	2 UI
9953.280	0.065	0.065	0.060	0.010
10709.225	0.065	0.065	0.060	0.010

Measurement condition: MU150100A, MU150134A, MU150123A loop-back measurement (Built-in MU150125A-05)
  Temperature condition: +10˚ to +40˚C
  Optical input level: –10 to –12 dBm
  Measurement time: 1 min
  Optical input wavelength: 1550 nm
  Mapping
  SDH: VC4-64c (9953M)
  SONET: STS192c (9953M)
  OTU-2: ODU2-OPU2-PRBS
Test pattern: PRBS23 (SDH), PRBS31 (OTU-2), Mark ratio 1/2, Scramble “On”
Clock: internal

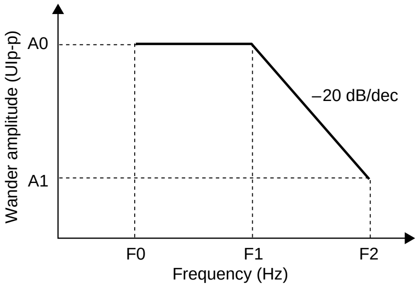
Continued on next page

<table>
<tr><td>Jitter measurement</td><td>
MU150123A with MU150125A Receiver only
<table>
<tr><td rowspan="4">Bit rate
(Mbit/s)</td><td colspan="4">W data signal (Typical)</td></tr>
<tr><td colspan="3">UIp-p</td><td>UIrms</td></tr>
<tr><td>HP1+LP</td><td>HP'+LP</td><td>HP2+LP</td><td>HP'+LP</td></tr>
<tr><td>2 UI</td><td>2 UI</td><td>2 UI</td><td>2 UI</td></tr>
<tr><td>9953.280</td><td>0.050</td><td>0.035</td><td>0.035</td><td>0.009</td></tr>
<tr><td>10709.225*</td><td>0.050</td><td>0.035</td><td>0.035</td><td>0.009</td></tr>
</table>
*: Built-in MU150125A-05

Measurement condition
Temperature condition: +10° to +40°C
Optical input level: –10 to –12 dBm
Measurement time: 1 min
Optical input wavelength: 1310 nm/1550 nm
Mapping
SDH: VC4-64c (9953M)
SONET: STS192c (9953M)
OTU-2: ODU2-OPU2-PRBS
Test pattern: PRBS23 (SDH), PRBS31 (OTU-2), Mark ratio 1/2, Scramble "On"
Clock: internal
Additional error [R]
<table>
<tr><td>Additional error</td><td>Frequency range</td></tr>
<tr><td>±15 %</td><td><100 Hz (52M)
<500 Hz (156M)
<1 kHz (622M)
<5 kHz (2488M, 2666M)
<20 kHz (9953M/10.3G/10.7G)</td></tr>
<tr><td>±7 %</td><td>100 Hz to 300 kHz (52M)
500 Hz to 300 kHz (156M)
1 kHz to 300 kHz (622M)
5 kHz to 300 kHz (2488M, 2666M)
20 kHz to 300 kHz (9953M/10.3G/10.7G)</td></tr>
<tr><td>±8 %</td><td>300 kHz to 400 kHz (52M)
300 kHz to 1 MHz (≥156M)</td></tr>
<tr><td>±10 %</td><td>1 MHz to 1.3 MHz (156M)
1 MHz to 3 MHz (≥622M)</td></tr>
<tr><td>±15 %</td><td>3 MHz to 5 MHz (622M)
3 MHz to 10 MHz (≥2448M)</td></tr>
<tr><td>±20 %</td><td>10 MHz to 20 MHz (2488M, 2666M)
10 MHz to 80 MHz (9953M/10.3G/10.7G)</td></tr>
</table>
</td></tr>
<tr><td>Hit measurement</td><td>Count, Hit seconds, % free seconds</td></tr>
<tr><td>Jitter tolerance</td><td>Evaluate jitter tolerance by selected Mask
Mask selection:
Telcordia GR-253, ANSI T1.105.03
ITU-T G.783, G.825, G.813, G.8251
ETSI EN 302 084
User</td></tr>
<tr><td>Jitter transfer</td><td>Evaluate jitter transfer by selected Mask
Accuracy:±0.05 dB ±0.12*g
Applicable frequency range
0.01*fc to 100*fc, or maximum frequency setting value
The maximum frequency setting value is applied in the case of 100*fc
g: Transfer gain (dB) for every frequency point
fc: Cut-off frequency of transfer mask
Measurement condition
Average level: Fine
Waiting time: 20 s
Input jitter value: ≥0.15 UIp-p
Jitter modulation frequency: ≥300 Hz
Dynamic range: ≤–40 dB (at the above measurement condition)
Mask selection (Maximum value of a mask is 100 times as much modulation frequency as a break point):
Telcordia GR-253
ANSI T1.105.03
ITU-T G.783, G.8251
ETSI 300 417-1-1
User</td></tr>
</table>

Continued on next page

<table>
<tr>
<td>Wander generation</td>
<td>
Modulation frequency: 10 µHz to 10 Hz
Amplitude: 0 to 400,000 UI/Step 1 UIp-p



<table>
<tr><th>Bit rate (bit/s)</th><th>F0 (Hz)</th><th>F1 (Hz)</th><th>F2 (Hz)</th><th>A0 (UIp-p)</th><th>A1 (UIp-p)</th><th>Step (UIp-p)</th></tr>
<tr><td>52M
156M
622M
2488M
9953M</td><td>10 µ</td><td>400m</td><td>10</td><td>400,000</td><td>16,000</td><td>1</td></tr>
</table>

Accuracy
±Q% of setting ±100 UIp-p

<table>
<tr><th>Error Q</th><th>Frequency range</th></tr>
<tr><td>±8 %</td><td>10 µHz to 0.125 Hz</td></tr>
<tr><td>±12 %</td><td>0.125 to 1 Hz</td></tr>
<tr><td>±15 %</td><td>1 to 10 Hz</td></tr>
</table>
</td>
</tr>
<tr>
<td>Wander measurement (Option 01)</td>
<td>
Bit rate (bit/s): 52M, 156M, 622M, 2488M, 9953M
Evaluation mode: TIE (P-P, +P, –P) MTIE, TDEV measurement is a future function
Range
p-p: 0.0 to 2E10 ns
+p, –p: 0.0 to 1E10 ns
Resolution: 0.1 ns
Accuracy: TIE
±0.5% ±Z0 (τ)

<table>
<tr><th>Z0 (τ)(ns)</th><th>Observation time τ (s)</th></tr>
<tr><td>2.5 + 0.0275 τ</td><td>0.05 ≤ τ ≤1000</td></tr>
<tr><td>29 + 0.001 τ</td><td>τ >1000</td></tr>
</table>

Filter selection: DC to 10 Hz, DC to 0.01 Hz, 0.01 to 10 Hz
</td>
</tr>
</table>

• MU150134A 10/10.7G Optical Unit (Tx external modulation)

Bit rate	9953.28 Mbit/s 10709.225 Mbit/s Depends on frequency accuracy and external input frequency of the MU150100A.
Optical output modulation	Output power: 0 to +3 dBm (C band) However, reference value when using built-in CW light source, and modulating by data signal of mark ratio 1/2. Extinction ratio: ≥10 dB Signal code: NRZ Connector: FC-PC (SMF) replaceable
External optical input	Light source: CW light source, polarization preservation fiber is used Peak wavelength: C band, L band Maximum input power: +15 dBm Insertion loss: ≤7 dB (C band), ≤8 dB (L band) Connector: FC-PC (PMF), replaceable
Clock input	Frequency: 9953.28 MHz ±100 ppm, 10709.225 MHz ±100 ppm Input voltage: 1.3 to 0.6 Vp-p Connector: SMA (50 Ω GND)
Data input	Bit rate: 9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm Input voltage Hi: 0.0074 to –0.2074 V, Lo: –0.8426 to –1.3074 V Connector: SMA (50 Ω GND)
Optical reference output	Optical source: CW light source Peak wavelength: 1550 ±20 nm (C band) –20 dB width: ≤1 nm Side mode suppression ratio: ≥30 dB Output power: +10 to +13 dBm Polarization Extinction ratio: ≥20 dB Connector: FC-PC (PMF), replaceable
Optical output power variable (Option 04)	Variable range: 0 to 20 dB, accuracy: ≤±0.5 dB (0 to 10 dB), ≤±1.0 dB (10.1 to 20 dB), setting resolution: 0.1 dB

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1590A	Network Performance Tester	
	Standard accessories	
J0491A[*1]	Shield power cord, 2.6 m:	1 pc
J0670A[*1]	Power cord L type (C7), 2.5 m:	1 pc
F0105	Fuse, 10 A:	2 pcs
E0008A	Optical output control key:	1 pc
E0010	Side cover:	1 pc
J0907Q	Remote inter lock cord:	1 pc
J0908	Remote inter lock terminator:	1 pc
B0329G	Front cover (3/4MW4U):	1 pc
W2234AE[*2]	MP1590A operation manual CD-ROM:	1 copy
J0617B[*3, *4]	Replaceable optical connector (FC-PC):	1 pc/2 pcs
J0739G[*5]	Optical adapter FC PANDA:	2 pcs
J0635A[*6]	Optical fiber cable (FC · PC-FC · PC-1M-SM), 1 m:	1 pc
J1200[*7]	Pmoptical fiber cord, 0.5 m:	1 pc
J0747B[*8]	Fixed optical attenuator (10 dB):	1 pc
J0747C[*9]	Fixed optical attenuator (15 dB):	1 pc
J1003N[*10]	Semi-rigid cable (136.6 mm):	2 pcs
J1003P[*10]	Semi-rigid cable (96 mm):	1 pc
J1003Q[*11, *12]	Semi-rigid cable (75.6 mm):	1 pc/2 pcs
J1003R[*10]	Semi-rigid cable (55.3 mm):	1 pc
J1003S[*9]	Semi-rigid cable (56.5 mm):	1 pc
	Units	
MU150100A[*13]	10/10.7G Unit	
MU150121A[*13]	10/10.7G Optical Unit (Tx)	
MU150122A	10/10.7G Optical Unit (Rx Narrow)	
MU150123A	10/10.7G Optical Unit (Rx Wide)	
MU150125A	10/10.7G Jitter Unit	
MU150134A	10/10.7G Optical Unit (Tx. Ex. mod)	
	Options	
MP1590A-01	RS-232C	
MP1590A-02	GPIB	
MP1590A-03	LAN	
MU150100A-01	Wavelength 1.31 µm	
MU150100A-02	Wavelength 1.55 µm	
MU150100A-03	Wavelength 1.31/1.55 µm	
MU150100A-04	Optical output power adjustable	
MU150100A-05	OTU1/OTU2	
MU150100A-07[*14]	10/10.7G Minus Option	
MU150100A-37[*15]	FC connector	
MU150100A-38[*15]	ST connector	
MU150100A-39[*15]	DIN connector	
MU150100A-40[*15]	SC connector	
MU150100A-43[*15]	HMS-10/A connector	
MU150121A-01	Wavelength 1.31 µm	
MU150121A-02	Wavelength 1.55 µm	
MU150121A-03	Wavelength 1.31/1.55 µm	
MU150121A-04	Optical output power adjustable	
MU150121A-37[*15]	FC connector	
MU150121A-38[*15]	ST connector	
MU150121A-39[*15]	DIN connector	
MU150121A-40[*15]	SC connector	
MU150121A-43[*15]	HMS-10/A connector	
MU150122A-37[*15]	FC connector	
MU150122A-38[*15]	ST connector	
MU150122A-39[*15]	DIN connector	
MU150122A-40[*15]	SC connector	
MU150122A-43[*15]	HMS-10/A connector	
MU150123A-05	OTU2	
MU150123A-37[*15]	FC connector	
MU150123A-38[*15]	ST connector	
MU150123A-39[*15]	DIN connector	
MU150123A-40[*15]	SC connector	
MU150123A-43[*15]	HMS-10/A connector	
MU150125A-01	Wander measurement	
MU150125A-05	OTU1/OTU2	
MU150125A-06	10.3G	
MU150134A-04	Optical output power adjustable	
MU150134A-37[*15]	FC connector	
MU150134A-38[*15]	ST connector	
MU150134A-39[*15]	DIN connector	
MU150134A-40[*15]	SC connector	
MU150134A-43[*15]	HMS-10/A connector	

Model/Order No.	Name
	Maintenance service
MP1590A-90	Extended three year warranty service
MU150100A-90	Extended three year warranty service
MU150121A-90	Extended three year warranty service
MU150122A-90	Extended three year warranty service
MU150123A-90	Extended three year warranty service
MU150125A-90	Extended three year warranty service
MU150134A-90	Extended three year warranty service
	Optional accessories
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0617B	Replaceable optical connector (FC-PC)
J1003N	Semi-rigid cable (136.6 mm)
J1003P	Semi-rigid cable (96 mm)
J1003R	Semi-rigid cable (55.3 mm)
J1003Q	Semi-rigid cable (75.6 mm)
J1003S	Semi-rigid cable (56.5 mm)
J1200	Pmoptical fiber cord (both-end SFC-SP connector), 0.5 m
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0162A	Balanced cable, 1 m (Siemens 3P- Siemens 3P)
J0162B	Balanced cable, 2 m (Siemens 3P- Siemens 3P)
J0845A	Balanced cable, 6 ft (BANTAM 3P/BANTAM 3P)
J0635A	Optical fiber cable, 1 m (SM, FC-SPC connector both ends)
J0635B	Optical fiber cable, 2 m (SM, FC-SPC connector both ends)
J0635C	Optical fiber cable, 3 m (SM, FC-SPC connector both ends)
J0008	GPIB cable, 2 m
MZ8012A	Connector Cleaning Set
Z0478	Polarization rotating module (for MU150134A)
B0336C	Carrying case
B0448	Soft case
W2188AE	MP1590A SDH operation manual
W2189AE	MP1590A remote control manual
W2216AE	MP1590A SONET operation manual
W2217AE	MP1590A specification

*1: J0491 or J0670A is attached.
*2: Supplied with main frame only, include W2188AE, W2189AE, W2216AE, W2217AE.
*3: Supplied with MU150100A, MU150121A, MU150122A, MU150123A, MU150134A.
*4: In MU150100A, 2 pcs are supplied.
*5: Supplied with MU150134A.
*6: Supplied with MU150100A, MU150122A, MU150123A. SM, FC-SPC connector both ends.
*7: Supplied with MU150134A, FC · PANDA cord.
*8: Supplied with MU150122A, MU150123A.
*9: Supplied with MU150100A.
*10: Supplied with MU150125A.
*11: Supplied with MU150121A, MU150122A, MU150123A, MU150134A.
*12: In MU150121A/MU150134A, 2 pcs are supplied.
*13: Requires Option 01, 02 or 03.
*14: This Option must be installed in the factory.
*15: Replaceable

ATM QUALITY ANALYZER
MP1220A

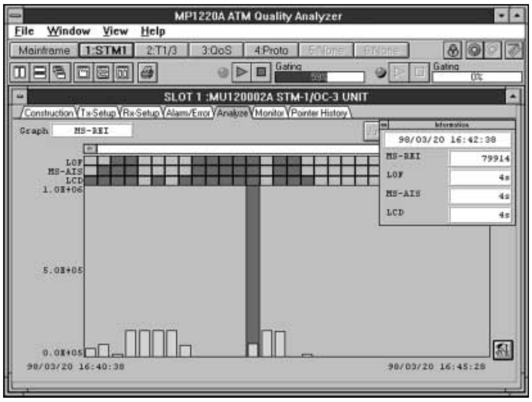
1.5 Mbps (T1) to 622 Mbps (STM-4c/OC-12c)

For Construction and Maintenance of ATM Networks

The MP1220A is a portable measuring instrument for ATM networks; it can measure the PDH/SDH physical layer, the ATM layer, and the AAL. It is the perfect instrument for troubleshooting ATM networks during construction and maintenance and has a wide range of convenient applications in manufacturing inspection of ATM devices.

Features

- Supports various interfaces from 1.5 Mbps (T1) to 622 Mbps (STM-4c/OC-12c) SONET and SDH
- Simultaneous measurement and real-time analysis up to the ATM-CPCS layer of two channels(up/down stream)
- Automated traffic monitoring of 1,023 network channels for bandwidth utilization
- Uses formatted payload data conforming to ITU-O.191 recommendations for cell delay performance measurements
- Small, lightweight, rack mount or portable
- Supports a variety of remote control testing configurations
- Online manuals and online help



Graph: MS-REI

Information: 98/03/20 16:42:38

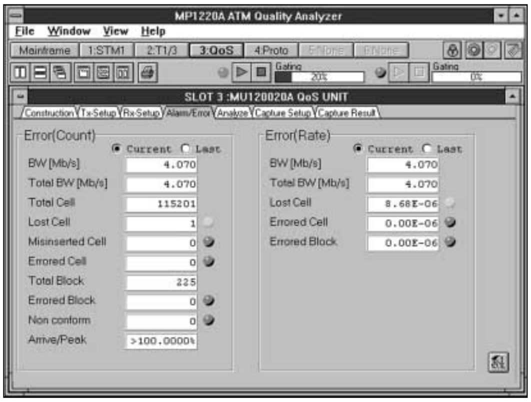
MS-REI: 79914

LOF: 4s

MS-AIS: 4s

LCD: 4s

Graphical display of alarm/error history



Error(Count) ● Current ○ Last

BW [Mb/s]: 4.070

Total BW [Mb/s]: 4.070

Total Cell: 115201

Lost Cell: 1

Misinserted Cell: 0

Errored Cell: 0

Total Block: 225

Errored Block: 0

Non conform: 0

Arrive/Peak: >100.0000%

Error(Rate) ● Current ○ Last

BW [Mb/s]: 4.070

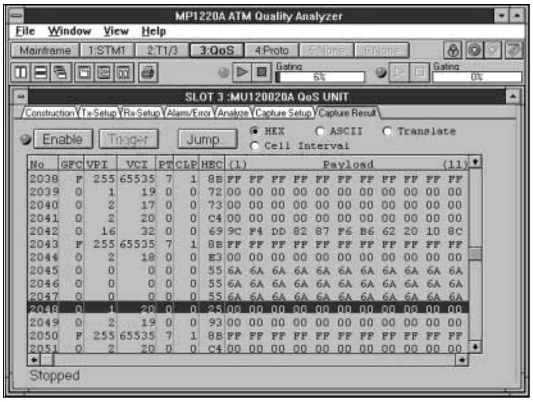
Total BW [Mb/s]: 4.070

Lost Cell: 8.68E-06

Errored Cell: 0.00E-06

Errored Block: 0.00E-06

Measurement items for test cells

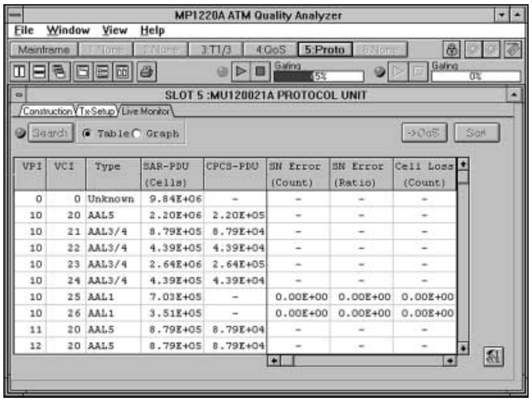


● HEX ○ ASCII ○ Translate ○ Cell Interval

No	GFC	VPI	VCI	PT	CLP	HEC	(1)				Payload						(11)
2038	F	255	65535	7	1	8B	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
2039	0	1	19	0	0	72	00	00	00	00	00	00	00	00	00	00	00
2040	0	2	17	0	0	73	00	00	00	00	00	00	00	00	00	00	00
2041	0	2	20	0	0	C4	00	00	00	00	00	00	00	00	00	00	00
2042	0	16	32	0	0	69	9C	F4	DD	82	87	F6	B6	62	20	10	8C
2043	F	255	65535	7	1	8B	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
2044	0	2	18	0	0	E3	00	00	00	00	00	00	00	00	00	00	00
2045	0	0	0	0	0	55	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A
2046	0	0	0	0	0	55	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A
2047	0	0	0	0	0	55	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A	6A
2048	0	1	20	0	0	25	00	00	00	00	00	00	00	00	00	00	00
2049	0	2	19	0	0	93	00	00	00	00	00	00	00	00	00	00	00
2050	F	255	65535	7	1	8B	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
2051	0	2	20	0	0	C4	00	00	00	00	00	00	00	00	00	00	00

Stopped

Cell capture display (hexadecimal)



VPI	VCI	Type	SAR-PDU (Cells)	CPCS-PDU	SN Error (Count)	SN Error (Ratio)	Cell Loss (Count)
0	0	Unknown	9.84E+06	–	–	–	–
10	20	AAL5	2.20E+06	2.20E+05	–	–	–
10	21	AAL3/4	8.79E+05	8.79E+04	–	–	–
10	22	AAL3/4	4.39E+05	4.39E+04	–	–	–
10	23	AAL3/4	2.64E+06	2.64E+05	–	–	–
10	24	AAL3/4	4.39E+05	4.39E+04	–	–	–
10	25	AAL1	7.03E+05	–	0.00E+00	0.00E+00	0.00E+00
10	26	AAL1	3.51E+05	–	0.00E+00	0.00E+00	0.00E+00
11	20	AAL5	8.79E+05	8.79E+04	–	–	–
12	20	AAL5	8.79E+05	8.79E+04	–	–	–

Automatic evaluation and measurement of AAL type for 1023 channels

Specifications

• MP1220A ATM Quality Analyzer

Display	10.4 inch TFT color LCD with touch panel (analog resistive membrane)
Memory storage	3.5 inch floppy disk drive (1.44 MB/720 KB) and hard disk drive (≥500 MB)
Buzzer	Alarm, error
External interface	RS-232C (D-sub 9-pin), printer (Centronics, D-sub, 25-pin), keyboard (PS/2, mini-DIN, 6-pin), mouse (PS/2, mini-DIN, 6-pin), VGA (analog RGB, D-sub, 15-pin)
Slots	6 (two channels max.)
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
Dimensions and mass	284 (W) x 221.5 (H) x 365 (D) mm, ≤12 kg (excluding units)
Power supply	100 to 120/200 to 240 Vac (autoswitching), 50 to 60 Hz, ≤300 VA
Operating range	Operating: +5° to +50°C (excluding FDD), Storage: –20° to +60°C

• MU120001A STM-4/OC-12 Unit

Bit rate	51.84, 155.52, 622.08 Mbps
Frames	SDH/SONET
Output signal	Connector: FC (replaceable), 1.31 µm band (SM) Clock: Internal (±10 ppm), external, receive Level: –15 to –8 dBm Code: NRZ Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I
Input signal	Connector: FC (replaceable), 1.31 µm band (SM) Frequency range: ±100 ppm Level: –34 to –8 dBm (51.84 Mbps, 155.52 Mbps), –28 to –8 dBm (622.08 Mbps) Code: NRZ
Functions	SOH/POH setting, SOH/POH monitoring, path trace, empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, B1, B2, B3, FEBE-L, FEBE-P, cell Alarm addition: LOS, LOF, AIS-L, RDI-L, AIS-P, RDI-P, LCD Error measurement: B1, B2, B3, MS-REI (FEBE-L), HP-REI (FEBE-P), HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, LOF, MS-AIS (AIS-L), MS-RDI (RDI-L), AU-AIS (AIS-P), HP-RDI (RDI-P), AU-LOP (LOP-P), LCD Pointers: Monitor, ±justification, NDF Auxiliary output: Receive clock output, trigger output

• MU120002A STM-1/OC-3 Unit

Bit rate	155.52 Mbps
Frames	SDH/SONET
Output signal	Connector Optical: SC 1.31 µm (SM); Electrical: BNC 75 Ω Clock: Internal (±10 ppm), external, receive Optical level: –15 to –8 dBm Electrical level: 1 ±0.1 Vp-p (CMI) Code Optical: NRZ, Electrical: CMI Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I

Continued on next page

Input signal	Connector Optical: SC 1.31 µm (SM/MM); Electrical: BNC 75 Ω Frequency range: ±100 ppm Optical level: –28 to –8 dBm (SM) Electrical level: 1 ±0.1 Vp-p (CMI) *Cable loss: 0 to 12 dB, Monitor: 20 dB attenuated level of above level can be applied. Code Optical: NRZ; Electrical: CMI
Functions	SOH/POH setting, SOH/POH monitoring, path trace, empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, B1, B2, B3, FEBE-L, FEBE-P, cell Alarm addition: LOS, LOF, AIS-L, RDI-L, AIS-P, RDI-P, LOP-P, LCD Error measurement: B1, B2, B3, MS-REI (FEBE-L), HP-REI (FEBE-P), HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, LOF, MS-AIS (AIS-L), MS-RDI (RDI-L), AU-AIS (AIS-P), HP-RDI (RDI-P), AU-LOP (LOP-P), LCD Pointers: Monitor, ±justification, NDF, history record Auxiliary output: Receive clock output, trigger output

- **MU120010A T1/T3 Unit**

Bit rate	1.544 Mbps (T1), 44.736 Mbps (T3)
Frames	1.5M ESF (PLCP: on/off), 45M C-bit parity (PLCP: on/off), 45M M23 (PLCP: on/off)
Output signal	Connector BNC: 75 Ω unbalanced (T3); 8-pin modular: 100 Ω balanced (ISO/IEC 10173, T1) Clock: Internal (±10 ppm), external, receive Level: 2.4 to 3.6 Vo-p (T1), 0.36 to 0.85 Vo-p (T3) Code T1: B8ZS, T3: B3ZS
Input signal	Connector BNC: 75 Ω unbalanced (T3); 8-pin modular: 100 Ω balanced (ISO/IEC 10173, T1) Frequency range: ±130 ppm (T1), ±20 ppm (T3) Level: 2.4 to 3.6 Vo-p (T1), 0.36 to 0.85 Vo-p (T3) *Monitor: 20 dB attenuated level of above level can be applied. Code T1: B8ZS, T3: B3ZS
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, FEBE, PLCP-BIP-8, PLCP-FEBE, cell Alarm addition: LOF, LOS, AIS, yellow, idle, PLCP-LOF, PLCP-yellow, LCD Error measurement: Code, CP, FEBE, CRC6, PLCP-BIP-8, PLCP-FEBE, HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, AIS, yellow, idle, PLCP-OOF, PLCP-yellow, LCD Auxiliary output: Receive clock output, trigger output

- **MU120011A E1/E3/E4 Unit**

Bit rate	2.048 Mbps (E1), 34.368 Mbps (E3), 139.264 Mbps (E4)
Frames	2M-CRC-4 off (PLCP: on/off), 2M CRC4 on (PLCP: on/off), 34M G.751 (PLCP: on), 34M GH.832 (PLCP: off), 139M G.832 (PLCP: off)
Output signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3/E4) Clock: Internal (±10 ppm), external, receive Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3), 1 ±0.1 Vp-p (E4) Code E1/E3: HDB3, E4: CMI
Input signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3/E4) Frequency range: ±100 ppm (E1/E4), ±20 ppm (E3) Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3), 1 ±0.1 Vp-p (E4) *Cable loss: 0 to 6 dB (E1), 0 to 12 dB (E3, E4), Monitor: 20 dB attenuated level of above level can be applied. Code E1/E3: HDB3, E4: CMI
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off (E1, E3) Error addition: Bit, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, cell Alarm addition: LOF, LOS, AIS, RA, RA (MF), RDI, PLCP-LOF, PLCP-yellow, LCD Error measurement: CRC4, code, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, AIS, MF loss (CRC), MF loss (sig), RA, RA (MF), RDI, PLCP-OOF, PLCP-yellow, LCD Trail trace: Monitor, setting Auxiliary output: Receive clock output, trigger output

- **MU120012A E1/E3 Unit**

Bit rate	2.048 Mbps (E1), 34.368 Mbps (E3)
Frames	2M-CRC-4 off (PLCP: on/off), 2M CRC4 on (PLCP: on/off), 34M G.751 (PLCP: on), 34M G.832 (PLCP: off)
Output signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3) Clock: Internal (±10 ppm), external, receive Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3) Code: HDB3

Continued on next page

Input signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3) Frequency range: ±100 ppm (E1), ±20 ppm (E3) Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3) *Cable loss: 0 to 6 dB (E1), 0 to 12 dB (E3), Monitor: 20 dB attenuated level of above level can be applied. Code: HDB3
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, cell Alarm addition: LOF, LOS, AIS, RA, RA (MF), RDI, PLCP-LOF, PLCP-yellow, LCD Error measurement: CRC4, code, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, AIS, MF Loss (CRC), MF Loss (Sig), RA, RA (MF), RDI, PLCP-OOF, PLCP-yellow, LCD Trail trace: Monitor, setting Auxiliary output: Receive clock output, trigger output

- **MU120015A ATM25M Unit**

Bit rate	32.00 Mbps (25M)
Output signal	Connector: 8-pin modular jack, 100 Ω (RJ45) Clock: Internal (±10 ppm), external, receive Level: 2.7 to 3.4 Vp-p (1 symbol) Code: NRZI (4B/5B)
Input signal	Connector: 8-pin modular jack, 100 Ω (RJ45); Frequency: ±100 ppm; Level: 2.7 to 3.4 Vp-p (1 symbol); Code: NRZI (4B/5B)
Functions	Empty cell setting, coset on/off Error addition: Code, cell Alarm addition: LOS Error measurement: Code, HEC uncorrected cell, illegal cell Alarm measurement: LOS Sync event: Send, measure Auxiliary output: Receive clock output, trigger output

- **MU120016A 6.3M Unit**

Bit rate	6.312 Mbps (6.3M)
Output signal	Connector: BNC, 75 Ω Clock: Internal (±10 ppm), external, receive Level: 2 ±0.3 Vo-p Code: B8ZS
Input signal	Connector: BNC, 75 Ω Frequency: ±30 ppm Level: 2 ±0.3 Vo-p *Cable loss: 0 to 6 dB, Monitor: 20 dB attenuated level of above level can be applied. Code: B8ZS
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, CRC5, cell Alarm addition: LOS, AIS, RAI, LOF, LCD Error measurement: CRC5, HEC corrected cell, HEC uncorrected cell Alarm measurement: LOS, AIS, RAI, LOF, LCD Auxiliary output: Receive clock output, trigger output

- **MU120017A 6.3/25M Unit**

Bit rate	6.312 Mbps (6.3M), 32.00 Mbps (25M)
Output signal	Connector BNC: 75 Ω (6.3M); 8-pin modular jack, 100 Ω (RJ45, 25M) Clock: Internal (±10 ppm), external, receive Level: 2 ±0.3 Vo-p (6.3M), 2.7 to 3.4 Vp-p (25M, 1 symbol) Code 6.3M: B8ZS, 25M: NRZI (4B/5B)
Input signal	Connector BNC: 75 Ω (6.3M); 8-pin modular jack, 100 Ω (RJ45, 25M) Frequency range: ±30 ppm (6.3M), ±100 ppm (25M) Level: 2 ±0.3 Vo-p (6.3M), 2.7 to 3.4 Vp-p (25M, 1 symbol) *Cable loss: 0 to 6 dB (6.3M), Monitor: 20 dB attenuated level of above level can be applied (6.3M). Code 6.3M: B8ZS, 25M: NRZI (4B/5B)
Functions	Empty cell setting, cell scramble (de-scramble) on/off (6.3M only), coset on/off, HEC error correction on/off (6.3M only), sync event send (25M only) Error addition 6.3M: Bit, CRC5, cell 25M: Code, cell Alarm addition 6.3M: LOS, AIS, RAI, LOF, LCD 25M: LOS Error measurement 6.3M: CRC5, HEC corrected cell, HEC uncorrected cell 25M: Code, HEC uncorrected cell, illegal cell Alarm measurement 6.3M: LOS, AIS, RAI, LOF, LCD 25M: LOS Sync event (25M only): Send, measure Auxiliary output: Receive clock output, trigger output

• MU120020A QoS Unit

Foreground cells (test cells)	O.191, extended O.191, OAM test cell (PRBS 15), null, AAL1, AAL3/4, (For null, AAL1, AAL3/4, next pattern settable to payload. PRBS 9, PRBS 15, PRBS 15 (non-inverted), PRBS 23, time stamp, programmable)
Cell generation timing	CBR, burst, sawtooth waveform, CBR with CDV, VBR, Poisson distribution, manual, external edge, external level, detailed CBR, burst for UPC measurement, programmable
Background cell	CBR (10 types)
OAM cell	AIS, RDI, continuity check, loopback, programmable, forward monitoring, backward reporting, PM activation/deactivation, CC activation/deactivation
Capture	Capacity: 4095 cells Filter: All cells, specified cells, header +first byte of payload match/mismatch cells Trigger: Manual, OAM cell receive, cell error detect, cell loss detect, cell misinsertion detect, cell tagging, external input signal, etc. Display: Hexadecimal, ASCII, cell interval, translate
Single-channel	Error addition: Cell loss, cell error Error detection: Bit error, error cell, cell loss, cell misinsertion, non-conforming cell, etc. (measurement items differ according to test cell) Alarm detection: VP-AIS, VP-RDI, VP-LOC, VC-AIS, VC-RDI, VC-LOC Others: Bandwidth, total cells, cell delay measurement, 1 point CDV measurement, 2 point CDV measurement, cell interval measurement
1023 channel measurement (live monitor)	Detect and measure 1023 channels on line Measurement items: Total cell count, CLP = 0 cell count, CLP = 1 cell count, OAM cell count
Auxiliary input	Trigger input

• MU120021A Protocol Unit

Send/receive memory	8 MB (≥130,000 cells, send: 8 MB, receive: 8 MB, send + receive: 4 + 4 MB selectable)
Cell send	Transmit from memory according to time stamp. Able to transmit in every 1 cell. Able to edit AAL1, AAL3/4, AAL5 frame
Capture	Capacity: ≥130,000 cells (at 8 MB receive setting) Filter: All cells, all cells (excluding idle cells), up to 16 specified channels Trigger: Specified event, specified event occurrence times, sequential event (second event after first event) Event: Specified channel, SN abnormality, ST abnormality, CRC abnormality, specified pattern, external input signal, etc. Display: Cell, SAR, CPCS, time stamp
Single-channel measurement	AAL type automatic evaluation and measurement Error addition: Cell loss, cell error Measurement items: Cell count, CPCS-PDU count, assembled timer timeout PDU count, frame size error count, CPI error count, SN error count, ST error count, LI error count, about count, BE tag error count, BA size error count, AL error count, length error count, CRC error count, etc. (measurement items differ according to AAL type)
1023 channel measurement (live monitor)	Detect and measure 1023 channels on line. AAL type automatically detected and measured Measurement items: Cell count, CPCS count, etc. (measurement items differ according to AAL type)
External interface	Trigger input (capture event)

• MX122020A Protocol Decoding Software

Supported protocols	ATM (ITU-T I.361), OAM (ITU-T I.610), AAL5-CPCS (ITU-T I.363), SSCOP (ITU-T Q.2110), UNI 3.1/4.0 (ATM forum), LLC (RFC2225), SNAP (RFC2225), ATMARP/InATMARP (RFC2225), IP (RFC791), ICMP (RFC792), UDP (RFC768), TCP (RFC793)
Decoded file type	Data captured by MU120021A Protocol Unit and saved in binary format
Operating environment	MP1220A or a PC running with Windows 3.1/95/98

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Mainframe
MP1220A	ATM Quality Analyzer
	Standard accessories
	AC power cord: 1 pc
F0012	Fuse, 3.15 A: 2 pcs
W1304AE	MP1220A operation manual: 1 copy
W1305AE	MP1220A remote control operation manual: 1 copy
Z0339	Software recovery floppy disk[*1]: 1 pc
Z0340B	Protective cover (without keyboard): 1 pc
Z0343A	Input pen: 1 pc
Z0345A	Accessory bag: 1 pc
	Options
MP1220A-01	RS-232C control
MP1220A-02	GPIB control
MP1220A-03	Ethernet control
MU120001A-38	ST connector
MU120001A-39	DIN connector
MU120001A-40	SC connector
MU120001A-43	HMS-10/A connector
	Units
MU120001A	STM-4/OC-12 Unit
W1308AE	MU120001A operation manual
W1314AE	MU120001A remote control operation manual
MU120002A	STM-1/OC-3 Unit
W1309AE	MU120002A operation manual
W1315AE	MU120002A remote control operation manual
MU120010A	T1/T3 Unit
W1310AE	MU120010A operation manual
W1316AE	MU120010A remote control operation manual
MU120011A	E1/E3/E4 Unit
W1311AE	MU120011A/120012A operation manual
W1317AE	MU120011A/120012A remote control operation manual
MU120012A	E1/E3 Unit
W1311AE	MU120011A/120012A operation manual
W1317AE	MU120011A/120012A remote control operation manual

*1: Sold only to MP1220A users

Note: Please consult our sales department about adding the VBR functions to your MP1220A.
Windows is a registered trademark of Microsoft Corporation.

Model/Order No.	Name
MU120015A	ATM25M Unit
W1312AE	MU120015A/120016A/120017A operation manual
W1318AE	MU120015A/120016A/120017A remote control operation manual
MU120016A	6.3M Unit
W1312AE	MU120015A/120016A/120017A operation manual
W1318AE	MU120015A/120016A/120017A remote control operation manual
MU120017A	6.3/25M Unit
W1312AE	MU120015A/120016A/120017A operation manual
W1318AE	MU120015A/120016A/120017A remote control operation manual
MU120020A	QoS Unit
W1313AE	MU120020A operation manual
W1319AE	MU120020A remote control operation manual
MU120021A	Protocol Unit
W1371AE	MU120021A operation manual
W1372AE	MU120021A remote control operation manual
	Application software
MX122020A	Protocol Decoding Software
W1648AE	MX122020A operation manual
	Optional accessories
J0008	GPIB cable, 2 m
J0775D	Coaxial cord, 2 m (75 Ω)
J0776D	BNC cord, 2 m (twin shield)
J0635B	Optical fiber cord (FC/PC-FC/PC-2m-SM), 2 m
J0660B	Optical fiber cord (SC/PC-SC/PC-2m-SM), 2 m
J0796A	Replaceable optical connector (ST)
J0796B	Replaceable optical connector (DIN)
J0796C	Replaceable optical connector (SC)
J0796D	Replaceable optical connector (HMS-10/A)
J0796E	Replaceable optical connector (FC)
J0844A	ISO 10173 cable (T1), 2 m
J0838A	UTP category 3 cable (25M), 2 m
Z0319A	PS/2 mouse
Z0340A	Protective cover (with keyboard)
Z0340B	Protective cover (without keyboard)
B0414A	Hard case
B0163	Soft case

NETWORK DATA ANALYZER

MD6430A

50 bit/s to 10 Mbit/s

CE GPIB OPTION

One Instrument for Installation and Maintenance

The MD6430A Network Data Analyzer can measure errors on 13 different interfaces for leased lines (64 kbit/s to 6.3 Mbit/s), ISDN (BRI, PRI), and V/X series interfaces, making it suitable for installation and maintenance of a variety of networks.
Measurements include bit errors, alarms, delay time, frequency, digital level measurements, user pattern send/trace, etc., all of which can be displayed on the large color LCD.
Error performance (ITU-T G.821, G.826, M.2100) is available with various pseudorandom patterns and user patterns up to 1024 characters. Frame Relay measurement function, ISDN signaling function (optional), and a simultaneous two-channel monitoring function are also provided. Single button "quick" function and touch-screen ensure easy operation. This unit offers the user sophisticated functions required for installation and maintenance in a small compact unit.

Features

- One unit supports installation and maintenance of leased lines, ISDN, and frame relay
- Single button quick test operation
- Lightweight, with a battery-operated function

Applications

- **Many applications ranging from low-speed modems to high-speed digital lines**

The MD6430A can evaluate the quality of lines ranging from low-speed modems to high-speed digital lines spanning 50 bit/s to 10 Mbit/s.

- **Support for various interfaces**

The MD6430A supports G.703 64k, I.430/I-430a 192k, G.703/G.704/I.431 1.5M, 2M, 2M CMI, 6.3M, V.24/V.28, V.35, V.36, RS-449, X.20, X.21, TTL/CMOS interfaces in a number of optional units designed to meet customer needs.

Units	Interfaces	Uses
MU643000A	G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 1.5M, G.703/G.704/I.431 2.0M, 2M CMI, G.703/G.704 6M	Europe and Japan
MU643000B	G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 1.5M, 2M CMI, G.703/G.704 6M	Japan
MU643000C	G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 2.0M	Europe

Note: All interface units support V.24/V.28, V.35, V.36, RS-449, X.20, X.21, and TTL/CMOS.

- **Wide variety of measurement functions**

Various measurements, such as error, alarm, clock slip, delay, frequency, and digital level can be performed. Also, can send user patterns with tracing functions.

- **Frame relay measurements**

Frame relay network connections (conforming to PVC and ITU-T Q.933 Annex A) can be tested by the MD6430A. The user can also monitor the congestion status such as FECN, BECN, and CLLM.

- **Optional ISDN signaling functions (BRI, PRI)**

The unit can be connected to ISDN networks so that both voice communication and error measurement can be performed.

- **Error data analysis and storage functions**

Error data can be collected in log or histogram format. This data can also be stored in internal memory or on a floppy disk for later analysis.

- **Touch-screen**

The touch-screen, large color LCD, and pop-up menus provide a much better GUI operating environment.

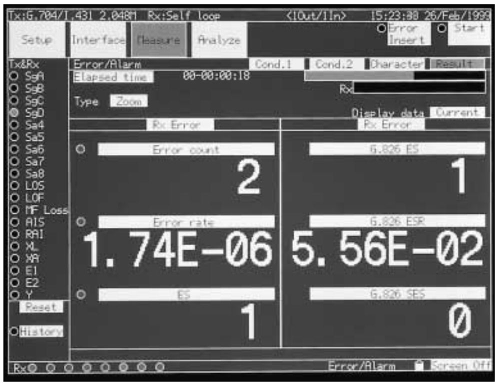
- **Battery operation**

When a commercial power supply is not available, the optional battery pack provides operation for up to 3 hours, and 5 hours in power save operation.

- **Full range of error measurement screens**

Various measurement items can be displayed simultaneously for error count, error rate, block error count, clock slip count, character error count, error performance (G.821, G.826, M.2100), HDLC error (bad frame, abort frame), and various types of alarm. The user can select the desired items and can display them using the zoom function.

```
Tx:G.704/I.431 2.048M  Rx:Self loop      <1Out/1In>   15:18:00 26/Feb/1999
Tx&Rx
○ SgA  ○ SgB  ○ SgC  ● SgD  ○ Sa4  ○ Sa5  ○ Sa6  ○ Sa7  ○ Sa8
○ LOS  ○ LOF  ○ MF Loss  ○ AIS  ○ RAI  ○ XL  ○ XA  ○ E1  ○ E2  ○ Y
Elapsed time        00-00:00:18
Type  All                                  Display data  Current
Error count                2 ○      Power fail     0 ○
Error rate          1.74E-06 ○      PSL            0 ○
Block error count          2 ○
Block error rate    1.74E-05 ○
ES                         1 ○      ALL0           0 ○
EFS                       17        ALL1           0 ○
Clock slip count           0 ●      LOS            0 ○
Clock slip second          0 ●      LOF            0 ○
PSL Count                  0 ●      MF Loss        0 ○
--           G.826           --     AIS            0 ○
EB         2
ES         1  ESR   5.56E-02
SES        0  SESR  0.00E-02
BBE        2  BBER  1.11E-04        RAI            0 ○
US         0
AT        18
Rx○ ○ ○ ○ ○ ○ ○ ○                      Error/Alarm
```



Tx:G.704/I.431 2.048M Rx:Self loop <IOut/IIn> 15:23:08 26/Feb/1999

Elapsed time 00-00:00:18

Type Zoom

Display data Current

Rx Error

Error count 2

G.826 ES 1

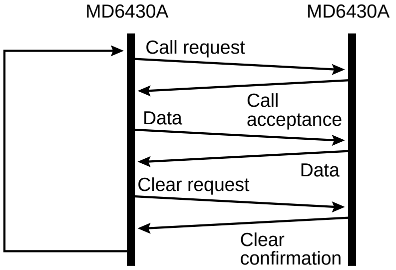
Error rate 1.74E-06

G.826 ESR 5.56E-02

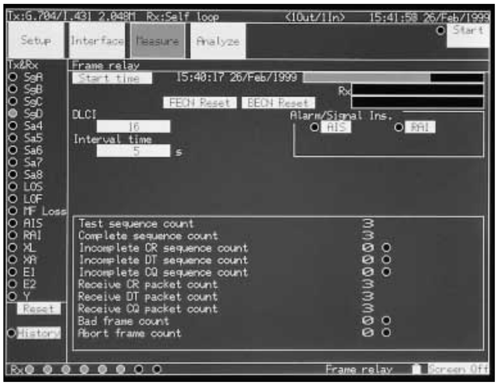
ES 1

G.826 SES 0

• Supports frame relay measurements
Specific DLCI connections can be checked. PVC status checking procedures are supported.



Frame relay measurement sequence



Tx:G.704/I.431 2.048M Rx:Self loop <IOut/IIn> 15:41:58 26/Feb/1999

Start time 15:40:17 26/Feb/1999

DLCI 16

Interval time 5 s

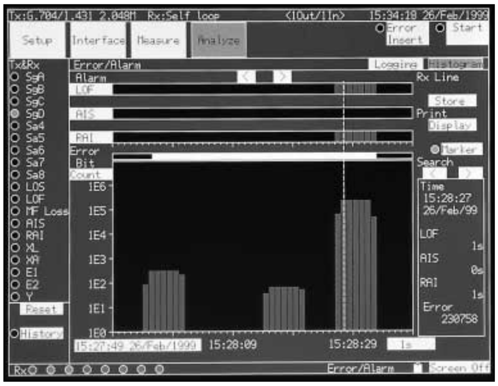
Alarm/Signal Ins. ○ AIS ○ RAI

Test sequence count	3
Complete sequence count	3
Incomplete CR sequence count	0
Incomplete DT sequence count	0
Incomplete CQ sequence count	0
Receive CR packet count	3
Receive DT packet count	3
Receive CQ packet count	3
Bad frame count	0
Abort frame count	0

• Substantial analysis functions
Error status and alarm condition can be logged and displayed as histograms. The received data can also be captured.

Tx:G.704/I.431 2.048M Rx:Self loop <IOut/IIn> 15:31:08 26/Feb/1999

```
15:28:17 26/Feb/1999
  Rx Error count              64
15:28:18 26/Feb/1999
  Rx Error count              64
15:28:19 26/Feb/1999
  Rx Error count              64
15:28:20 26/Feb/1999
  Rx Error count              51
15:28:26 26/Feb/1999
  Rx Error count           65844
  Rx MF Loss               Occur
  Rx RAI                   Occur
15:28:27 26/Feb/1999
  Rx Error count          230758
15:28:28 26/Feb/1999
  Rx Error count          230617
15:28:29 26/Feb/1999
  Rx Error count          229354
15:28:30 26/Feb/1999
  Rx Error count          230407
15:28:31 26/Feb/1999
  Rx Error count          229679
```



Tx:G.704/I.431 2.048M Rx:Self loop <IOut/IIn> 15:34:18 26/Feb/1999

Time 15:28:27 26/Feb/99

LOF 1s

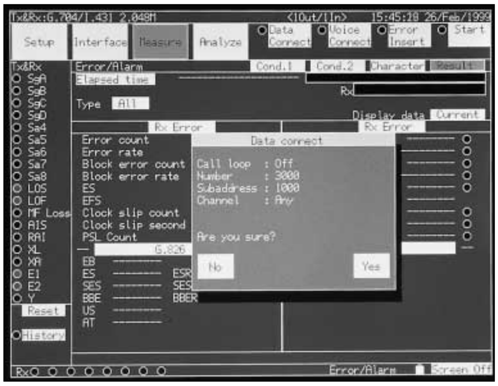
AIS 0s

RAI 1s

Error 230758

15:27:49 26/Feb/1999 15:28:09 15:28:29 1s

• Supports ISDN networks (BRI, PRI)
The unit can be connected to the ISDN public telephone network. Return testing using one unit can be done by using the call loop function as below.



Tx&Rx:G.704/I.431 2.048M <IOut/IIn> 15:45:28 26/Feb/1999

Type All

Display data Current

Data connect

Call loop : Off
Number : 3000
Subaddress : 1000
Channel : Any

Are you sure?

• Voice channel function
The CODEC function permits voice communications over a specified channel. Simultaneous voice communications and measurements are possible.

Tx:G.704/I.431 2.048M Rx:Self loop <IOut/IIn> 15:51:58 26/Feb/1999

Interface P 4/4

Voice channel On

Idle time slot 11111111

TSn 1-31 (1step) 2

• Easy operation
The touch-screen and pop-up menus are quick and user-friendly, making operation easy for all levels of expertise.

Specifications

Interface	High speed: G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 1.5M[*1, *2], G.703/G.704/I.431 2.0M[*1, *3], 2M CMI[*1, *2], G.703/G.704 6M[*1, *2] (2-wire simultaneous monitoring) Low speed: V.24/V.28, V.35, V.36, RS-449, X.20, X.21, TTL/CMOS (Send/receive simultaneous monitoring)
Clock (high-speed interface)	Internal clock: 64 kbit/s, 1.544 Mbit/s[*1, *2], 2.048 Mbit/s, 6.312 Mbit/s[*1, *2] (accuracy ≤±5 ppm) External clock: 64k + 8k or slave sync to received data (slave oscillation range: ≤±100 ppm)
G.703 64k clock mode	Centralized clock, codirectional clock
Code law (high-speed interface)	G.703 64k: AMI I.430/I430-a 192k: AMI G.703/G.704/I.431 1.5M: AMI/B8ZS[*1, *2] G.703/G.704/I.431 2.0M: AMI/HDB3[*1, *3] 2M CMI: CMI G.703/G.704 6M:B8ZS[*1, *2]
Impedance	64k: 110 Ω/HIGH, 192k: 50/100 Ω/HIGH, 1.5M:100 Ω/HIGH, 2 M:75/120 Ω/HIGH, 2M CMI: 110 Ω/HIGH, 6M: 75 Ω/HIGH
Frames (high-speed interface)	G.703/G.704/I.431 1.5M[*1, *2]: 12MFP (G.704), 24MFP (G.704), 24MFP (NTT), unframe G.703/G.704/I.431 2.0M[*1, *3]: 16MFP (30B + D), 16MFP (31B), 2MFP (30B + D), 2MFP (31B), Unframe 2M CMI[*1, *2]: PBX (TTC), CRV, ST (send only), unframe G.703/G.704 6M[*1, *2]: 4MFP (G.704), unframe
Data bit rate (high-speed interface)	64k x n: 64 to 6272 kbit/s (n =1 to 98[*4] , sequential or mixed configuration may be selected.) 56k (1-7) x n: 56 to 5488 kbit/s (n =1 to 98[*4]) 56k (2-8) x n: 56 to 5488 kbit/s (n =1 to 98[*4]) 8k x n: 8, 16, 32 kbit/s 2.4k x n: 2.4 to 48 kbit/s (n = 1 to 20, sequential or mixed configuration may be selected for X.50 20 multiframe.) 0.6k x n: 0.6 to 48 kbit/s (n = 1 to 80, sequential or mixed configuration may be selected for X.50 80 multiframe.) Others: Signaling, 1.544 Mbit/s
Send clock (low-speed interface)	Internal clock Sync (ST1): 50 bit/s to 10 Mbit/s (5 bit/s steps. However, V.24/V.28 and X.20 up to 200 kbit/s) Async: 50, 75, 100, 110, 150, 200, 256, 300, 400, 500, 512, 600, 768, 800, 1k, 1.2k, 1.6k, 1.8k, 2k, 2.4k, 2.56k, 3k, 3.2k, 3.6k, 4.8k, 7.2k, 8k, 9.6k, 12k, 12.8k, 14.4k, 16k, 16.8k, 19.2k, 28.8k, 32k, 38.4k, 46k, 48k, 50k, 56k, 56.6k, 64k, 72k, 76.8k, 115.2k (bit/s) Self oscillation accuracy: ≤±5 ppm External clock (ST2, RTS): Frequency for each interface of 50 to10 Mbit/s (may be inverted.)
Receive clock (low-speed interface)	External clock (ST, RTS): Frequency for each interface of 50 to 10 Mbit/s (May be inverted) Internal clock (Async): 50, 75, 100, 110, 150, 200, 256, 300, 400, 500, 512, 600, 768, 800, 1k, 1.2k, 1.6k, 1.8k, 2k, 2.4k, 2.56k, 3k, 3.2k, 3.6k, 4.8k, 7.2k, 8k, 9.6k, 12k, 12.8k, 14.4k, 16k, 16.8k, 19.2k, 28.8k, 32k, 38.4k, 46k, 48k, 50k, 56k, 56.6k, 64k, 72k, 76.8k, 115.2k (bit/s)
Error measurement pattern	Pseudorandom pattern: PRBS 6, 7, 9, 11, 15, 19, 20, 23, RPRBS 20 (reversed PRBS20), QRSS, positive/negative logic Programmable pattern: 8 bit repetitive (start-stop sync: 5 to 8 bits) Code pattern: 1:1, ALL 1, ALL 0 User pattern: 1 to 1024 characters (1 character steps), for character error measurement
Send pattern	User pattern: 1 to 128 kbyte
Error insertion	Error type: bit, bit + code, code Insertion types Single: 1 bit error inserted each time insert button pressed Repeat: 1 bit error inserted each second Cyclic: 2.5E-1 to 1.7E-7
Start-stop synchronization	Start bit length: 1 bit Stop bit length: 1, 1.5, 2 bits Data length: 5, 6, 7, 8 bits Parity: None, odd, even
Error/alarm measurement	Detected errors: Bit, code, parity, CRC, frame, character Measurements: Error count, error rate, block error count, block error rate, ES, EFS, clock slip, clock slip seconds, pattern sync loss count/time, frame sync loss time, alarm time, signal loss time, AC power loss time Error performance: G.821, G.826, M.2100 Measurement modes Single: 1 s to 99 d 23 h 59 min 59 s Repeat: 1 s to 99 d 23 h 59 min 59 s Manual: 1 y max. Measurement range Error rate: 1.00E-15 to 1.00E00, Error count: 0 to 9.99E15
Pattern trace	Trace byte count: 1 Mbit max. Trace start trigger: Manual, code detect Trace stop trigger: Manual, code detect, code mismatch detect, trace byte count Trigger detect delay: 0 to 8,000 bytes
Frequency measurement	Measurement range: DC to 10 MHz, Accuracy: ≤ (±5 ppm ±1 digit)
Delay time measurement (Sync. mode only)	Measurement range: 0 to 16 s (0.001 ms steps)
Frame relay measurement	Measurement items: Correct test packet count, lost test packet count, HDLC bad frame count, HDLC abort frame count PVC connect confirmation test: To MD6430A or circuit loopback test (Conforms to ITU-T Q.933 Annex A) DLCI: 16 to 991 (1 steps) Test packet send interval time: 5 to 30 s (1 s steps) Traffic congestion status monitoring: BECN, FECN, CLLM message detection (Conforms to ITU-T Q.922 Annex A)
Digital level measurement	Code law: A-law, µ-law Measurement range: –60 to +3 dBm (0.1 dBm steps) Send pattern: 0 dBm, 1 kHz pattern (Conforms to ITU-T G.711)

Continued on next page

ISDN calling/called function	INS64, INS1500 (Option: MU643000A/B-01), ETS1 ISDN (Option: MU643000A/C-02)
MUX/DEMUX	Able to drop/insert specified channels in high-speed interface through X.21 interface at 64k x n (n = 1 to 98)
Voice communication	Voice communication possible in any TS in high-speed interfaces (except G.703 64 kbit/s)
Error analysis	Displays sequential error/alarm measurement data and graphs
Signal monitor lamp	Indicates status of each signal line
External printer	Interface Centronics, D-sub 25-pin connector
External printer output	Enables printout of error measurement data Measurement start time: Prints time and measurement conditions During measurement: Prints specified error and alarm occurrence at each detected instance or at predefined time interval Measurement stop time: Prints measured total results Prints on screen contents
Display	Color TFT-LCD (8.4 inch)
Remote interface	RS-232C, D-sub 9-pin connector, GPIB (option)
Memory	3.5 inch FDD
Built-in timer	Year, month, day, hour, minute, second
Power supply	AC: 85 to 250 V, DC: Lithium ion battery (rechargeable, optional accessory), 50 VA
Battery operation time	3 h (max.) ∗5 h when using power save function
Operating temperature	0˚ to 50˚C, (FDD and at battery usage: +5˚ to +40˚C)
Dimensions and mass	290 (W) x 194 (H) x 94 (D) mm, ≤4.2 kg (excluding battery)
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class D), EN61326: 1997/A1: 1998 (Annex A)
LVD	EN610101-1: 1993/A2, 1995 (Installation Category Ⅱ, Pollution degree 2)

∗1: Specification when using MU643000A Datacom Interface
∗2: Specification when using MU643000B Datacom Interface
∗3: Specification when using MU643000C Datacom Interface
∗4: Max. n value depends on interfaces

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MD6430A	Network Data Analyzer	
	Standard accessories	
G0104	ADP60WB-24.0 AC adapter (100 to 240 Vac/24 Vdc converter):	1 pc
	Power cord:	1 pc
Z0406A	Touch pen (for touch panel):	1 pc
Z0402A	Protective cover (protects display):	1 pc
W1542AE	MD6430A operation manual (includes MU643000A/B/C):	1 copy
W1543AE	MD6430A remote control operation manual (includes MU643000A/B/C):	1 copy
Z0417	MD6430A sample program (remote sample program):	1 pc
Z0403A	Belt with hook (MD6430A carrying belt):	1 pc
	Option	
MD6430A-01	GPIB	
	Units	
MU643000A	Datacom Interface Unit (for Europe and Japan)	
MU643000B	Datacom Interface Unit (for Japan)	
MU643000C	Datacom Interface Unit (for Europe)	
	Options	
MU643000A-01	JT-Q921/Q931 ISDN signaling	
MU643000A-02	ETSI ISDN signaling	
MU643000B-01	JT-Q921/Q931 ISDN signaling	
MU643000C-02	ETSI ISDN signaling	
MU643000A-22	CAS/FAS option (for Europe and Japan)	
MU643000B-22	CAS/FAS option (for Japan)	
MU643000C-22	CAS/FAS option (for Europe)	
	Optional accessories	
Z0404A	Lithium ion battery pack (battery pack for main frame)	
B0441	Hard carrying case	
B0442	Soft carrying case	
B0443	Rack mount kit	
A0006	Headset	
J1026A	GPIB cable (for MD6430A-01's accessory), 2 m	
J0654A	Serial interface cross cable [D-Sub 9-pin (female) · D-Sub 9-pin (male)], 2 m (for remote control of main frame)	
J0661A	RS-232C straight cable [D-Sub 9-pin (female) · D-Sub 25-pin (male)], 2 m (for remote control of main frame)	
J0920B	Cross cable [D-Sub 9-pin (female) · D-Sub 25-pin (male)], 3 m (for remote control of main frame)	
J0913A	Measurement cable [D-Sub 25-pin (male) · half pitch 36-pin], 2 m (for V.24/V.28)	
J0914A	Measurement cable [V.35 connector (male) · half pitch 36-pin), 2 m (for V.35)	

Model/Order No.	Name
J0915A	Measurement cable [D-Sub 37-pin (male) · half pitch 36-pin], 2 m (for V.36/RS-449)
J0916A	Measurement cable [D-Sub 15-pin (male) · half pitch 36-pin], 2 m (for X.20/X.21, using B terminal as ST1 output type)
J0945	Measurement cable [D-Sub 15-pin (male) · half pitch 36-pin], 2 m (for X.20/X.21, using B terminal as ST2 input type)
J0929	Cross measurement cable [D-Sub 15-pin (male) · half pitch 36-pin], 2 m (for X.20/X.21 MUX/DEMUX)
J0388B	DCE/DTE conversion adapter (D-Sub 25-pin, for V.24/V.28)
J0390	DCE/DTE conversion adapter (D-Sub 34-pin, for V.35)
J0392B	DCE/DTE conversion adapter (D-Sub 37-pin, for V.36/RS-449)
J0917A	TTL/CMOS connection box[∗1] (I/O connector: BNC type)
J0923	Measurement cable (both-end Amphenol half pitch 36-pin), 1 m (for connection between MD6430A to TTL/CMOS)
J0463C	Measurement cable [both-end 8-pin modular (RJ45) with shield], 2 m (for 192k)
J0959B	Measurement cable (RJ45 8-pin modular · clip), 2 m (for 192K)
J0844A	ISO1073 cable [both-end 8-pin modular (ISO10173)], 2 m (for 1.5M, 2M)
J0127B	Coaxial cord (BNC-P · RG58A/U · BNC-P), 2 m (for 2M, 6M)
J0939	Coaxial cord (C-H3T type plug · BNC), 2 m (for 6M)
J0921B	Measurement cable [8-pin modular (ISO10173) · M-1PS], 2 m (for 1.5M, 2M)
J0922B	Measurement cable (mini-BANTAM · M-1PS), 2 m (for 64k, 2M CMI)
J0924B	Measurement cable (mini-BANTAM · I-214APS), 2 m (for external input clock, 64k + 8k)
J0930	Measurement cable (mini-BANTAM · M-3912), 2 m (for 64k, Siemens type)
J0960B	Measurement cable (mini-BANTAM · clip), 2 m (for 64k, 2M, CMI)
J0946A	Measurement cable [8-pin modular (ISO10173) · M-3912], 1 m (for 1.5M/2M)
J0946B	Measurement cable [8-pin modular (ISO10173) · M-3912], 2 m (for 1.5M/2M)
J0950	Measurement cable [8-pin modular (ISO10173) · clip], 2 m (for 1.5M/2M)
J0968	Balance cable (RJ45 · ISO10173), 2 m (for 192k)
J0969C	Unbalance cable [SP3CP/3CV-P (BNC)], 2 m (for 6M)
J0925B	Y cable (D-sub 25-pin · half pitch 36-pin/D-sub 25-pin), 2 m (for V.24/V.28 monitor)
J0926B	Y cable (D-sub 25-pin · half pitch 36-pin/D-sub 25-pin), 2 m (for V.35 monitor)
J0927B	Y cable (V.37 · half pitch 36-pin/D-sub 37), 2 m (for V.36/RS-449 monitor)
J0928B	Y cable (D-sub 15-pin · half pitch 36-pin/D-sub 15-pin), 2 m (for X.20/X.21 monitor)

∗1: Cable (J0923) required when using with TTL/CMOS interface
Note: For details of the measurement cable, refer to the Measurement Cable Selection Guide in the MD6430A Application Note.

DATA TRANSMISSION ANALYZER
MD6420A

GPIB
OPTION

For Evaluating Quality of Digital Data Networks

Bit error rate measurement is the most critical parameter in evaluating the quality of digital transmission modes. However, conventional methods, which measure only average bit error rates, are inadequate. In the MD6420A, various types of extension and remote control units are provided as options, as well as units which allow the use of various types of interfaces.
The measuring conditions can be stored in memory and recalled prior to measurement with the touch of a single key. In addition, the analyzer is portable so that it can be used on site for maintenance operations.

Features

- **Can measure a variety of devices from low-speed modems to high-speed digital lines**

Can be configured to a variety of communications protocols via ITU-T V, X, G, and I series by using plug-in units. Can perform high-quality evaluations of data communications systems that have bit rates from 50 b/s to 10 Mb/s.

- **Simultaneous error measurement of various error parameters**

The error count (bit error, parity error, and CRC error, etc.) error rate, block error count, block error rate, US, %US, SES, %SES, DM, %DM, ES, %ES, EFS, %EFS, AT, %AT, BBER, clock slip, and synchronization loss can be measured, Alarm states such as AIS can be continuously monitored*.

*: Conforms to ITU-T G.821

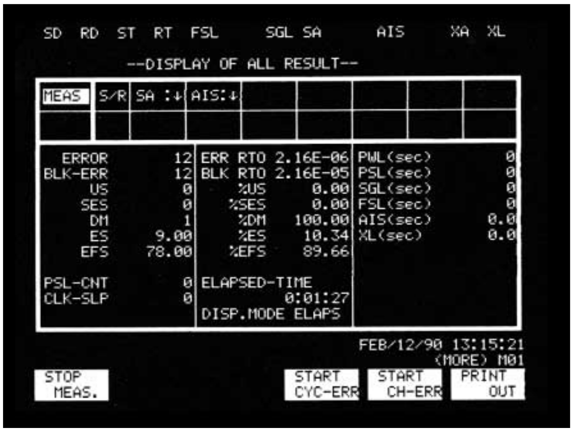
- **Data will not be lost if a power failure occurs during measurement**

If an AC power failure occurs during error rate measurements, all data obtained prior to the failure is recalled from memory and the measurement is automatically continued when the power is resupplied. When the power returns, the time at which power failure occurred is displayed on the EL display.

Example of display screen

- **Overall display of error measurements**

Up to 22 measurement items can be monitored simultaneously. If a power failure occurs during measurements then measurements will be continued from the time at which the power is resupplied. The failure time (PWL) will be displayed when power is resupplied.



```
 SD  RD  ST  RT  FSL     SGL SA      AIS      XA  XL

          --DISPLAY OF ALL RESULT--
 MEAS  S/R SA :↓ AIS:↓

   ERROR        12 ERR RTO 2.16E-06 PWL(sec)        0
 BLK-ERR        12 BLK RTO 2.16E-05 PSL(sec)        0
      US         0     %US     0.00 SGL(sec)        0
     SES         0    %SES     0.00 FSL(sec)        0
      DM         1     %DM   100.00 AIS(sec)      0.0
      ES      9.00     %ES    10.34 XL(sec)       0.0
     EFS     78.00    %EFS    89.66

 PSL-CNT         0 ELAPSED-TIME
 CLK-SLP         0          0:01:27
                   DISP.MODE ELAPS

                                   FEB/12/90 13:15:21
                                         (MORE) M01
 STOP                     START    START    PRINT
  MEAS.                   CYC-ERR   CH-ERR     OUT
```

Combinations of interface and extension units

The MD6420A can be combined with many plug-in units to perform a variety of measurement.

Extension units / Interface units	MD0627A Analog
MD0621A V.24/V.28 (RS232C)	√
MD0621B V.35	√
MD0621C V.36 (RS-449)	√
MD0621D X.20 (RS-423)/X.21 (RS-422)	√
MD0622B G.703/G.704 1.544 Mb/s Bipolar	√*
MD0622D G.703/G.704 6.312 Mb/s Bipolar	√*
MD0622E G.703 64 kb/s	√*
MD0625B I.431 1.544 Mb/s	√*
MD0626A TTL	√*

*: Except DC voltage measurement

Interface units

• V/X series

MD0621A	V.24/V.28 (RS-232C)
MD0621B	V.35
MD0621C	V.36 (RS-449)
MD0621D	X.20 (RS-423)/X.21 (RS-422)

• G.703

MD0622B	G.703/G.704 1.544 Mb/s Bipolar
MD0622D	G.703/G.704 6.312 Mb/s Bipolar
MD0622E	G.703 64 kb/s

• I.431

MD0625B	I.431 1.544Mb/s

• TTL

MD0626A	TTL

Extension units

• Analog

MD0627A	Analog

Remote control units

MD0620A	GPIB
MD0620B	RS-232C

Specifications

Sending clock signal	Internal clock signal (ST1, ASYNC, ST/SP)[*1]	Clock: 50 to 20 kb/s in 5 b/s steps, 20 k to 400kb/s in 100 b/s steps 512 k, 576 k, 672 k, 768 k, 1024 k, 1152 k, 1344 k, 1536 k, 1920 k, 2048 k, 4096 k, 8192 kb/s Accuracy Self oscillation: ±5 ppm Slave oscillation: Subject to 8 kb/s or 8 kb/s of (64 k + 8 k) external input or receiving data Slave oscillation range: ≥ ±100 ppm
	External input	Operated by the external input clock signal (TTL level or sine waves)
	External clock signal (ST2, RT)	Clock (inversion can be used.) by each 50 b/s to 10 Mb/s interface
Receiving clock signal	External clock signal (RT)	Clock (inversion can be used.) by each 50 b/s to 10 Mb/s interface
	Internal clock signal (ASYNC, ST/SP)	50, 70, 100, 150, 200, 256, 300, 400, 500, 512, 600, 768, 800, 1 k, 1.2 k, 1.6 k, 1.8 k, 2 k, 2.4 k, 2.56 k, 3 k, 3.6 k, 4.8 k, 7.2 k, 9.6 k, 14.4 k, 19.2 kb/s
Pattern	Code	A, Z, 1:1, 3:1, 1:3, 7:1, 1:7
	Programmable pattern	8 bit repetition (5 to 8 bits for ST/SP, 5 bits for 2.0 M G.704 spare bit)
	Pseudorandom pattern	2^n – 1 bits repetition (n: 6, 7, 9, 11, 15, 19, 20, 23), positive/negative logic
	Word pattern	8 bits x 8 k words (manual input, setting, user's pattern)
	FOX pattern	Conforms to ITU-T (EBCDIC, ASCII, EBCD, BAUDOT)
Error insertion	Manual error	Single-bit error whenever the key is pressed or single-bit error every second
	Cyclic error	2.5 x 10^{-1} to 1.7 x 10^{-7}(N x 10^{-n}, N: 1.0, 1.1, 1.3, 1.5, 1.7, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0)
Start-stop synchro-nization	Start-stop bit length	Start bit: 1 bit, Stop bit: 1, 1.5, and 2 bits
	Data length	5, 6, 7 and 8 bits
	Parity	None, odd, even
Error measure-ment	Detection error	Bit error, code error, parity error, CRC error and frame mismatch are selected.
	Measurement items	Error count, error rate, block error count, block error rate, ES, %ES, DM, %DM, SES, %SES, US, %US, EFS, %EFS, AT, %AT, BBER clock slip, sync count/time, frame sync loss time, signal loss, AC power failure time
	Block length	2^5 to 2^{16} bits or 10^1 to 10^{16} bits
	Measurement time	10^2 to 10^9 bits measurement and repetition of 1 s to 999 hr 59 min. 59 s
	Display of measurement results	Among the measurement results, five or all optional items can be displayed simultaneously. The buzzer sounds if an error is detected (the volume can be adjusted). The lapse time after the measurement starts is displayed in units of seconds.
Pattern trace	No. of trace bytes	32 KB max.
	Traces stop trigger	Manual code detection, not code detection, signal lines ON/OFF, No. of trace bytes, external input signal ON/OFF
	Delay trace after trigger detection	10 to 8000 bytes
	Trace data display	Displays together with trace stop time in HEX, JIS8, ASCII, EBCDIC, EBCDIK, EBCD, Baudot bit (shift: +4 to –3 bits)
Voltage measurement		Measuring range: –30 to +30 V Accuracy: ±5% ±1 digit
Frequency measurement and count		Measuring range: DC to 10 MHz Accuracy:±5 ppm ±1 digit Display: Decimal 7 digits
Time measurement[*3]		Measuring range: 0 to 10 sec.(10 µs steps) except for ASYNC and ST/SP Accuracy: ±5 ppm ±1 digit Display: Decimal 7 digits
Signal monitor lamp		Displays the status of each signal line ("1"/"ON" : green or red[*2], "0"/"OFF": lamp off)

Continued on next page

External output		Error: Negative logic, TTL level (half clock with of receiving clock) Pattern sync loss: Negative logic, TTL level Clock: Receiving gate clock, TTL level Receiving clock: TTL level (64 k + 8 k) b/s clock: 64 kb/s clock with 8 kb/s violation, AMI, RZ, 1.0 V±10%, Impedance: 120 Ω Video output: Composite video signal (vertical: 16.666 ms ±100 ppm, horizontal: 63.61 µs±100 ppm, 1 Vp-p±10%
External input		Clock: 50 b/s to 10 Mb/s, TTL (64 k +8 k) b/s clock: 64 kb/s clock with 8 kb/s violation, AMI/RZ, Input level: 0.6 to 1.1 Vp-p, Impedance: 110 Ω Trigger: TTL level
Print output	Printing in error measurement	At measurement start: Prints measurement conditions and time During measurement Print time, error count and alarm generation/recovery information at specified intervals Prints time and measurement result after start of measurement Prints time and error count at termination of each measurement cycle At measurement end: Prints time and measurement result
	Other printing	Prints measurement conditions, measurement results, and time in manual measurement
Internal timer		Year, month, day, hour, minute, second
Power		85 to 132 Vac/170 to 250 Vac (changeable), 47 to 64 Hz, ≤180 VA (with full units)
Operating temperature range		0° to +40°C
Connectable unit		5 units max.
Dimensions and mass		319 (W) x 177 (H) x 450 (D) mm, ≤10.5 kg

∗1: Up to 20 kb/s for ASYNC and STSP
∗2: Denotes red LED alarm
∗3: Can not measure delay time for async system and start-stop system

Ordering information

Please specify model/order number, name, and quantity when ordering.

MD6420A (main frame)

Model/Order No.	Name
	Main frame
MD6420A	Data Transmission Analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0013*	Fuse, 5 A: 2 pcs
F0012*	Fuse, 3.15 A: 2 pcs
B0301	Protection cover: 1 pc
Z0031A	Printer paper: 2 rolls
B0254C	Blank panel (for interface units): 5 pcs
B0254D	Blank panel (for remote control units): 1 pc
W0618AE	MD6420A operation manual: 1 copy
W0618BE	MD6420A service manual: 1 copy
	Options
MD6420A-01	Sending pattern synchronized signal output (video output cannot be used with this option.)
MD6420A-02	Sending pattern for word memory, 32 KB
	Optional accessories
B0291B	Carrying case (with casters)
B0251F	Shoulder bag (for MD6420A)
B0302	Rack mount kit
B0251E	Unit housing case (accommodates 10 units)
A0006	Headset
J0386	Probe for external input (BNC-P · IC clip), 1 m
J0135	Balanced cord (I-214APS · – · M-1PS), 2 m
J0162B	Balanced cord (M-3912 · – · M-3912), 2 m
J0050B	Balanced cord [M-214S · – · M-214S (shielded)], 2 m
J0127B	Coaxial cable (BNC-P · RG-58A/U · BNC-P)
J0106	Coaxial cable (3CV-P2 · M-1P), 2 m
Z0174	Service kit for MD6420A
J0673A	Double-ended 25 pin cross cable, 3 m

∗: Supplied one kind of fuse depending on the power supply voltage specified when ordering.

Interface units

Model/Order No.	Name
MD0621A	V.24/V.28 (RS-232C) Interface Unit
	Standard accessory
W0595AE	MD0621A operation manual: 1 copy
	Optional accessories
J0387	Double-ended 25-pin connector cable, 2 m
J0388	25-pin DCE-DTE conversion adapter (used for DTE mode)
MD0621B	V.35 Interface Unit
	Standard accessory
W0596AE	MD0621B operation manual: 1 copy
	Optional accessories
J0864B	Double-ended 34-pin connector cable, 2 m
J0390	34-pin DCE-DTE conversion adapter (used for DTE mode)
MD0621C	V.36 (RS-449) Interface Unit
	Standard accessory
W0597AE	MD0621C operation manual: 1 copy
	Optional accessory
J0391	Double-ended 37-pin connector cable, 2 m
J0392	37-pin DCE-DTE conversion adapter (used for DTE mode)
MD0621D	X.20 (RS-423)/X.21 (RS-422) Interface Unit
	Standard accessory
W0598AE	MD0621D operation manual: 1 copy
	Optional accessory
J0393	Double-ended 15-pin connector cable, 2 m
MD0622B	G.703/G.704 1.544 Mb/s Bipolar Interface Unit
	Standard accessory
W0599AE	MD0622B operation manual: 1 copy
	Optional accessories
J0393	Double-ended 15-pin connector cable, 2 m
J0440	Balanced cord (CS1-MM2), 2 m
J0990	Measurement cable (D-SUB15/SBMD06FBS), 2 m
J0991	Measurement cable (D-SUB15/CLIP), 2 m
MD0622D	G.703/G.704 6.312 Mb/s Bipolar Interface Unit
	Standard accessory
W0600AE	MD0622D operation manual: 1 copy
	Optional accessories
J0393	Double-ended 15-pin connector cable, 2 m
J0127B	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m

Continued on next page

Model/Order No.	Name
MD0622E	G.703 64 kb/s Interface Unit
	Standard accessory
W0601AE	MD0622E/E1 operation manual: 1 copy
	Optional accessories
J0162A	Balanced cord (M-3912 · – · M-3912), 1 m
J0162B	Balanced cord (M-3912 · – · M-3912), 2 m
J0162C	Balanced cord (M-3912 · – · M-3912), 2.5 m
J0162D	Balanced cord (M-3912 · – · M-3912), 5 m
J0537	Balanced cord (M-3912 · – · M-1PS), 2 m
J0164	Balanced cord (M-3912 · – · M-214-SP), 2 m
J0440	Balanced cord (CS1-MM2), 2 m
MD0625B	I.431 1.544 Mb/s Interface Unit
	Standard accessory
W0606AE	MD0625B operation manual: 1 copy
	Optional accessories
J0393	Double-ended 15-pin connector cable (GMP-AS12-001), 2 m
J0440	Balanced cord, CS1-MM2, 2 m
J0539	Cable with 15-pin and modular connectors, (ISO4903 · 15P-IS8877 · 8P), 3 m
J0540	Cable with 15-pin connector and screw terminals, [ISO4903 · 15P-4 screw terminals (3 mm)], 3 m
J0594	Cable with 8-pin modular connector, and alligator clip, ISO8877-8P alligator, 2 m
MD0626A	TTL Interface Unit
	Standard accessory
W0608AE	MD0626A operation manual: 1 copy
	Optional accessory
J0127B	Coaxial cable (BNC-P · RG-58A/U · BNC-P), 2 m
J0386	Probe for external input (BNC-P · IC clip), 1 m

Extension units

Model/Order No.	Name
MD0627A	Analog Unit
	Standard accessory
W0609AE	MD0627A operation manual: 1 copy
	Optional accessory
A0006	Head set
J0135	Balanced cord (I-214APS · – · M-1PS), 2 m

Remote control units

Model/Order No.	Name
MD0620A	GPIB Remote Control Unit (The operation is described in the MD6420A operation manual.)
	Optional accessory
J0008	GPIB cable, 2 m
MD0620B	RS-232C Remote Control Unit (The operation is described in the MD6420A operation manual.)
	Optional accessories
J0387	Double-ended 25-pin connector cable, 2 m
J0673A	Double-ended 25-pin cross cable, 3 m

MOBILE COMMUNICATIONS MEASURING INSTRUMENTS

Mobile communication measurement equipment

(example of an application; various other types of measurement equipment are also available)

Type of measurement equipment	Communication system																		Anritsu model	Equipment to be measured										
	Digital																			Mobile equipment				Base station						
	8PSK	GMSK		GFSK		π/4 DQPSK					CDMA			π/4 DQPSK			M-16QAM													
	Europe etc.							USA				Japan																		
	EDGE	GSM	PCN (DCS1800)	CT2	DECT	TFTS	TETRA	NADC	PACS	WCPE	CDMA (IS-95)	CDMA (ARIB STD-T53)	W-CDMA	PDC	PHS	RCR STD-39	DMCA	Analog		Transmitter	Receiver	Signalling	Maintenance, troubleshooting	Transmitter	Receiver	Signalling	Construction, maintenance	Service areas	Entrance circuitry	Parts
Radio communication analyzer		√	√					√			√	√		√	√			√	MT8801C	√	√	√	√	√	√					√
		√	√								√	√	√	√					MT8820A	√	√	√	√							√
Digital mobile radio transmitter tester	√	√											√						MS8608A/8609A	√				√			√			√
		√	√	√	√	√	√	√	√	√				√	√	√	√		MS8604A	√				√			√			√
Time-domain-capable spectrum analyzer		√									√	√		√				√	MS2661B/C, MS2663C, MS2665C, MS2667C, MS2668C	√				√			√	√		√
	√	√									√	√	√	√	√	√	√	√	MS2681A/2683A/2687B	√			√	√			√	√		√
Digital modulation signal generator		√	√						√		√	√	√						MG3681A		√		√		√		√			√
Signalling tester		√											√						MD8480B			√	√							√
Radio communication test system												√	√		√	√			ME7812 series	√	√	√	√							
Error rate tester		√	√	√	√	√	√	√	√	√				√	√	√	√		MD6420A		√				√		√		√	
Signal generator		√		√			√	√								√		√	MG3641A		√				√		√	√		√
		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MG3642A		√				√		√	√		√
		√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√	MG3633A		√				√		√			√
		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MG3690A series		√				√		√		√	√
Power meter		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	ML2437A/2438A	√				√			√			√
		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	ML2407A/2408A	√				√			√			√
Frequency counter		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MF2400B series	√				√			√			√
Measuring receiver														√			√	√	ML5655C								√	√		
		√															√	√	ML524B*								√	√		
Site master		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	S331C								√			
Network analyzer		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	54100A series								√			√
		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MS4630B	√	√			√	√					√
		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MS462X series	√	√			√	√					√
Area tester													√						ML8720B								√	√		

*: Custom-made product

DIGITAL MOBILE RADIO TRANSMITTER TESTER

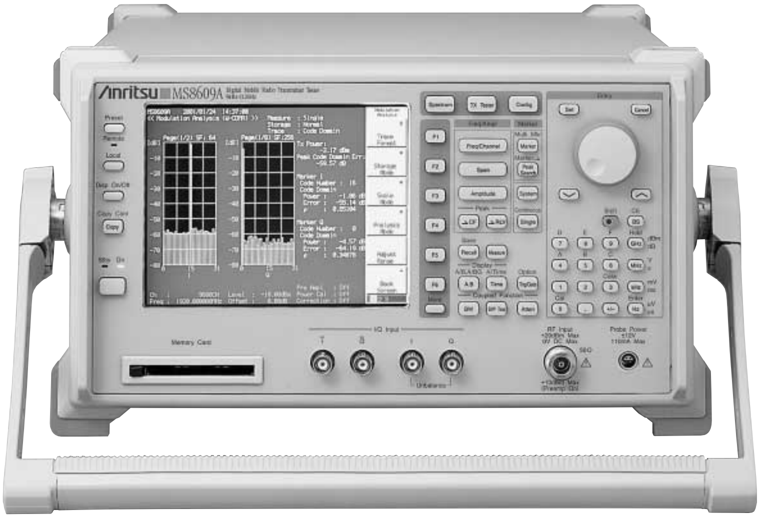
MS8609A

9 kHz to 13.2 GHz

CE GPIB

Measures Wide-Band Signals up to IMT-2000 2 Mbit/s

Anritsu Eco Product
Lightweight
Power saving
Small size
(Conventional product ratio)



The MS8609A is a transmitter tester equipped with an internal spectrum analyzer, a modulation analyzer and a power meter. One tester covers the development, manufacturing of base stations, mobile stations to construction, maintenance of base stations.

The spectrum analyzer has resolution bandwidths up to 20 MHz, meaning that it can readily support measurement of wide-band signal.

The modulation analyzer realizes all Vector Signal Analysis (VSA) functions through high-speed DSP. The power sensor can perform highly accurate power measurements of ±0.4 dB by using an amorphous power sensor.

Up to three dedicated measurement software options (such as W-CDMA and GSM/EDGE) can be installed simultaneously. Input signals can be selected from either RF or I/Q inputs. For I/Q signals, balanced or unbalanced input can also be selected.

It is equipped with GPIB, RS-232C and 10 Base-T (optional) interfaces for remote measurement. High-speed GPIB data transmission of 120 kbyte/s enables high-speed measurement on the manufacturing line. The monitor uses an easy-to-see 6.5 type TFT color LCD.

Spectrum analyzer functions

- **Frequency**

Frequency range: 9 kHz to 13.2 GHz
Resolution bandwidth:
  300 Hz to 3 MHz, 5 MHz, 10 MHz, 20 MHz (to 3 GHz)
Frequency span: Zero, 1 kHz to 13.2 GHz
Span accuracy: ±1%
Reference frequency accuracy:
  ±2 x 10^{-8}/day, ±5 x 10^{-10}/day (option), ±1 x 10^{-10}/year (option)

- **Level**

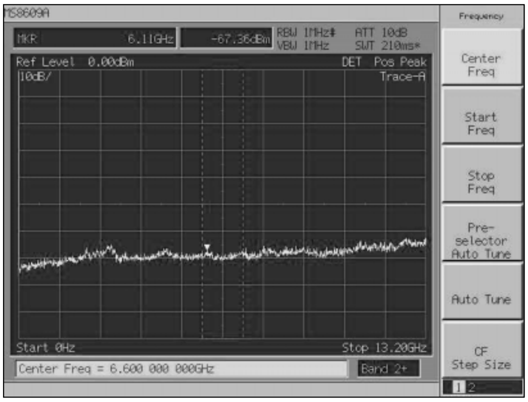
Maximum input level: +20 dBm
Input attenuator: 0 to 62 dB (2 dB steps)
1 dB gain compression: +3 dBm (≥500 MHz)
Two tone 3rd order distortion: ≤–85 dBc (0.1 to 3.2 GHz)

- **Sweep**

Frequency span: 10 ms to 1000 s
Time span: 1 µs to 1000 s
Refresh rate: >20 times/s

- **Others**

Detection mode:
  Normal, positive, negative, sample, average, RMS (option)
Measurement functions:
  Frequency counter, noise power, C/N, ACP, OBW, etc.
GPIB transmission speed: 120 kbyte/s

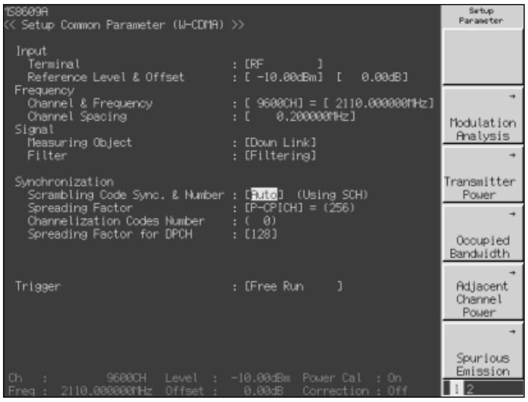


```
MS8609A
MKR          6.11GHz     -67.36dBm  RBW 1MHz#    ATT 10dB
                                    VBW 1MHz     SWT 210ms*
Ref Level  0.00dBm                        DET  Pos Peak
10dB/                                          Trace-A
Start 0Hz                                 Stop 13.20GHz
Center Freq = 6.600 000 000GHz            Band 2+
```

MX860901B W-CDMA Measurement Software

- **Parameter setup**

The measurement parameters such as modulation accuracy and code domain power, etc. are set on the screen shown below. Measurement are simply performed via a soft-key menu after setting the measurement parameters.

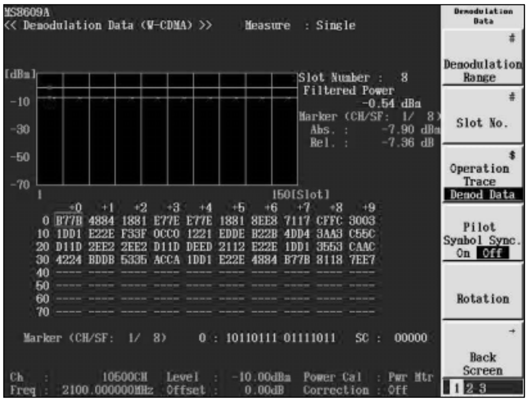


```
MS8609A
<< Setup Common Parameter (W-CDMA) >>

 Input
   Terminal                       : [RF         ]
   Reference Level & Offset       : [ -10.00dBm]  [   0.00dB]
 Frequency
   Channel & Frequency            : [ 9600CH] = [ 2110.000000MHz]
   Channel Spacing                : [    0.200000MHz]
 Signal
   Measuring Object               : [Down Link]
   Filter                         : [Filtering]

 Synchronization
   Scrambling Code Sync. & Number : [Auto]  (Using SCH)
   Spreading Factor               : [P-CPICH] = (256)
   Channelization Codes Number    : (  0)
   Spreading Factor for DPCH      : [128]


 Trigger                          : [Free Run     ]



Ch   :        9600CH   Level  :  -10.00dBm  Power Cal   : On
Freq :  2110.000000MHz Offset :    0.00dB   Correction  : Off
```

• Code domain power
Only 1.5 seconds are required for measurement. Either automatic detection of scrambling code from SCH, or specification of scrambling code can be selected.

• Modulation accuracy measurement
The modulation accuracy of base station and mobile equipment can be measured and modulation analysis of multiple waveforms can be performed. The residual vector error (rms) accuracy is high (1%, typical).

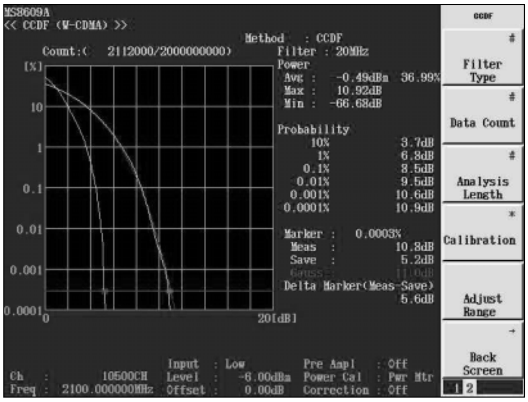
• Demodulation data monitoring
After de-spreading, up to 10 frames of demodulation data can be evaluated.



```
MS8609A
<< Demodulation Data (W-CDMA) >>     Measure  : Single

Slot Number :   8
 Filtered Power
          -0.54 dBm
Marker (CH/SF:  1/  8)
  Abs. :      -7.90 dBm
  Rel. :      -7.36 dB

    +0   +1   +2   +3   +4   +5   +6   +7   +8   +9
 0 B77B 4884 1881 E77E E77E 1881 8EE8 7117 CFFC 3003
10 1DD1 E22E F33F OCCO 1221 EDDE B22B 4DD4 3AA3 C55C
20 D11D 2EE2 2EE2 D11D DEED 2112 E22E 1DD1 3553 CAAC
30 4224 BDDB 5335 ACCA 1DD1 E22E 4884 B77B 8118 7EE7
40 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
50 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
60 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
70 ---- ---- ---- ---- ---- ---- ---- ---- ---- ----

Marker (CH/SF:  1/  8)     0 : 10110111 01111011   SC :  00000

Ch   :          10500CH  Level  :  -10.00dBm  Power Cal   : Pwr Mtr
Freq :  2100.000000MHz  Offset :    0.00dB   Correction : Off
```

• I/Q level measurement
Measures and displays each I and Q input voltage (rms, p-p value). dBmV or mV units are selectable.

• CCDF measurement
It enables distribution display or cumulative distribution display of the power difference between instantaneous power and average power. Max. 20 MHz of filter bandwidth is able to perform multi-carrier measurement.



```
MS8609A
<< CCDF (W-CDMA) >>
                                Method   : CCDF
  Count:(   2112000/2000000000)     Filter : 20MHz
                                    Power
                                     Avg :   -0.49dBm  36.99%
                                     Max :    10.92dB
                                     Min :   -66.68dB

                                    Probability
                                         10%          3.7dB
                                          1%          6.8dB
                                        0.1%          8.5dB
                                       0.01%          9.5dB
                                      0.001%         10.6dB
                                     0.0001%         10.9dB

                                     Marker :   0.0003%
                                      Meas  :        10.8dB
                                      Save  :         5.2dB
                                      Gauss :        11.0dB
                                     Delta Marker(Meas-Save)
                                                      5.6dB

                         Input  : Low        Pre Ampl    : Off
Ch   :          10500CH  Level  :   -6.00dBm  Power Cal   : Pwr Mtr
Freq :  2100.000000MHz  Offset :    0.00dB   Correction : Off
```

• Power meter function
The built-in power meter uses the amorphous power sensor and the measurement accuracy is very high (±0.4 dB).

```
MS8609A
<< Power Meter (W-CDMA) >>           Measure  : Single

  POWER          :     -1.35 dBm
                    --------- dB
                       0.733 mW

  (Range :     0dBm )

Ch   :           9600CH  Level  :  -10.00dBm
Freq :  1920.000000MHz  Offset :    0.00dB   Correction : Off
```

MX860902A GSM Measurement Software

• Parameter setup
The measurement parameters such as GMSK modulation of GSM and 8PSK modulation of EDGE are set on the screen. Measurement are simply performed via a soft-key menu after setting the measurement parameters.

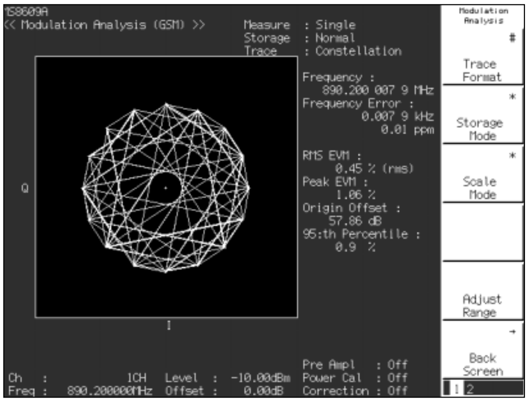
• Modulation accuracy measurement
The modulation accuracy is high. (The residual phase error of GMSK modulation: rms, < 0.5° and residual EVM of 8PSK modulation: rms, < 1.0%)

• Transmitter power measurement
The screen displays the amplitude waveforms with horizontal axis a symbol, vertical axis a level and the template simultaneously.

• Output RF spectrum measurement
The output RF spectrum measurement can be performed at high speed and simply.

• Spurious measurement
Spurious measurement has three kinds of method: Sweep, Search, and Spot. These can be selected depending on the usage.

• EDGE constellation display
The following screen represents constellation display through the filter of the EDGE constellation display of the GSM standard. And the screen represents constellation display of the 8PSK modulation through Nyquist filter and Gaussian inverse correction filter.



```
MS8609A
<< Modulation Analysis (GSM) >>      Measure  : Single
                                     Storage  : Normal
                                     Trace    : Constellation

                                    Frequency :
                                       890.200 007 9 MHz
                                    Frequency Error :
                                           0.007 9 kHz
                                              0.01 ppm

                                    RMS EVM :
                                       0.45 % (rms)
                                    Peak EVM :
                                       1.06 %
                                    Origin Offset :
                                      57.86 dB
                                    95:th Percentile :
                                       0.9  %

                                    Pre Ampl    : Off
Ch   :              1CH  Level  :  -10.00dBm  Power Cal   : Off
Freq :   890.200000MHz  Offset :    0.00dB   Correction : Off
```

MX860903A cdma Measurement Software (sold separately)

• Parameter setup
A setup screen is provided for the entry of required parameters for modulation accuracy and code domain power measurements in cdmaOne or cdma2000® 1xRTT analysis.
Measurement can be performed after parameter setup.

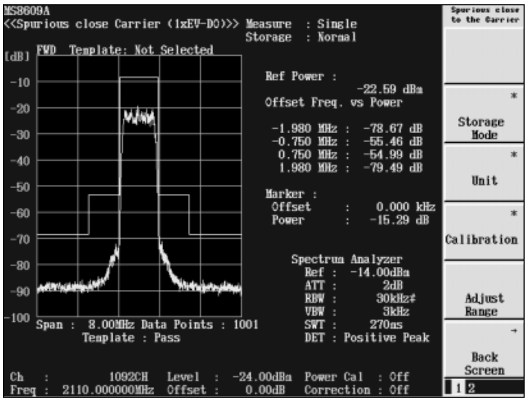
• Modulation accuracy measurement
Frequency error, modulation accuracy and code domain analysis are performed and then results are displayed on the screen. The measurement accuracy is 1% (typical value) of residual vector error (rms).

• BTS code domain analysis
Only 2 seconds are required for code domain analysis of 1xRTT signals, RC* 1 through RC5 can be measured.
Spreading factor of each code is automatically detected and displayed on the screen.
*: Radio Configuration

• MS code domain analysis
Perform code domain analysis of 1xRTT signals in RC3 and RC4 in only 2 seconds. Code domains of I/Q phase are displayed on the screen.

• Transmission power measurement
When transmission power is measured both the value and signal waveform are displayed on the screen. High accuracy power measurements are achieved using the built-in power meter function.

• Spurious close to the carrier measurement
Spurious close to the carrier is measured using the spectrum analyzer function. The PASS/FAIL result of a template judgement is displayed on the screen.



```
MS8609A
<<Spurious close Carrier (1xEV-DO)>> Measure  : Single
                                     Storage  : Normal
FWD  Template: Not Selected
                                       Ref Power :
                                               -22.59 dBm
                                       Offset Freq. vs Power

                                        -1.980 MHz :  -78.67 dB
                                        -0.750 MHz :  -55.46 dB
                                         0.750 MHz :  -54.99 dB
                                         1.980 MHz :  -79.49 dB

                                       Marker :
                                        Offset      :    0.000 kHz
                                        Power       :   -15.29 dB

                                           Spectrum Analyzer
                                             Ref :  -14.00dBm
                                             ATT :        2dB
                                             RBW :     30kHz#
                                             VBW :       3kHz
Span :  8.00MHz Data Points : 1001           SWT :      270ms
       Template : Pass                       DET : Positive Peak

Ch   :         1092CH   Level  :  -24.00dBm  Power Cal   : Off
Freq :  2110.000000MHz  Offset :    0.00dB   Correction  : Off
```

- **Spurious measurement**

A frequency table can be set up in spurious measurement to provide a PASS/FAIL measurement result. Fifteen different frequencies and their limit values can be entered.

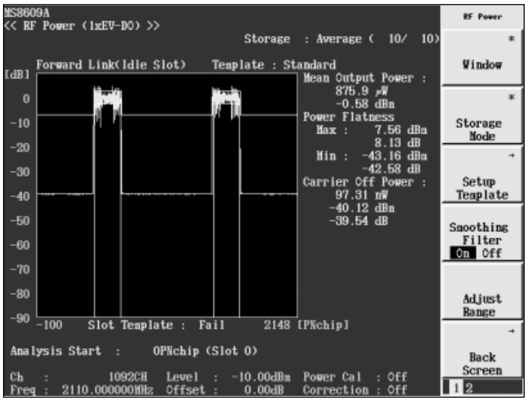
MX860904A cdma2000® 1xEV-DO Measurement Software (sold separately)

- **BTS code domain analysis**

Perform code domain analysis of forward link signals in approx. 2 seconds. Code domains of I/Q phase are displayed on the screen.

- **Transmission power measurement**

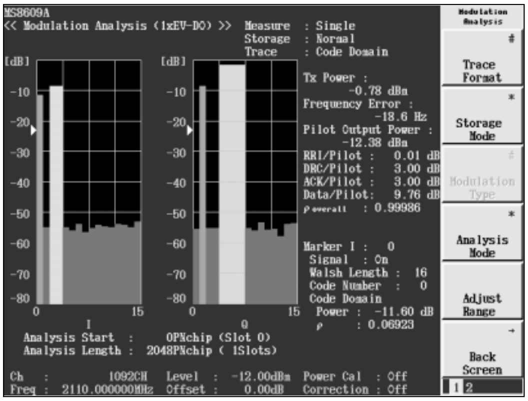
When transmission power is measured both the value and signal waveform are displayed on the screen. High accuracy power measurements are achieved using the built-in power meter function.



```
MS8609A
<< RF Power (1xEV-DO) >>
                          Storage   : Average (  10/  10)

Forward Link(Idle Slot)    Template : Standard
                                    Mean Output Power :
                                         875.9 µW
                                         -0.58 dBm
                                    Power Flatness
                                      Max :     7.56 dBm
                                                8.13 dB
                                      Min :   -43.16 dBm
                                              -42.58 dB
                                    Carrier Off Power :
                                         97.31 nW
                                        -40.12 dBm
                                        -39.54 dB

-100     Slot Template :  Fail      2148 [PNchip]

Analysis Start  :     0PNchip (Slot 0)

Ch   :         1092CH   Level  :  -10.00dBm  Power Cal   : Off
Freq :  2110.000000MHz  Offset :    0.00dB   Correction  : Off
```

- **MS code domain analysis**

Perform code domain analysis of reverse link signals in approx. 2 seconds. Code domains of I/Q phase are displayed on the screen.



```
MS8609A
<< Modulation Analysis (1xEV-DO) >>  Measure  : Single
                                     Storage  : Normal
                                     Trace    : Code Domain
                                    Tx Power :
                                          -0.78 dBm
                                    Frequency Error :
                                              -18.6 Hz
                                    Pilot Output Power :
                                         -12.38 dBm
                                    RRI/Pilot :   0.01 dB
                                    DRC/Pilot :   3.00 dB
                                    ACK/Pilot :   3.00 dB
                                    Data/Pilot:   9.76 dB
                                    ρ overall   : 0.99986

                                    Marker I :   0
                                     Signal   : On
                                     Walsh Length :  16
                                     Code Number  :   0
                                     Code Domain
                                      Power :  -11.60 dB
                                      ρ      : 0.06923
   Analysis Start   :    0PNchip (Slot 0)
   Analysis Length :  2048PNchip ( 1Slots)

Ch   :         1092CH   Level  :  -12.00dBm  Power Cal   : Off
Freq :  2110.000000MHz  Offset :    0.00dB   Correction  : Off
```

- **Spurious close to the carrier measurement**

Spurious close to the carrier is measured using the spectrum analyzer function. The PASS/FAIL result of a template judgement is displayed on the screen.

MX860905A π/4DQPSK Measurement Software (sold separately)

- **Parameter setting**

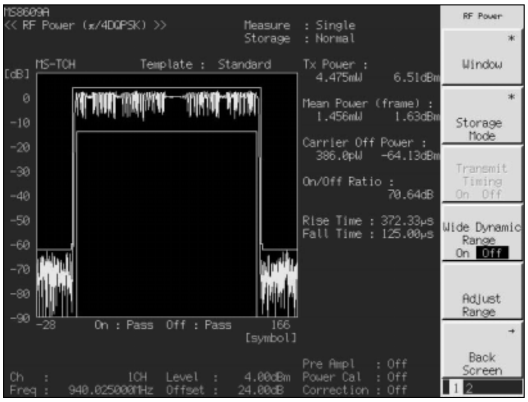
Analysis of PDC, PHS and NADC (IS-136) systems requires setting of parameters for important measurement such as modulation accuracy at this screen. Changing the symbol rate also permits analysis of systems other than PDC, PHS and NADC.

- **Modulation accuracy measurement**

The constellation display is combined with the modulation accuracy measurement results to monitor the residual vector error (rms) with a high accuracy of 0.5 % (PDC).

- **Transmitter power measurement**

This screen displays the transmitter power and waveform.
The power value is calibrated by the built-in power meter to achieve even higher accuracy power measurement.



```
MS8609A
<< RF Power (π/4DQPSK) >>            Measure  : Single
                                     Storage  : Normal

MS-TCH          Template :  Standard    Tx Power :
                                          4.475mW     6.51dBm

                                        Mean Power (frame) :
                                          1.456mW     1.63dBm

                                        Carrier Off Power :
                                          386.0pW   -64.13dBm

                                        On/Off Ratio :
                                                     70.64dB

                                        Rise Time : 372.33µs
                                        Fall Time : 125.00µs

-28       On : Pass   Off : Pass      166
                                   [symbol]

                                        Pre Ampl     : Off
Ch   :            1CH   Level  :    4.00dBm  Power Cal   : Off
Freq :   940.025000MHz  Offset :   24.00dB   Correction  : Off
```

- **Transmission timing measurement**

This screen displays the PHS send timing. In addition, when average measurement is selected, the send jitter is also displayed.

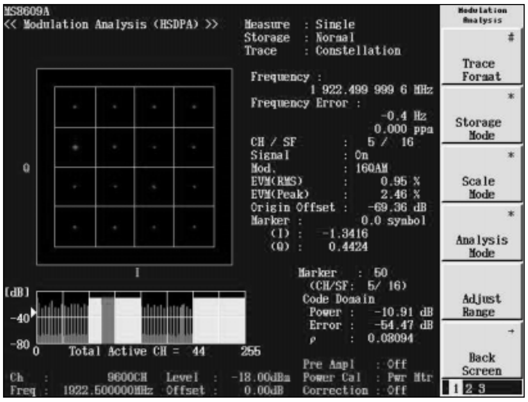
- **Occupied bandwidth measurement**

The occupied bandwidth is measured with a spectrum analyzer or by FFT using DSP, and displayed.

MX860950A HSDPA Measurement Software (sold separately)

- **Modulation analysis (constellation)**

Display pattern is selective from either constellation only or constellation and code domain. Constellation of the code channel selected on code domain screen is displayed.



```
MS8609A
<< Modulation Analysis (HSDPA) >>   Measure  : Single
                                    Storage  : Normal
                                    Trace    : Constellation

                                     Frequency :
                                          1 922.499 999 6 MHz
                                     Frequency Error :
                                                   -0.4 Hz
                                                  0.000 ppm
                                     CH / SF       :   5 /  16
                                     Signal        : On
                                     Mod.          : 16QAM
                                     EVM(RMS)      :      0.95 %
                                     EVM(Peak)     :      2.46 %
                                     Origin Offset :   -69.36 dB
                                     Marker :            0.0 symbol
                                        (I) :   -1.3416
                                        (Q) :    0.4424

                                          Marker    :  50
                                           (CH/SF:  5/ 16)
                                          Code Domain
                                           Power :   -10.91 dB
                                           Error :   -54.47 dB
                                           ρ     :  0.08094
0    Total Active CH =  44      255
                                         Pre Ampl     : Off
Ch   :         9600CH   Level  :  -18.00dBm  Power Cal   : Pwr Mtr
Freq :  1922.500000MHz  Offset :    0.00dB   Correction  : Off
```

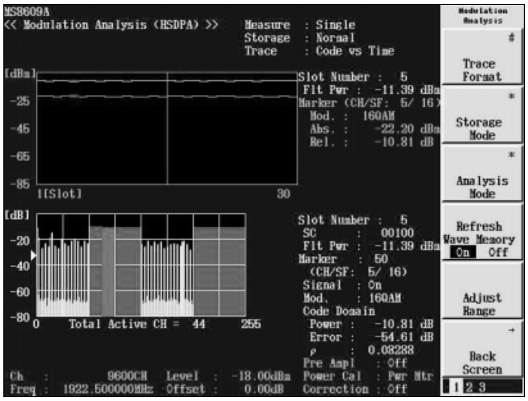
- **Parameter setup**

This setup screen is for conditions necessary for HSDPA analysis, such as modulation accuracy and code domain power measurement. Measurement is performed with simple operations after parameter setup.

- **Modulation analysis (vector error)**

Display pattern is selective from either vector error only or vector error and code domain. Residual vector error (rms) is 1% (typ.), enabling high-accuracy measurement.

- **Code domain analysis**
Code vs Slot can be displayed as well as normal code domain analysis display.



```
MS8609A
<< Modulation Analysis (HSDPA) >>    Measure   : Single
                                     Storage   : Normal
                                     Trace     : Code vs Time

Slot Number :   5
 Flt Pwr :  -11.39 dBm
Marker (CH/SF:  5/ 16)
  Mod. :  16QAM
  Abs. :     -22.20 dBm
  Rel. :     -10.81 dB

Slot Number :   5
 SC        :   00100
 Flt Pwr :  -11.39 dBm
Marker    :  50
  (CH/SF:  5/ 16)
 Signal   : On
 Mod.     : 16QAM
 Code Domain
  Power :    -10.81 dB
  Error :    -54.61 dB
  ρ     :  0.08288
 Pre Ampl    : Off
Ch   :          9600CH  Level  :  -18.00dBm  Power Cal   : Pwr Mtr
Freq :  1922.500000MHz  Offset :    0.00dB   Correction : Off
```

- **IQ level measurement**
Input voltage (rms value, p-p value) for IQ can be measured.
- **Demodulation data display**
Demodulation data display of multiple signals including 16QAM (10 frames max.) is available per code channel. Max. 10 frames of demodulation data can be outputted to a PC card.
- **CCDF measurement**
Display pattern is selective from either CCDF for instantaneous power and average power difference or APD. CCDF for 4 multi carriers can be measured.
- **Adjacent channel power measurement**
When measurement is performed using a spectrum analyzer, the adjacent channel power is measured after passage through a built-in filter (root Nyquist). A high-speed measurement method can also be selected.
- **Spurious measurement**
There are three methods: spot, sweep and search.
Frequency and limit value can be set maximum 15 in the tables. The measurement results are displayed with a limit evaluation.

MX860930A Wireless LAN Measurement Software (sold separately)

Refer to the individual catalogs for the software.

Specifications

- **MS8609A**

Frequency range		9 kHz to 13.2 GHz
Max. input level		+20 dBm (100 mW), continuous average power, DC input: 0 Vdc
Input impedance		Power meter 50 Ω, VSWR: ≤1.3 (30 MHz to 3 GHz) Except power meter 50 Ω, VSWR: ≤1.5 (input attenuator: ≥4 dB, ≤3 GHz)/≤2.3 (input attenuator: ≥10 dB, >3 GHz)
Input connector		N-type
Reference oscillator		Frequency: 10 MHz Starting characteristics: ≤5 x 10^{-8}/day (after 10 minute warm-up, compared to frequency after 24 hour warm-up) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (compared to frequency after 24 hour warm-up) Temperature characteristics: ±5 x 10^{-8} (0˚ to 50˚C, compared to frequency at 25˚C)
Power meter		Frequency range: 30 MHz to 3 GHz Level range: –20 to +20 dBm Measurement accuracy (after zero calibration): ±10%
Spectrum analyzer	Frequency	Frequency setting Setting range: 9 kHz to 13.2 GHz, Pre-selector range: 3.15 to 13.2 GHz (Band 1 and 2) Frequency accuracy Accuracy: ± (display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 x N Hz) ∗N: Mixer harmonic order Normal marker: Same as display frequency accuracy Delta marker: Same as span accuracy Frequency span setting range: 0 Hz, 5 kHz to 13.2 GHz Span accuracy: ±1.0% (at single band sweep, number of data points: 1001) RBW (resolution bandwidth) Setting range: 300 Hz to 3 MHz (1-3 sequence), 5 MHz, 10 MHz, 20 MHz (Band 0) Accuracy: ±20% (300 Hz to 10 MHz), ±40% (20 MHz) Selectivity (60 dB: 3 dB): ≤15:1 VBW (video bandwidth): 1 Hz to 3 MHz (1-3 sequence), off Sideband noise: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 100 kHz offset)

Continued on next page

Spectrum analyzer	Amplitude	Maximum input level Continuous average power: +20 dBm, DC voltage: 0 V Average noise level (RBW: 300 Hz, VBW: 1 Hz): [Without Option 08] ≤–124 dBm + 1.5 x f [GHz] dB (1 MHz to 2.5 GHz, Band 0) ≤–120 dBm + 1.5 x f [GHz] dB (2.5 to 3.2 GHz, Band 0) ≤–116 dBm (3.15 to 7.8 GHz, Band 1) ≤–107 dBm (7.7 to 13.2 GHz, Band 2) [With Option 08] ≤–122 dBm + 1.8 x f [GHz] dB (1 MHz to 2.5 GHz, Band 0) ≤–120 dBm + 1.8 x f [GHz] dB (2.5 to 3.2 GHz, Band 0) ≤–116 dBm (3.15 to 7.8 GHz, Band 1) ≤–107 dBm (7.7 to 13.2 GHz, Band 2) Residual response: ≤–100 dBm (1 MHz to 3.2 GHz, Band 0), ≤–90 dBm (3.15 to 7.8 GHz, Band 1) Reference level Setting range: –100 to +30 dBm Accuracy: ±0.75 dB (+0.1 to 20 dBm), ±0.5 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, frequency: 50 MHz, span: 1 MHz (Input attenuator, RBW, VBW and sweep time are set to AUTO.) Input attenuator: 0 to 62 dB (2 dB steps) Frequency response: ±0.6 dB (9 kHz to 3.2 GHz, Band 0), ±1.5 dB (3.15 to 7.8 GHz, Band 1[∗1]), ±2.0 dB (7.7 to 13.2 GHz, Band 2[∗1]) Log linearity: ±0.4 dB (0 to –20 dB, RBW: ≤1 kHz), ±1.0 dB (0 to –90 dB, RBW: ≤1 kHz) 2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz), ≤–75 dBc (200 to 850 MHz, Band 0), ≤–70 dBc (0.85 to 1.6 GHz, Band 0), ≤–90 dBc (1.6 to 6.6 GHz, Band 1 and 2) Two-tone 3rd order distortion: ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 3.2 GHz), ≤–80 dBc (3.15 to 7.8 GHz), ≤–75 dBc (7.7 to 13.2 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm 1 dB gain compression: ≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz, Band 0), ≥–3 dBm (≥3150 MHz, Band 1 and 2)
	Sweep	Setting range: 10 ms to 1000 s (frequency axis sweep), 1 µs to 1000 s (time axis sweep) Trigger switch: Free-run, triggered Trigger source: Wide IF video, Line, External (TTL level), External (±10 V) Trigger delay Pre-trigger range: –time span to 0 s Resolution: time span/500 or 100 ns whichever is larger. Post trigger: 0 µs to 65.5 ms Resolution: 100 ns (sweep time: ≤4.9 ms), 1 µs (sweep time: ≥5 ms) Gate sweep mode Gate delay range: 0 to 65.5 ms (resolution: 1 µs), Gate length range: 2 µs to 65.5 ms (resolution: 1 µs)
	Functions	Number of data points: 501, 1001 Detection modes: Normal, Positive peak, Negative peak, Sample, Average, RMS (Option 04) Display functions: Trace A, Trace B, Trace A/B, Trace A/BG, Trace A/Time Storage functions: Normal, View, Max hold, Min hold, Average, Linear average, Cumulative, Overwrite Markers Signal search: Auto tune, Peak → CF, Peak → Ref, Scroll Zone markers: Normal, Delta Marker function: Marker → CF, Marker → Ref, Marker → CF step size, Δ marker → Span, Zone → Span Peak search: Peak, Next peak, Min dip, Next dip Multi-marker: 10 max. Measurements Noise power: dBm/Hz, dBm/ch, dBµ√Hz C/N: dBc/Hz, dBc/ch Frequency counter Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Measurement accuracy: ± (display frequency x reference frequency accuracy + 2 x N Hz + 1 LSB) ∗At S/N 20 dB or more and RBW 3 MHz or less, N: Mixer harmonic order Occupied bandwidth: Power N% method, X-dB down method Adjacent channel power Reference measurement: Total power, reference level, in-band method Display methods: Channel specified display (3 channels x 2), graphic display Average power of burst signal: Average power within specified time range of time domain waveform Template comparison measurement (time sweep): Upper limit x 2, lower limit x 2 Mask measurement (frequency sweep): Upper limit x 2, lower limit x 2
Others		Display: Color TFT-LCD, VGA 6.5 type Hard copy: Hard copy of screen via parallel interface (ESC/P compatible printer) Memory card interface: ATA flash card (3.3/5V) GPIB: Can be controlled from external controller (except power switch) when specified as device Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Parallel interface: Centronics printer I/F, D-sub 25-pin connector (female) Video output: Analog RGB output, D-sub 15-pin connector (female)
Dimensions and mass		320 (W) x 177 (H) x 411 (D) mm (except handle, feet, front cover and fan cover), ≤16 kg (nominal)
Power		100 to 120/200 to 240 Vac (–15/+10%, max. voltage: 250 V, automatic voltage selection), 47.5 to 63 Hz, ≤400 VA
Operating temperature and humidity		0˚ to 50˚C, ≤85% (no condensation)
EMC		EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD		EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

∗1: Reference frequency: 50 MHz, input attenuator: 10 dB, +18˚ to +28˚C

• MX860901B W-CDMA Measurement Software

Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08) Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on[*1]) Carrier frequency accuracy: ±(reference oscillator accuracy + 10 Hz) ∗Input level: ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on[*1]),1 code channel Modulation accuracy (residual vector error): <2% (rms) ∗Input level: ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on[*1]), 1 code channel Origin offset accuracy: ±0.5 dB ∗Input level: ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on[*1]), 1 code channel, relative to signal with origin offset of –30 dBc Waveform display (for one-channel to multi-channel) Constellation, eye pattern, vector error vs. chip, phase error vs. chip, amplitude error vs. chip, code vs. slot
Code domain analysis	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08) Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on[*1]) Code domain power accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) ∗Input level: ≥–10 dBm (pre-amplifier: off), ≥–20 dBm (pre-amplifier: on[*1]) Code domain error Residual error: <–50 dB Accuracy: ±0.5 dB (error: relative to signal with origin offset of –30 dBc) ∗Input level: ≥–10 dBm (pre-amplifier: off); ≥–20 dBm (pre-amplifier: on[*1]), spread factor: 512 (down-link)/256 (up-link) Display Function: Code domain power, code domain error Spread factor: 4 to 256 (up-link)/4 to 512 (down-link), spread factor auto detection function, SCH level measurement function, I/Q separately at up-link Code vs. slot measurement: Measures code domain power per slot of specified code channel for Max.150 slots. (Supporting compressed mode in downlink)
Amplitude measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08) Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on[*1]) Transmitter power measurement Measurement range: –20 to +20 dBm (average power, pre-amplifier: off), –20 to +10 dBm (average power, pre-amplifier: on[*1]) ∗Auto calibrated at internal power meter Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –40 dB) ∗Input level: ≥–10 dBm (pre-amplifier: off); ≥–20 dBm (pre-amplifier: on[*1]), after the range adjusted, with the reference level setting unchanged Filter selection function: Power measurement through RRC (α = 0.22) filter Transmitter power control measurement function: Relative power display per slot for Max. 150 slots, NO/GO evaluation RACH measurement function: Measures the time difference between preamble RACH signal and message RACH signal.
Occupied bandwidth measurement	Frequency range: 50 MHz to 3 GHz Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on[*1]) Measurement method Sweep method: Displays result after signal measured with sweep spectrum analyzer FFT method: Displays result after FFT
Adjacent channel power measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08, 30) Input level: –10 to +20 dBm (average power, pre-amplifier: off) Measurement method Sweep method (all): Calculates and displays result after signal measured with sweep spectrum analyzer Sweep method (separate): Calculates and displays power after each adjacent channel measured with sweep spectrum analyzer Filter method: Measures and displays power of adjacent channels after passing via built-in receiving filters (RRC: α = 0.22) Measurement range Input level: ≥0 dBm (filter method, wide dynamic range mode) Code channel (1 code): ≥55 dBc (5 MHz offset), ≥62 dBc (10 MHz offset) Code channel (16 multi-code): ≥50 dBc (5 MHz offset), ≥60 dBc (10 MHz offset, without Option 08) Input level: ≥–10 dBm (filter method, wide dynamic range mode) Code channel (1 code): 55 dBc (5 MHz offset, typical), 62 dBc (10 MHz offset, typical) Code channel (16 multi-code): 50 dBc (5 MHz offset, typical), 60 dBc (10 MHz offset, typical)
Spurious measurement	Measurement frequency: 9 kHz to 12.75 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): 0 to +20 dBm (average power, pre-amplifier: off) Measurement method Sweep method: Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Spot method: Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Search method: Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range[*2]: ≥79 dB (RBW: 1 kHz, 9 to 150 kHz, Band 0) ≥79 dB (RBW: 10 kHz, 150 kHz to 30 MHz, Band 0) ≥79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) ≥76 –f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0) ≥76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1) ∗Carrier frequency: 1.8 to 2.2 GHz
Spectrum emission mask measurement	Measures the signal under measurement with sweep spectrum analyzer and displays template evaluation result.
Demodulation display	Outputs Max. 10 frames of despread data for specified code channel.

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CCDF measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08, 30) Measurement level range: –60 to +20 dBm (average power, pre-amplifier: off), +30 dBm (peak power, pre-amplifier: off) –80 to +10 dBm (average power, pre-amplifier: on), +20 dBm (peak power, pre-amplifier: on) Measurement method CCDF: Cumulative distribution display of the power difference between instantaneous power and average power. APD: Distribution display of the power difference between instantaneous power and average power. Filter selection function: 20 MHz, 10 MHz, 5 MHz, 3 MHz, RRC: α = 0.22, RC: α = 0.22
I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Residual vector error: <2% (rms) ∗Input level: ≥0.1 V (rms), DC coupling I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

∗1: Can be set when MS8609A-08 option is installed in the main unit.

∗2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

- **MX860902A GSM Measurement Software**

Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –40 to +20 dBm (burst average power, pre-amplifier: off), –60 to +10 dBm (burst average power, pre-amplifier: on[∗1]) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) ∗Input level (burst average power): ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on[∗1]) Residual phase error (GMSK modulation): <0.5 deg (rms), <2.0 deg (peak) ∗Input level (burst average power): ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on[∗1]) Residual EVM (8PSK modulation): <1% (rms) Waveform display: Trellis (GMSK modulation), eye pattern, EVM vs. bit (8PSK modulation), phase vs. bit, amplitude vs. bit, I/Q diagram
Amplitude measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –40 to +20 dBm (burst average power, pre-amplifier: off), –60 to +10 dBm (burst average power, pre-amplifier: on[∗1]) Transmitter power measurement (auto calibrated at internal power meter) Measurement range: –10 to +20 dBm (burst average power), –10 to +10 dBm (burst average power, pre-amplifier: on[∗1]) Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –30 dBm) ∗Input level (burst average power): ≥–10 dBm (pre-amplifier: off); ≥–20 dBm (pre-amplifier: on[∗1]), without changing the reference level setting after range optimization Carrier-off power measurement range Input level (burst average power): ≥–10 dBm (pre-amplifier: off), ≥–20 dBm (pre-amplifier: on[∗1]) Normal mode: ≥60 dB (compared with burst average power) Wide dynamic range mode: ≥80 dB (compared with 10 mW of burst average power) ∗Measurement limit is decided by average nose level (≤–70 dBm, 50 MHz to 2.7 GHz). Rise/fall characteristics: Display rising/falling edges while synchronizing to modulation data of signal data to be measured. Standard line display possible (measured by 1 MHz bandwidth). NO/GO judgment function
Output RF spectrum measurement	Frequency range: 100 MHz to 2.7 GHz Input level: –10 to +20 dBm (burst average power, pre-amplifier: off), –20 to +10 dBm (burst average power, pre-amplifier: on[∗1]) Modulation portion measurement range: ≥60 dB (≥200 kHz offset), ≥68 dB (≥250 kHz offset) ∗CW signal, RBW: 30 kHz (<1.8 MHz offset), RBW: 100 kHz (≤1.8 MHz offset) Transient portion measurement range: ≥63 dB (CW, ≥400 kHz offset)
Spurious measurement	Measurement frequency: 100 kHz to 12.75 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): 0 to +20 dBm (burst average power, pre-amplifier: off) Measurement method Sweep method: Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Spot method: Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Search method: Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range: ≥72 dB (RBW: 10 kHz, 100 kHz to 50 MHz, Band 0) ≥72 dB (RBW: 100 kHz, 50 to 500 MHz, Band 0) ≥66 –f [GHz] dB (RBW: 3 MHz, 0.5 to 3.15 GHz, Band 0, except harmonic frequency) ≥66 dB (RBW: 3 MHz, 3.15 to 7.8 GHz, Band 1) ∗Carrier frequency: 0.8 to 1 GHz, 1.8 to 2 GHz

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I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, I/Q level Modulation accuracy Residual phase error: <0.5 deg (rms), DC coupling Residual EVM: <1.0% (rms), DC coupling *Input level: ≥0.1 V (rms), 18° to 28°C I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

*1: Can be set when MS8609A-08 option is installed in the main unit.

• MX860903A cdma Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on[*1]) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on[*1]), at 1 code channel Modulation accuracy (residual vector error): <2.0% (rms) *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on[*1]), at 1 code channel Origin offset accuracy: ±0.50 dB *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on[*1]), at 1 code channel, relative to signal with origin offset of –30 dBc Waveform display: Displays the following items for 1 CH to multi CH input signals; constellation, eye pattern, vector error vs. chip number, phase error vs. chip number, amplitude error vs. chip number
Code domain analysis	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on[*1]) Analysis signal: Forward link (radio configuration 1 to 5), Reverse link (radio configuration 1 to 4), Reverse link (radio configuration 3, 4) at long code mask: 0 Code domain power accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) Display function: Code domain power, code domain timing offset, code domain phase offset
Amplitude measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on[*1]) Tx power measurement: (after level calibration using built-in power meter, automatic operation by pushing key) Measurement range: –20 to +20 dBm (average power within burst, pre-amp off), –20 to +10 dBm (average power within burst, pre-amp on[*1]) Accuracy: ±0.40 dB Power measurement linearity: ±0.20 dB (0 to –40 dB) *Input level: ≥+10 dBm (pre-amp off), ≥–20 dBm (pre-amp on[*1]) , unchanged reference level setup after range adjustment Burst analysis: Rising/falling characteristics and on/off ratio analysis function
Occupied bandwidth measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on[*1]) Measurement method Sweep method: Sweeps signal using spectrum analyzer and calculates result FFT Method: Analyzes signal with FFT and calculates result
Spurious close carrier to the measurement	Frequency range: 50 MHz to 2.3 GHz Input level range: –10 to +20 dBm (average power within burst, pre-amp off) Measurement method: Calculates and displays the ratio of Tx power to the power measured by spectrum analyzer with sweep method Tx power measurement Tx power method: Carrier power measured in 1.23 MHz bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range: ± 50 dBc (900 kHz offset), ±60 dBc (1.98 MHz offset) *Input level (average power within burst): ≥0 dBm (pre-amp off), RBW: 30 kHz, VBW: 300 kHz, detection mode: positive

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Spurious measurement	Measurement frequency range: 10 MHz to 12.75 GHz (except within ±50 MHz of carrier frequency) Input level range (Tx power): +20 to +40 dBm (average power within burst) Measurement method Sweep method: Sweeps specified frequency range using spectrum analyzer and calculates ratio of carrier power and peak value detected during the sweep. Detection mode is average. Spot method: Measures average power of specified frequencies in time domain using spectrum Analyzer and calculates ratio of carrier power and measured power of the frequencies. Detection mode is average. Search method: Sweeps specified frequency range using spectrum analyzer and detects frequency of peak spurious. Measures average power of the detected frequencies in time domain using spectrum analyzer and calculates ratio of carrier power and the measured power for the frequencies. Detection mode is Average. Tx power measurement Tx power method: Carrier power measured in 1.23 bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range (typical) 79 dB (RBW: 10 kHz, 10 to 30 MHz, Band 0), 79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) *Carrier frequency: 800 to 1000 MHz/1.8 to 2.2 GHz, referential value of power ratio in Tx power[*2] Normal mode: 76 – f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0), 76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1)
Electric performance (I/Q input)	Input impedance: 1 MΩ (parallel capacitance: <100 pF), 50 Ω Balance input Differential voltage: 0.1 to 1 Vp-p, In-phase voltage: ±2.5 V Unbalance Input: 0.1 to 1 Vp-p DC/AC coupling: Changeable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Modulation accuracy measurement (residual vector error): <2% (rms) *DC coupling, input level: ≥0.1 V (rms) I/Q level measurement: Measures input level of I and Q (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

*1: Can be set when MS8609A-08 option is installed in the main frame.
*2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

• MX860904A cdma2000® 1xEV-DO Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on[*1]) Carrier frequency accuracy: ±(reference oscillator accuracy +10 Hz) *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on[*1]), at 1 code channel Modulation accuracy (residual vector error): <2.0% (rms) *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on[*1]), at 1 code channel Origin offset accuracy: ±0.50 dB *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on[*1]), at 1 code channel, relative to signal with origin offset of –30 dBc Waveform Display Forward link Displays the following items for each or entire domain of DATA, MAC and Pilot: Constellation, Eye Pattern, Vector Error vs. Chip Number, Phase Error vs. Chip Number, Amplitude Error vs. Chip Number Displays the symbol constellation of DATA domain Reverse link Displays the following items for 1CH to multi CH input signals: Constellation, Eye pattern, Vector Error vs. Chip Number, Phase Error vs. Chip Number, Amplitude Error vs. Chip Number
Code domain analysis	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on[*1]) Code domain power accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) Input level: ≥–10 dBm (pre-amp off), ≥–20 dBm (pre-amp on[*1]) Analysis signal: Forward link, Reverse link Display function Forward link: Displays the code domain power for each DATA and MAC domain Code domain power for DATA domain, Spread factor: IQ separate display for fixed 16 codes Code domain power for MAC domain, Spread factor: IQ separate display for fixed 64 codes Reverse link: Displays the code domain power for IQ separately, Detects the following channels
Amplitude measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on[*1]) Tx power measurement: (after level calibration using built-in power meter, automatic operation by pushing key) Measurement range: –20 to +20 dBm (average power within burst, pre-amp off) –20 to +10 dBm (average power within burst, pre-amp on[*1]) Accuracy: ±0.40 dB Power measurement linearity: ±0.20 dB (0 to –40 dB) *Input level: ≥0 dBm (pre-amp off), ≥–20 dBm (pre-amp on[*1]) , unchanged reference level setup after range adjustment Idle slot analysis: Rise/Fall characteristics and On/Off ratio analysis function are equipped.

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Occupied bandwidth measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on[*1]) Measurement method Sweep method: Sweeps signal using spectrum analyzer and calculates result FFT method: Analyzes signal with FFT and calculates result
Spurious close to the carrier measurement	Frequency range: 50 MHz to 2.3 GHz Input level range: –10 to +20 dBm (average power within burst, pre-amp off) Measurement method: Calculates and displays the ratio of Tx power to the power measured by spectrum analyzer with sweep method Tx power measurement Tx power method: Carrier power measured in 1.23 MHz bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range: ≥50 dBc (900 kHz offset), ≥60 dBc (1.98 MHz offset) *Input level (average power within burst): ≥0 dBm (pre-amp off), RBW: 30 kHz, VBW: 3 kHz, detection mode: positive
Spurious measurement	Measurement frequency range: 10 MHz to 12.75 GHz (except within ±50 MHz of carrier frequency) Input level range (Tx power): 0 to +20 dBm (average power within burst, pre-amp off) Measurement method Sweep method: Sweeps specified frequency range using spectrum analyzer and calculates ratio of carrier power and peak value detected during the sweep. Detection mode is average. Spot method: Measures average power of specified frequencies in time domain using spectrum Analyzer and calculates ratio of carrier power and measured power of the frequencies Detection mode is average. Search method: Sweeps specified frequency range using spectrum analyzer and detects frequency of peak spurious. Measures average power of the detected frequencies in time domain using spectrum analyzer and calculates ratio of carrier power and the measured power for the frequencies. Detection mode is Average. Tx power measurement Tx power method: Carrier power measured in 1.23 MHz bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range (typical): 79 dB (RBW: 10 kHz, 10 to 30 MHz, Band 0) 79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) *Carrier frequency: 800 to 1000 MHz/1.8 to 2.2 GHz, reference value of power ratio in Tx power[*2] Normal mode: 76 – f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0) 76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1)
CCDF measurement	Frequency range: 50MHz to 3GHz, 50MHz to 2.3GHz (when Option MS8609A-08 or MS8609A-30 is installed) Measurement level range –60 to +20 dBm (average power), +30 dBm (peak power): Pre-amp off –80 to +10 dBm (average power), +20 dBm (peak power): Pre-amp on[*1] Measurement method CCDF: Displays the cumulative distribution of the power difference between instantaneous power and average power APD: Displays the distribution of the power difference between instantaneous power and average power Filter selection function: 20 MHz, 10 MHz, 5 MHz, 3 MHz, 1.23 MHz
Electric performance (I/Q input)	Input impedance:1 MΩ (parallel capacitance: <100 pF), 50 Ω Balance input Differential voltage: 0.1 to 1 Vp-p, In-phase voltage: ±2.5 V Unbalance input: 0.1 to 1 Vp-p DC/AC coupling: Changeable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Modulation accuracy measurement: (residual vector error): <2% (rms) *DC coupling, input level: ≥0.1 V (rms) I/Q level measurement: Measures input level of I and Q (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I-phase and Q-phase signals.

*1: Can be set when MS8609A-08 option is installed in the main frame.
*2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

• MX860905A π/4DQPSK Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measured frequency range: 50 MHz to 2.1 GHz Measured level ranges: –40 to +20 dBm (average power within burst, pre-amp off[*1]), –60 to +10 dBm (average power within burst, pre-amp on[*1]) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) ∗Input level (average power within burst): ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]) Modulation accuracy (residual vector error) PDC/NADC: <0.5% (rms), PHS: <0.7% (rms) ∗Input level: ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]), averaging: 10 times Origin offset accuracy: ±0.50 dB ∗Input level (average power within burst): ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]), relative to signal with origin offset of –30 dBc Transmission rate accuracy: ±1 ppm ∗Input level (average power within burst): ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]) Symbol rate: 2 to 300 k symbol/s Roll off ratio: 0.2 to 1.0 Analysis symbol: 48 to 1000 symbol Waveform displays: Constellation, eye diagram, EVM vs. symbol No., phase error vs. symbol No., amplitude error vs. symbol No.
Amplitude measurement	Frequency range: 50 MHz to 2.1 GHz Measurement level ranges: –40 to +20 dBm (average power within burst, pre-amp off[*1]), –60 to +10 dBm (average power within burst, pre-amp on[*1]) Transmitter power measurement[*1] Measurement ranges: –10 to +20 dBm (average power within burst, pre-amp off[*1]), –10 to +10 dBm (average power within burst, pre-amp on[*1]) Accuracy: ±0.40 dB Power measurement linearity: ±0.20 dB (0 to –30 dB) ∗Input level (average power within burst): ≥–10 dBm (pre-amp off[*1]), ≥–20 dBm (pre-amp on[*1]), without changing the reference level setting after range optimization Carrier-off power measurement[*3] Normal mode measurement range PDC/NADC: ≥65 dB, PHS: ≥60 dB ∗Relative to average power within burst Wide dynamic range mode measurement range PDC/PHS: ≥90 dB (measurement limits of average noise level: ≤–80 dBm, 50 Hz to 2.1 GHz) PHS: ≥80 dB (measurement limits of average noise level: ≤–70 dBm, 50 Hz to 2.1 GHz) ∗Average power within burst: 10 mW Rise/fall characteristics: Display rising/falling edges while synchronizing to modulation data of signal data to be measured. Standard line display, NO/GO judgement function
Occupied bandwidth measurement	Measured frequency range: 50 MHz to 2.1 GHz Measured level ranges: –40 to +20 dBm (average power within burst, pre-amp off[*1]), –60 to +10 dBm (average power within burst, pre-amp on[*1]) Measurement methods Sweep method: Calculates and displays result after signal measured with sweep spectrum analyzer FFT method: Calculates and displays result after FFT
Adjacent channel power measurement	Frequency range: 100 MHz to 2.1 GHz Input level range: –10 to +20 dBm (average power within burst, pre-amp off[*1]), –20 to +10 dBm (average power within burst, pre-amp on[*1]) Measurement methods Sweep method (all): Calculates and displays result after signal measured with sweep spectrum analyzer Sweep method (separate): Calculates and displays after measuring adjacent channel and next adjacent channel signal with sweep spectrum analyzer High-speed method: Calculates and displays after measuring adjacent channel and next adjacent channel power (rms) through internal receive filter Measurement range (CW signal input, at high-speed method) PDC: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset) PHS: ≥60 dB (600 kHz offset), ≥60 dB (900 kHz offset) NADC: ≥30 dB (30 kHz offset), ≥60 dB (60 kHz offset), ≥65 dB (90 kHz offset) ∗Adjacent channel power averaging ratio found from average power within burst and during burst on interval
Spurious measurement	Measured frequency range: 100 kHz to 7.8 GHz (except within carrier frequency ±50 MHz) Input level range (transmitter power): –10 to +20 dBm (average power within burst, pre-amp off[*1]), –20 to +10 dBm (average power within burst, pre-amp on[*1]) Measurement methods Sweep method: Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Spot method: Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Search method: Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average

Continued on next page

Electrical performance (I/Q input)	Input method: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacitance: <100 pF), 50 Ω Input level range Balanced input Differential voltage range: 0.1 to 1 Vp-p, In-phase voltage range: ±2.5 V (at input terminal) Unbalanced input: 0.1 to 1 Vp-p (at input terminal, switchable DC/AC coupling) Measurement items: modulation accuracy, amplitude, occupied bandwidth (FFT method), I/Q level Modulation accuracy measurement Input level: ≥0.1 V (rms) *Temperature range: 10° to 28°C Residual vector error PDC/NADC: <0.5% (rms) *Typical, DC coupling PHS: <0.7% (rms) *Typical, DC coupling I/Q level measurement Level measurement: Measurement and display each I, Q input voltage (rms, p-p) I/Q phase difference measurement: Phase difference between I and Q phase signals when CW signal input to I and Q input terminals

*1: Can be set when MS8609A-08 option is installed in the main frame.
*2: After level calibration using internal power meter
*3: Input level (average power within burst): ≥–10 dBm (pre-amp off[*1]), ≥–20 dBm (pre-amp on[*1])

• MX860950A HSDPA Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (when MS8609A-08 is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off[*1]) –80 to +10 dBm (average power within burst, pre-amp on[*1]) Carrier frequency accuracy: ± (reference oscillator accuracy ±10 Hz), at 1 code channel (Modulation methods: QPSK) *Input level: ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]) Modulation accuracy Residual vector error: <2.0%(rms), at 1 code channel (Modulation methods: QPSK) *Input level: ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]) Origin offset accuracy: ±0.5 dB, at 1 code channel (Modulation methods: QPSK) *Input level: ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]) For the signals with Origin Offset = –30 dBc Waveform display Displays the following items for 1CH to multi CH input signals: Constellation, Vector error, Phase error, Amplitude error
Code domain analysis	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (When MS8609A-08 option is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off[*1]) –80 to +10 dBm (average power within burst, pre-amp on[*1]) Code domain power Input level: ≥–10 dBm (pre-amp off[*1]), ≥–20 dBm (pre-amp on[*1]) Modulation methods: QPSK Accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) Code domain error Input level: ≥–10 dBm (pre-amp off[*1]), ≥–20 dBm (pre-amp on[*1]) Modulation methods: QPSK Spread factor: 512 Residual error: <–50 dB Accuracy: ±0.5 dB (Error: –30 dBc) Display function Code domain power, code domain error display Supporting SF: 4 to 512 SF auto-detect function is equipped. SCH level measurement function is equipped. Code vs. Slot measurement: Code domain power is measured per slot (Max.150 slots) for the specified code channel. (supporting compressed mode)
Amplitude measurement	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (when MS8609A-08 is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off[*1]) –80 to +10 dBm (average power within burst, pre-amp on[*1]) Tx power measurement: After level calibration with built-in power meter (executed automatically by a key push) Measurement range: –20 to +20 dBm (average power within burst, pre-amp off[*1]) –20 to +10 dBm (average power within burst, pre-amp on[*1]) Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –40dB) unchanged reference level setup after range adjustment *Input level: ≥–30 dBm (pre-amp off[*1]), ≥–40 dBm (pre-amp on[*1]) Filter select function: Power value after passing RRC (α = 0.22) filter can be measured
CCDF measurement	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (when MS8609A-08 is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off[*1]) –80 to +10 dBm (average power within burst, pre-amp on[*1]) Measurement methods CCDF: Displays an accumulation distribution of a ratio between instantaneous power and average power APD: Displays a distribution of a ratio between instantaneous power and average power Filter select function: 20 MHz, 10 MHz, 5 MHz, 3 MHz, RRC: α = 0.22, RC: α = 0.22

Continued on next page

Electric performance (IQ input)	Input methods: Balance, Unbalance Input impedance: 1 MΩ (parallel capacitance: <100 pF), 50 Ω Input level range Balance input Differential voltage: 0.1 to 1.0 Vp-p, In-phase voltage: ≤±2.5 V (at input terminal) Unbalance input: 0.1 to 1.0 Vp-p (at input terminal), DC/AC coupling: Changeable Measurement items: Modulation accuracy, code domain power, amplitude, IQ level Modulation accuracy measurement Residual vector error: <2.0%(rms), typical 1.0%(rms) Input level: ≥0.1 V(rms), DC coupling IQ level measurement Level measurement: Measures input level of I and Q (rms, p-p) IQ phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q- phase signals.

∗1: Can be set when MS8609A-08 option is installed in the main frame.

• Option 01: Precision frequency reference

Frequency	10 MHz
Start-up characteristics	≤5 x 10^{-8}/7 min. (with the frequency at 24 hours after the power is turned on referenced)
Aging rate	≤±5 x 10^{-10}/day (with the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	≤±5 x 10^{-10} (with the frequency at 0 to 50˚C and 25˚C referenced)

• Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz), ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	When RBW is 1 Hz, RF ATT is 0 dB, sample detection mode ≤–146.5 dBm + 1.5 x f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–142.5 dBm + 1.5 x f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–138.5 dBm Typical (3.15 to 7.8 GHz, band 1) ≤–129.5 dBm Typical (7.7 to 13.2 GHz, band 2)

• Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW ≥100 Hz), ±10% Typical (RBW ≤30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW ≥100 Hz), ≤5:1 Typical (RBW ≤30 Hz) RBW switching uncertainty: ±0.5 dB
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level display	Without Option 08, when RBW is 10 Hz, RF ATT is 0 dB, sample detection mode ≤–136.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–128.5 dBm Typical (3.15 to 7.8 GHz, band 1) ≤–119.5 dBm Typical (7.7 to 13.2 GHz, band 2) With Option 08, when RBW is 10 Hz, RF ATT is 0 dB, sample detection mode ≤–134.5 dBm + 1.8 x f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + 1.8 x f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–128.5 dBm Typical (3.15 to 7.8 GHz, band 1) ≤–119.5 dBm Typical (7.7 to 13.2 GHz, band 2)

• Option 05: Rubidium reference oscillator

Frequency	10 MHz
Start-up characteristics	±1 x 10^{-9}/7 min. (with frequency one hour after the power is turned on referenced)
Aging rate	±1 x 10^{-10}/month (with frequency one hour after the power is turned on referenced)
Temperature characteristics	±1 x 10^{-9} (with frequency at 0 to 45˚C and 25˚C referenced)
Accessories	J1066 coaxial code 0.15 m (BNC211-LP4)

• Option 08: Pre-amplifier

Gain	20 dB typical
Noise figure	6.5 dB typical (input frequency: ≤2 GHz) ,12 dB (input frequency: >2 GHz)
Frequency	Frequency range: 100 kHz to 3 GHz Band 0: 100 kHz to 3.0 GHz, 1–: 3.15 to 6.3 GHz, 1+: 6.2 to 7.8 GHz, 2+: 7.7 kHz to 13.2 GHz *The band, which can use with a pre-amplifier, is only band 0.
Amplitude	Level measurement: Average noise level to +10 dBm Max. input level: +10 dBm Average noise level: –137 dBm + 2.0 x f [GHz] dB (1 MHz to 2.5 GHz, band 0) *At RBW 300 Hz, VBW 1 Hz, RF ATT 0 dB, and detection mode of SAMPLE Reference level Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 2.24 µV to 707 mV Reference level accuracy: ±0.90 dB (–69.9 to +10 dBm), ±1.50 dB (–90 to –70 dBm) *After calibration, with 50 MHz referenced, 1 MHz span (RF ATT, RBW, VBW, and sweep time are set to AUTO) RBW switching uncertainty: ±0.5 dB (300 Hz to 5 MHz), ±0.75 dB (10 MHz, 20 MHz) *After calibration, with RBW 3 kHz referenced RF ATT switching uncertainty: ±0.5 dB (10 to 50 dB), ±1.0 dB (52 to 62 dB) Frequency response: ±2.0 dB (100 kHz to 3 GHz) *With 100 MHz referenced, when RF ATT is 10 to 50 dB, and temperature is 18˚ to 28˚C Linearity of waveform display Log scale (after calibration): ±0.5 dB (0 to –20 dB, RBW ≤1 kHz), ±1.0 dB (0 to –60 dB, RBW ≤1 kHz), ±1.5 dB (0 to –75 dB, RBW ≤1 kHz) Linear scale (after calibration): ±5% (relative to reference level) Spurious response: Two-tone 3rd order distortion: ≤–70 dBc (10 MHz to 3 GHz) *Frequency difference of two signals ≥50 kHz, at pre-amplifier input level[*1] of –55 dBm 1 dB gain compression: ≥–35 dBm (input frequency ≥100 MHz) *At pre-amplifier input level[*1] Input impedance: VSWR ≤2.5 typical

*1: Pre-amplifier input level is shown by the following equation: Pre-amplifier input level = RF input level – RF ATT setting level

• Option 09: Ethernet interface

Function	Control with external controller (except for power switch)
Connector	10BASE-T

• Option 30: LPF for 2 GHz band carrier cut

Function	This is for suppression the distortion inside spectrum analyzer by the carrier wave (1.8 to 2 GHz) in W-CDMA low frequency band spurious measurement. *Option 08 cannot be installed simultaneously.
Frequency range	9 kHz to 3.2 GHz (LPF: OFF), 9 kHz to 1.0 GHz (LPF: ON)
LPF attenuation characteristics	≤–20 dB, –30 dB typical, at 1.8 to 2.2 GHz
Average noise level display	[LPF: ON] ≤–122 dBm + 2.0 x f [GHz] dB (1 MHz to 1.0 GHz, band 0) *RBW: 300 Hz, VBW: 1 Hz, RF ATT: 0 dB
Frequency response	[LPF: ON] ±1.0 dB (9 kHz to 1.0 GHz, band 0) *With 50 MHz referenced, when RF ATT is 10 dB, and temperature is 18˚ to 28˚C

• Option 31: Low noise floor

Function	This is used to decrease the floor noise in frequency band 2+.
Average noise level display	≤–112 dBm (7.7 to 13.2 GHz, band 2) *RBW: 300 Hz, VBW: 1 Hz, RF ATT: 0 dB

• Option 32: Maximum Input Level Extension

Function	The measurement level range is extended changed to +26 dBm
Max. input level	+30 dBm (1 W), continuous wave average power
Power meter function	Level range: –14 to +26 dBm
Spectrum analyzer amplitude	Setting range Log scale: –100 to +40 dBm or Equivalent level Linear scale: 22.4 µV to 22.4 V Reference level accuracy: ±0.75 dB (+0.1 to +30 dBm), ±0.5 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, with frequency 50 MHz when span 1 MHz (RF ATT, RBW, VBW, and sweep time set to AUTO)

• Option 33: High accuracy power measurement

Function	Power measurement accuracy is improved without using the internal power meter when MX860901A W-CDMA Measurement Software is used.
Frequency range	1848 to 2171 MHz (Except 1995 to 2105 MHz)
Transmission power measurement range	–50 dBm to +20 dBm (average power)
Reference level	–10 dBm to +20 dBm
Transmission power accuracy	±0.4 dB ∗At reference input level, 25° ±3°C, input ATT: AUTO, after calibration and except mismatch error
Power measurement linearity	±0.2 dB (0 to –40 dB) ∗Input level: ≥–10 dBm, at range optimization and no change of reference level setting.
Temperature coefficient	0.015 dB/°C
Accessories	ATA flash memory card
Calibration interval	Six months

• Option 46: Auto power recovery

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. ∗Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

• Option 47: Rack mount (IEC)

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

• Option 48: Rack mount (JIS)

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MS8609A	Digital Mobile Radio Transmitter Tester
	Standard accessories
	Power cord, 2.6 m: 1 pc
J0996	RS-232C cable: 1 pc
JT32MA3-NT1	PC-ATA card (32 MB): 1 pc
F0014	Fuse, 6.3 A: 1 pc
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m: 1 pc
MX268001A	File Transfer Utility: 1 pc
W1709AE	MS8608A/MS8609A operation manual (Vol. 1): 1 copy
W1744AE	MS8608A/MS8609A operation manual (Vol. 2): 1 copy
W1745AE	MS8608A/MS8609A operation manual (Vol. 3): 1 copy
	Options
MS8609A-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)
MS8609A-02	Narrow resolution bandwidth (FFT)
MS8609A-04	Digital resolution bandwidth
MS8609A-05	Rubidium reference oscillator
MS8609A-08	Pre-amplifier
MS8609A-09	Ethernet interface
MS8609A-30	LPF for 2 GHz band carrier cut
MS8609A-31	Low noise floor
MS8609A-32	Maximum input level extension
MS8609A-33	High accuracy power measurement
MS8609A-46	Auto-power recovery
MS8609A-47	Rack mount without handle (JIS)
MS8609A-48	Rack mount without handle (IEC)
MU860920A	Demodulation unit
	Measurement software
MX860901B	W-CDMA Measurement Software
MX860902A	GSM Measurement Software
MX860903A	cdma Measurement Software
MX860905A	π/4DQPSK Measurement Software
MX860904A	cdma2000® 1xEV-DO Measurement Software
MX860920A	BER/BLER Measurement Software (requires MU860920A)
MX860930A	Wireless LAN Measurement Software
MX860950A	HSDPA Measurement Software
W1746AE	MX860801A/B, MX860901A/B operation manual
W1795AE	MX860802A/MX860902A operation manual
W1865AE	MX860803A/MX860903A operation manual
W1866AE	MX860805A/MX860905A operation manual

Model/Order No.	Name
	Optional accessories
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127C	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 0.5 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
MA1612A	Four-Point Junction Pad (5 to 3000 MHz)
J0395	High-power fixed attenuator (30 dB, 30 W, DC to 9 GHz)
B0472	High-power fixed attenuator (30 dB, 100 W, DC to 18 GHz)
B0452A	Hard carrying case (with casters)
B0452B	Hard carrying case (without casters)
B0329G	Front cover (3/4 MW4U)
B0488	Rear panel protective pad
B0480	Tilt handle soft type
A3933	Circulator (1760 to 2115 MHz)
H3930	Isolator (1760 to 2115 MHz)
	Maintenance service
MS8609A-90	Extended three year warranty service
MS8609A-91	Extended five year warranty service

DIGITAL MOBILE RADIO TRANSMITTER TESTER

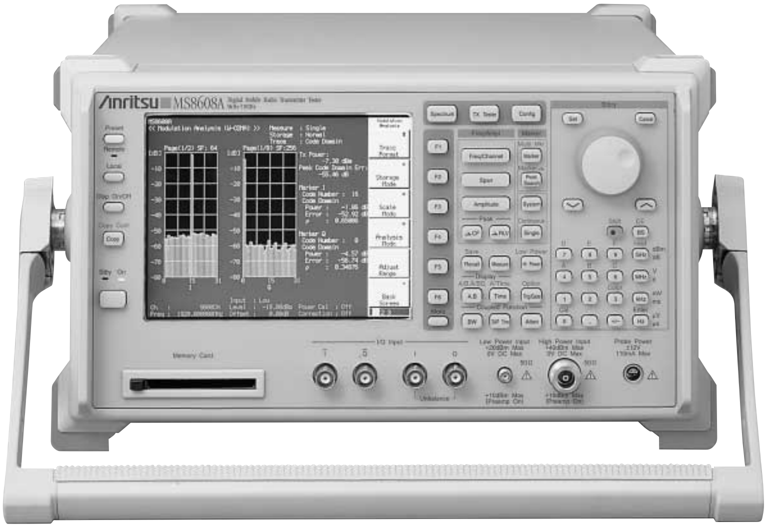
MS8608A

9 kHz to 7.8 GHz

GPIB

4

Transmitter Tester for W-CDMA 3GPP Specification



The MS8608A is a transmitter tester equipped with an internal spectrum analyzer, a modulation analyzer and a power meter. One tester covers the development to manufacturing of base stations, mobile stations and devices.
The spectrum analyzer has resolution bandwidths up to 20 MHz, meaning that it can readily support measurement of a 2 Mbit/s (16 Mcps) wide-band signal for IMT-2000.
The modulation analyzer realizes all Vector Signal Analysis (VSA) functions through high-speed DSP processing.
The power sensor can perform highly accurate power measurements of ±0.4 dB by using an amorphous power sensor.
Up to three dedicated measurement software options (such as W-CDMA and GSM/EDGE) can be installed simultaneously.
Input signals can be selected from either RF or I/Q inputs. For I/Q signals, balanced or unbalanced input can also be selected.
It is equipped with GPIB, RS-232C and 10 Base-T (optional) interfaces for remote measurement. High-speed GPIB data transmission of 120 kbyte/s enables high-speed measurement on the manufacturing line. The monitor uses an easy-to-see 6.5 type TFT color LCD.

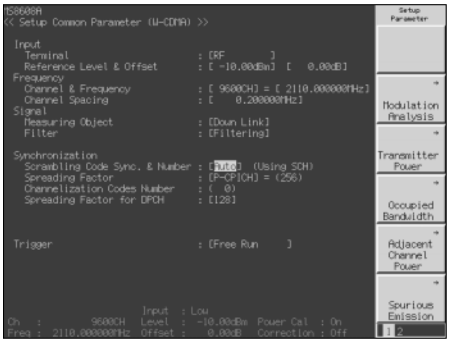
Feature

- Broadband signal support (up to IMT-2000 2 Mbit/s)

MX860801B W-CDMA Measurement Software

- **Parameter setup**

The measurement parameters such as modulation accuracy and code domain power, etc. are set on the screen shown below.
Measurement are simply performed via a soft-key menu after setting the measurement parameters.



```
MS8608A
<< Setup Common Parameter (W-CDMA) >>

  Input
    Terminal                        : [RF        ]
    Reference Level & Offset        : [ -10.00dBm]  [   0.00dB]
  Frequency
    Channel & Frequency             : [ 9600CH] = [ 2110.000000MHz]
    Channel Spacing                 : [    0.200000MHz]
  Signal
    Measuring Object                : [Down Link]
    Filter                          : [Filtering]

  Synchronization
    Scrambling Code Sync. & Number  : [Auto]  (Using SCH)
    Spreading Factor                : [P-CPICH] = (256)
    Channelization Codes Number     : (   0)
    Spreading Factor for DPCH       : [128]


  Trigger                           : [Free Run     ]



                             Input  : Low
 Ch   :        9600CH   Level  :  -10.00dBm  Power Cal   : On
 Freq :  2110.000000MHz Offset :    0.00dB   Correction : Off
```

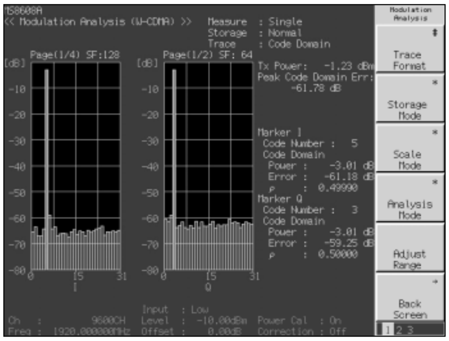
- **Base station code domain power**

Only 3 seconds are required for measurement. Either automatic detection of scrambling code from SCH, or specification of scrambling code can be selected.

- **Modulation accuracy measurement**

The modulation accuracy of base station and mobile equipment can be measured and modulation analysis of multiple waveforms can be performed. The residual EVM (rms) accuracy is high (1%, typical).

• Mobile terminal code domain power
Displays the code domain power measurement results of phase I and phase Q, separately. Either synchronization with DPCCH or specification of spreading factor and code can be selected.



<< Modulation Analysis (W-CDMA) >>
Measure : Single
Storage : Normal
Trace : Code Domain
Tx Power: -1.23 dBm
Peak Code Domain Err: -61.78 dB
Marker I
Code Number : 5
Code Domain
Power : -3.01 dB
Error : -61.18 dB
ρ : 0.49990
Marker Q
Code Number : 3
Code Domain
Power : -3.01 dB
Error : -59.25 dB
ρ : 0.50000
Input : Low
Ch : 9600CH
Level : -10.00dBm
Power Cal : On
Freq : 1920.000000MHz
Offset : 0.00dB
Correction : Off

• I/Q level measurement
Measures and displays each I and Q input voltage (rms, p-p value). dBmV or mV units are selectable.

• Spectrum analyzer function
This analyzer has a wide dynamic range and various useful measurement functions.

• Power meter function
The built-in power meter uses the amorphous power sensor and the measurement accuracy is very high (±0.4 dB).

<< Power Meter (W-CDMA) >>
Measure : Single
POWER : -1.35 dBm
--------- dB
0.733 mW
(Range : 0dBm)
Input : Low
Ch : 9600CH
Level : -10.00dBm
Freq : 1920.000000MHz
Offset : 0.00dB
Correction : Off

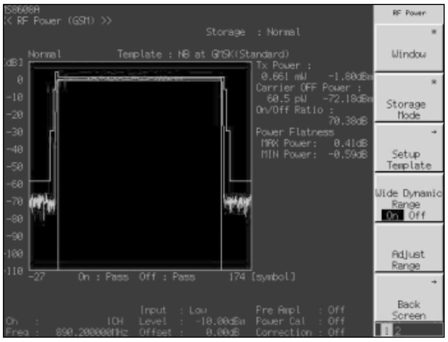
• Demodulation data monitoring
After de-spreading, up to 10 frames of I/Q data can be evaluated with external application software.

MX860802A GSM Measurement Software

• Parameter setup
The measurement parameters such as GMSK modulation of GSM and 8PSK modulation of EDGE are set on the screen.
Measurement are simply performed via a soft-key menu after setting the measurement parameters.

• Modulation accuracy measurement
The modulation accuracy is high. (The residual phase error of GMSK modulation: rms, <0.5° and residual EVM of 8PSK modulation: rms, <1.0%)

• Transmitter power measurement
The screen displays the amplitude waveforms with horizontal axis a symbol, vertical axis a level and the template simultaneously.



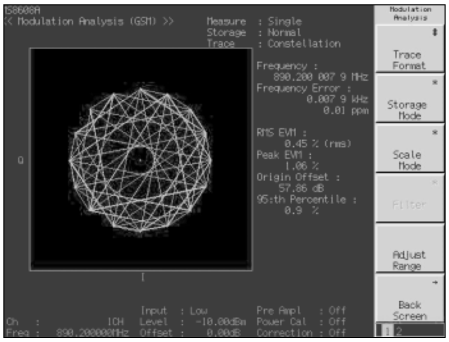
<< RF Power (GSM) >>
Storage : Normal
Normal
Template : NB at GMSK(Standard)
Tx Power : 0.661 mW -1.80dBm
Carrier OFF Power : 60.5 pW -72.18dBm
On/Off Ratio : 70.38dB
Power Flatness
MAX Power: 0.41dB
MIN Power: -0.59dB
On : Pass Off : Pass
Input : Low
Pre Ampl : Off
Ch : 1CH
Level : -10.00dBm
Power Cal : Off
Freq : 890.200000MHz
Offset : 0.00dB
Correction : Off

• Trellis display function
The screen displays the trellis and the modulation accuracy result simultaneously.

• Output RF spectrum measurement
The output RF spectrum measurement can be performed at high speed and simply.

• Spurious measurement
Spurious measurement has three kinds of method: Sweep, Search, and Spot. These can be selected depending on the usage.

• EDGE constellation display
The following screen represents constellation display of the 8PSK modulation through Nyquist filter and Gaussian inverse correction filter.



<< Modulation Analysis (GSM) >>
Measure : Single
Storage : Normal
Trace : Constellation
Frequency : 890.200 007 9 MHz
Frequency Error : 0.007 9 kHz 0.01 ppm
RMS EVM : 0.45 % (rms)
Peak EVM : 1.06 %
Origin Offset : 57.86 dB
95:th Percentile : 0.9 %
Input : Low
Pre Ampl : Off
Ch : 1CH
Level : -10.00dBm
Power Cal : Off
Freq : 890.200000MHz
Offset : 0.00dB
Correction : Off

Specifications

• MS8608A

Frequency range	9 kHz to 7.8 GHz, 9 kHz to 7.9 GHz (with option 35)
Max. input level	High-power input: +40 dBm (10 W), Low-power input: +20 dBm (100 mW)
Input impedance	High-power input 50 Ω, VSWR: ≤1.2 (≤3 GHz)/≤1.3 (>3 GHz) Low-power input Power meter: 50 Ω, VSWR: ≤1.3 (≤3 GHz) Except power meter: 50 Ω, VSWR: ≤1.5 (≤3 GHz)/≤2.0 (>3 GHz) ∗Input attenuator: ≥4 dB
Input connector	N-type (high-power input), SMA-type (low-power input), BNC-type (I/Q input)
I/Q input	Input: Balanced, unbalanced Input impedance: 1MΩ (parallel capacitance: <100 pF), 50 Ω Balanced input Differential Voltage: 0.1 to 1V(p-p), In-phase voltage ±2.5 V Unbalanced input: 0.1 to 1V(p-p), AC/DC switchable

Continued on next page

Reference oscillator		Frequency: 10 MHz Starting characteristics: ≤5 x 10^{-8} (compared to frequency after 24 hour warm-up characteristics after 10 minute warm-up) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (compared to frequency after 24 hour warm-up) Temperature characteristics: ≤5 x 10^{-8} (0° to 50°C, compared to frequency at 25°C)
Power meter		Frequency range: 30 MHz to 3 GHz Level range: 0 to +40 dBm (high-power input), –20 to +20 dBm (low-power input) Measurement accuracy (after zero calibration): ±10%
Spectrum analyzer	Frequency	Frequency setting Setting range: 9 kHz to 3.2 GHz (Band: 0), 3.15 to 7.8 GHz (Band: 1) *Setting resolution: 1 Hz Pre-selector range: 3.15 to 7.8 GHz (Band: 1) Frequency accuracy Display accuracy: ± (display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 Hz) Normal marker: Same as display frequency accuracy Delta marker: Same as span accuracy Frequency span setting range: 0 Hz, 5 kHz to 7.8 GHz Span accuracy: ±1.0% (at single band sweep) RBW (resolution bandwidth) Setting range: 300 Hz to 3 MHz (1-3 sequence), 5 MHz, 10 MHz, 20 MHz (Band 0) Accuracy: ±20% (300 Hz to 10 MHz) Selectivity (60 dB: 3 dB): ≤15:1 VBW (video bandwidth): 1 Hz to 3 MHz (1-3 sequence), off Sideband noise: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 100 kHz offset)
	Amplitude	Maximum input level Continuous average power: +40 dBm (high-power input), +20 dBm (low-power input) DC voltage: 0 V Average noise level (at RBW: 300 Hz, VBW: 10 Hz): [Without Option 08] ≤–104 dBm + 1.5 f [GHz] dB (high-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 1.5 f [GHz] dB (high-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 0.8 f [GHz] dB (high-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 20 dB) [With Option 08] ≤–102 dBm + 1.8 f [GHz] dB (high-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 1.8 f [GHz] dB (high-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 0.8 f [GHz] dB (high-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 20 dB) [Without Option 08] ≤–124 dBm + 1.5 f [GHz] dB (low-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 1.5 f [GHz] dB (low-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 0.8 f [GHz] dB (low-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 0 dB) [With Option 08] ≤–122 dBm + 1.8 [GHz] dB (low-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 1.8 f [GHz] dB (low-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 0.8 f [GHz] dB (low-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 0 dB) Residual response: ≤–80 dBm (high-power input, 1 MHz to 3.2 GHz, input attenuator: 20 dB) ≤–70 dBm (high-power input, 3.15 to 7.8 GHz, input attenuator: 20 dB) ≤–100 dBm (low-power input, 1 MHz to 3.2 GHz, input attenuator: 0 dB) ≤–90 dBm (low-power input, 3.15 to 7.8 GHz, input attenuator: 0 dB) Reference level Setting range: –80 to +50 dBm (high-power input), –100 to +30 dBm (low-power input) Accuracy (high-power input, after calibration): ±0.5 dB (–29.9 to +20 dBm), ±0.75 dB (–49.9 to –30 dBm, +20.1 to +40 dBm), ±1.5 dB (–60 to –50 dBm) Accuracy (low-power input, after calibration): ±0.5 dB (–49.9 to +0 dBm), ±0.75 dB (–69.9 to –50 dBm, +0.1 to +20 dBm), ±1.5 dB (–80 to –70 dBm) *Frequency: 50 MHz, span: 1 MHz (Input attenuator, RBW, VBW and sweep time are set to AUTO.) RBW switching uncertainty: ±0.3 dB (300 Hz to 5 MHz, referenced to RBW: 3 kHz) Input attenuator: 20 to 82 dB (high-power input), 0 to 62 dB (low-power input), 2 dB steps Frequency response: ±0.6 dB (9 kHz to 3.2 GHz, Band 0), ±1.0 dB (3.15 to 7.8 GHz, Band 1) *Referenced to 50 MHz, input attenuator: 30 dB (high power input)/10 dB (low power input), 18° to 28°C Log linearity: ±0.5 dB (0 to –20 dB, RBW: ≤1 kHz), ±1.0 dB (0 to –90 dB, RBW: ≤1 kHz) 2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, Band 0, mixer input: –30 dBm) ≤–75 dBc (200 to 850 MHz, Band 0, mixer input: –30 dBm) ≤–70 dBc (0.85 to 1.6 GHz, Band 0, mixer input: –30 dBm) ≤–90 dBc (1.6 to 3.9 GHz, Band 1, mixer input: –10 dBm) Two tone 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 7.8 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm 1 dB gain compression: ≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz)

Continued on next page

Spectrum analyzer	Sweep	Setting range: 10 ms to 1000 s (frequency axis sweep), 1 µs to 1000 s (time axis sweep) Trigger switch: Free-run, triggered Trigger source: Wide IF video, video, external (TTL level), external (±10 V), line Trigger delay Pre-trigger range: –time span to 0 s Resolution: time span/500 or 100 ns whichever is lager. Post trigger: 0 µs to 65.5 ms, Resolution: 100 ns (sweep time: ≤4.9 ms), 1 µs (sweep time: ≥5 ms) Gate sweep mode Gate delay range: 0 to 65.5 ms (resolution: 1 µs) Gate length range: 2 µs to 65.5 ms (resolution: 1 µs)
	Functions	Number of data points: 501 Detection modes: Normal, Positive peak, Negative peak, Sample, Average, rms (option 04) Display functions: Trace A, Trace B, Trace A/B, Trace A/BG, Trace A/Time Storage functions: Normal, View, Max hold, Min hold, Average, Cumulative, Overwrite Markers Signal search: Auto tune, Peak → CF, Peak → Ref, Scroll Zone markers: Normal, Delta Marker function: Marker → CF, Marker → Ref, Marker → CF step size, Δ marker → Span, Zone → Span Peak search: Peak, Next peak, Min dip, Next dip Multi-marker: 10 max. Measurements Noise power: dBm/Hz, dBm/ch, dBµV/$\sqrt{\text{Hz}}$ C/N: dBc/Hz, dBc/CH Occupied bandwidth: Power N% method, X-dB down method Adjacent channel power Reference measurement: Total power, reference level, in-band method Display methods: Channel specified display (3 channels x 2), graphic display Average power of burst signal: Average power within specified time range of time domain waveform Template comparison measurement (time sweep): Upper limit x 2, lower limit x 2 Mask measurement (frequency sweep): Upper limit x 2, lower limit x 2
Others		Display: Color TFT-LCD, VGA 6.5 type Hard copy: Hard copy of screen via parallel interface (ESC/P compatible printer) Memory card interface: ATA Flash card (3.3/5 V) GPIB: Can be controlled from external controller (except power switch) when specified as device Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Parallel interface: Centronics printer I/F, D-sub 25-pin connector (female) Video output: Analog RGB output, D-sub 15-pin connector (female)
Dimensions and mass		320 (W) x 177 (H) x 411 (D) mm (except handle, feet, front cover and fan cover), ≤16 kg (nominal)
Power		100 to 120/200 to 240 Vac (–15%/+10%, max. voltage: 250 V, automatic voltage selection), 47.5 to 63 Hz, ≤400 VA
Operating temperature and humidity		0˚ to 50˚C, ≤85% (no condensating)
EMC		EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD		EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

- **MX860801B W-CDMA measurement software**

Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on^{*1}) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) *Input level: ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on^{*1}), at 1 code channel Modulation accuracy (residual EVM): <2% (rms) *Input level: ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on^{*1}), at 1 code channel Origin offset accuracy: ±0.5 dB *Input level: ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), at 1 code channel, relative to signal with origin offset of –30 dBc Waveform display (for 1 CH to multi-channel) Constellation display, EVM vs. chip, amplitude error vs. chip, phase error vs. chip
Code domain analysis	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on^{*1}) Code domain power measurement accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) *Input level: ≥+10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (pre-amplifier: on^{*1}) Code domain error measurement Residual error: <–50 dB, Measurement accuracy: ±0.5 dB (at error of –30 dBc) *Input level: ≥+10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (pre-amplifier: on^{*1}), spread factor: 512 (down-link)/256 (up-link) Display function: Code domain power, code domain error Spread factor: 4 to 256 (up-link)/4 to 512 (down-link), I/Q separately displayed at up-link

Continued on next page

Amplitude measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on*1) Transmitter power measurement Measurement range: 0 to +40 dBm (average power, high-power input), –20 to +20 dBm (average power, low-power input), –20 to + 10 dBm (average power, low-power input, pre-amplifier: on*1) Accuracy: ±0.4 dB (calibrated at internal power meter) Power measurement linearity: ±0.2 dB (0 to –40 dB) *Input level: ≥+10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (pre-amplifier: on*1) , after the range adjusted, with the reference level setting unchanged Filter selection function: Power measurement through RRC (α = 0.22) filter Transmitter power control measurement function: Relative power per slot, NO/GO evaluation
Occupied bandwidth measurement	Frequency range: 50 MHz to 3 GHz Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on*1) Sweep mode: Displays result after signal measured with sweep spectrum analyzer FFT mode: Displays result after FFT
Adjacent channel power measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: +10 to +40 dBm (average power, high-power input), –10 to +20 dBm (average power, low-power input) Sweep method (all): Calculates and displays result after signal measured with sweep spectrum analyzer Sweep method (separate): Calculates and displays power after each adjacent channel measured with sweep spectrum analyzer Filter method: Measures and displays power of adjacent channels after passing via built-in receiving filters (RRC: α = 0.22) Measurement range Input level: +20 to +40 dBm (high-power input), 0 to +20 dBm (low-power input) ≥55 dBc (5 MHz offset), ≥62 dBc (10 MHz offset) *Filter method, wide dynamic range mode, 1 code channel ≥50 dBc (5 MHz offset), ≥60 dBc (10 MHz offset) *At 16 multi-code channel Input level: +10 to +40 dBm (high-power input), –10 to +20 dBm (low-power input) 55 dBc (5 MHz offset), 62 dBc (10 MHz offset) *Filter method, wide dynamic range mode, 1 code channel (typical) 50 dBc (5 MHz offset), 60 dBc (10 MHz offset) *At 16 multi-code channel (typical)
Spurious measurement	Measurement frequency: 9 kHz to 7.8 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): +20 to +40 dBm (average power, high-power input), 0 to +20 dBm (average power, low-power input) Measurement method [Sweep method] Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Spot method] Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Search method] Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range*2 [Carrier frequency: 1.8 to 2.2 GHz] ≥79 dB (RBW: 1 kHz, 9 to 150 kHz, Band 0), ≥79 dB (RBW: 10 kHz, 150 kHz to 30 MHz, Band 0), ≥79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) [Normal mode] ≥76 –f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0), ≥76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1) [Spurious mode (with option 03)] ≥76 dB (RBW: 1 MHz, 1.6 to 7.8 GHz, Band 1)
I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Residual vector error: <2% (rms) *Input level: ≥0.1 V (rms), DC coupling I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

*1: Can be set when MS8608A-08 option is installed in the main frame.
*2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

• MX860802A GSM measurement software

Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –20 to +40 dBm (average power within burst, high-power input) –40 to +20 dBm (average power within burst, low-power input) –60 to +10 dBm (average power within burst, low-power input, pre-amplifier: on*1) Carrier frequency accuracy: ±(reference oscillator accuracy + 10 Hz) *Input level (average power within burst: ≥–10 dBm (high-power input): ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on*1) Residual phase error (GMSK modulation): <0.5° (rms), <2.0° (peak) *Input level (average power within burst): ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on*1) Residual EVM (8PSK modulation): <1% (rms) Waveform display: Trellis (GMSK modulation), eye pattern, EVM vs. bit (8PSK modulation), phase vs. bit, amplitude vs. symbol, I/Q diagram
Amplitude measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –20 to +40 dBm (average power within burst, high-power input) –40 to +20 dBm (average power within burst, low-power input) –60 to +10 dBm (average power within burst, , low-power input, pre-amplifier: on*1) Transmitter power measurement (auto calibrated at internal power meter) Measurement range: +10 to +40 dBm (average power within burst, high-power input) –10 to +20 dBm (average power within burst, low-power input) –10 to +10 dBm (average power within burst, low-power input, pre-amplifier: on*1) Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –30 dBm) *Input level (average power within burst): +10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (low-power input, pre-amplifier: on*1), without changing the reference level setting after range optimization Carrier-off power measurement range [Input level (average power within burst)] +10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (low-power input, pre-amplifier: on*1) [Normal mode] ≥60 dB (compared with average power within burst) [Wide dynamic range mode] ≥80 dB (high-power input: 1 W, compared with 10 mW of average power within burst, low-power input) *Measurement limit is decided by average nose level (≤50 dBm, 50 MHz to 2.7 GHz). Rise/fall characteristics: Display rising/falling edges while synchronizing to modulation data of signal data to be measured. Standard line display possible (measured by 1 MHz bandwidth). NO/GO judgement function
Output RF spectrum measurement	Frequency range: 100 MHz to 2.7 GHz Input level: +10 to +40 dBm (average power within burst, high-power input) –10 to +20 dBm (average power within burst, low-power input) –20 to +10 dBm (average power within burst, low-power input, pre-amplifier: on*1) Modulation portion measurement range: ≥60 dB (≥200 kHz offset), ≥68 dB (≥250 kHz offset) *CW signal, RBW: 30 kHz (<1.8 MHz offset), RBW: 100 kHz (≥1.8 MHz offset) Transient portion measurement range: ≥63 dB (CW, ≥400 kHz offset)
Spurious measurement	Measurement frequency: 100 kHz to 7.8 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): +20 to +40 dBm (average power within burst, high-power input) 0 to +20 dBm (average power within burst, low-power input) Measurement method [Sweep method] Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Spot method] Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Search method] Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range [Carrier frequency: 0.8 to 1 GHz, 1.8 to 2 GHz] ≥72 dB (RBW: 10 kHz, 100 kHz to 50 MHz, Band 0), ≥72 dB (RBW: 100 kHz, 50 to 500 MHz, Band 0) [Normal mode] ≥66 –f [GHz] dB (RBW: 3 MHz, 0.5 to 3.15 GHz, Band 0, except harmonic frequency) ≥66 dB (RBW: 3 MHz, 3.15 to 7.8 GHz, Band 1) [Spurious mode (with option 03)] ≥66 dB (RBW: 3 MHz, 1.6 to 7.8 GHz, Band 1)

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I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, I/Q level Modulation accuracy Residual phase error: <0.5° (rms), DC coupling Residual EVM: <1.0% (rms), DC coupling ∗Input level: ≥0.1 V (rms), 18° to 28°C I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

∗1: Can be set when MS8608A-08 option is installed in the main frame.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MS8608A	Digital Mobile Radio Transmitter Tester
	Standard accessories
	Power cord, 2.6 m: 1 pc
J0996B	RS-232C cable: 1 pc
JT32MA3-NT1	PC-ATA card (32 MB): 1 pc
F0014	Fuse, 6.3 A: 1 pc
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m: 1 pc
MX268001A	File transfer utility: 1 pc
W1709AE	MS8608A/8609A operation manual (Vol. 1): 1 copy
W1744AE	MS8608A/8609A operation manual (Vol. 2): 1 copy
W1745AE	MS8608A/8609A operation manual (Vol. 3): 1 copy
	Options
MS8608A-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)
MS8608A-03	Extension of pre-selector lower limit (to 1.6 GHz)
MS8608A-04	Digital resolution bandwidth
MS8608A-05	Rubidium reference oscillator
MS8608A-08	Pre-amplifier (100 kHz to 3 GHz)
MS8608A-09	Ethernet interface
MS8608A-35	7.9 GHz frequency extension
MS8608A-46	Auto-power recovery
MS8608A-47	Rack mount without handle (IEC)
MS8608A-48	Rack mount without handle (JIS)
MU860820A	RER/BLER Measurement Software
	Measurement software
MX860801B	W-CDMA Measurement Software
MX860802A	GSM Measurement Software
MX860803A	cdma Measurement Software
MX860804A	cdma2000® 1xEV-DO Measurement Software
MX860805A	π/4DQPSK Measurement Software
MX860820A	BER/BLER Measurement Software (requires MU860820A)
MX860830A	Wireless LAN Measurement Software
MX860850A	HSDPA Measurement Software
W1746AE	MX860801B/860901B operation manual
W1795AE	MX860802A/860902A operation manual
	Optional accessories
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127C	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 0.5 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
MA1612A	Four-Way Junction Pad (5 to 3000 MHz)
J0395	High-power fixed attenuator (30 dB, 30 W, DC to 9 GHz)
B0472	High-power fixed attenuator (30 dB, 100 W, DC to 18 GHz)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0452A	Hard carrying case (with casters)
B0452B	Hard carrying case (without casters)
B0329G	Front cover (3/4MW4U)
B0488	Rear panel protective pad
B0480	Tilt handle soft type
A3933	Circulator (1760 to 2115 MHz)
H3930	Isolator (1760 to 2115 MHz)
	Maintenance service
MS8608A-90	Extended three year warranty service
MS8608A-91	Extended five year warranty service

DIGITAL MOBILE RADIO TRANSMITTER TESTER

MS8604A

100 Hz to 8.5 GHz

PTA GPIB

For Mobile Communications Systems Worldwide

Custom-made product

The MS8604A offers full test performance in a single unit capable of evaluating the major characteristics of transmitters used in digital mobile communication worldwide. Applicable systems are PDC, PHS, NADC, digital MCA, GSM, DCS1800 (PCN), CT2, DECT, WCPE, PACS, RCR STD-39 and TETRA. In addition, the MS8604A has GMSK and p/4 DQPSK universal analysis functions for analysis of the GMSK and p/4 DQPSK modulation signal. It covers frequencies from 100 Hz to 8.5 GHz and measures spurious emissions over a broad frequency range. It can also measure RF signals directly up to 10 W (average burst power), and baseband devices can be evaluated using its I/Q signal input function (option). The MS8604A is ideal for high-speed measurement of carrier frequency, modulation accuracy, antenna power, leakage power during carrier-off, transmission ramp-up and ramp-down power, and occupied bandwidth (adjacent channel power, spurious emissions, and signal transmission rate)* of digital mobile transmitters. In addition to measurements conforming to EIA/TIA, ETSI, RCR, and MKK standards, DSP (digital signal processing) and high-speed measurement functions based on a unique measurement algorithm combine to greatly reduce the time required for manufacturing and inspecting transmitters. PTA functions enabling free programming of test procedures are provided as a standard feature.

*: Measurement items depend on the measurement software. For details, refer to the specifications.

Features

- Major transmitter functions evaluated by a single system
- Compatible with NADC, PDC, PHS, Digital MCA, GSM, DCS1800 (PCN), CT2, DECT, WCPE, PACS, RCR STD-39 TETRA systems, and GMSK and π/4 DQPSK universal measurement (measurement software can be installed as an option)
- High-speed measurement (under 1 second for modulation-accuracy measurements)
- Input up to 10 W (internal 20 dB attenuator and power meter for high power levels)

Measurement example

• Quick configuration for different communication systems

Optional measurement software can be installed in the MS8604A. When these options are chosen, the communication system can be selected by pressing a single key.

• One-touch selection of measurement items

Measurement items can be selected by pressing a single key. The input connector (RF/IQ), maximum input power, and type of signal for measurement (uplink/downlink, channel number/frequency, frequency steps, synchronizing words) can be preset. In particular, synchronizing words can be predefined to any value. Measurement can be performed in either the single-measurement mode (one measurement performed each time key pressed) or in the automatic continuous repeat mode.

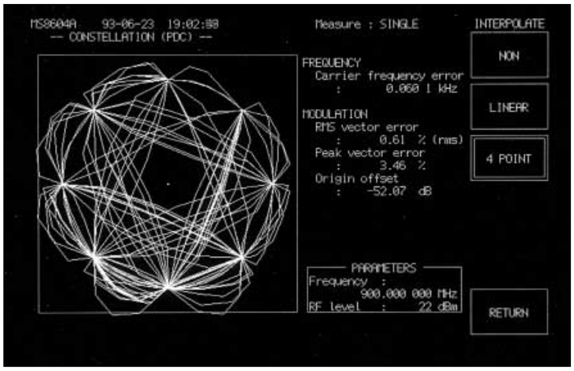
```
-- SETUP PARAMETER (PDC) --
INPUT       Terminal                 : RF
            RF level                 :  22 dBm
SIGNAL      Measuring object         : MS-COM
            (Ramp up symbol point =  2 , Number of symbols = 135)
            Channels per carrier     : 3 (FULL RATE)
FREQUENCY   Channel & Frequency      :    7 CH =   900.000 000 MHz
            Channel spacing          :    25.000 kHz
SYNC WORD   Pattern                  : S 1   = 785B4

Root-Nyquist filter                  : YES

TERMINAL = RF/I,Q-AC/I,Q-DC
```

• Measurement of frequency, modulation accuracy

Frequency and modulation accuracy (vector error, phase error) can be measured. The numerical display and modulation waveform (constellation etc.) are displayed simultaneously, providing an accurate visual representation of the modulation waveform.



```
MS8604A    93-06-23  19:02:00          Measure : SINGLE
  -- CONSTELLATION (PDC) --
                                FREQUENCY
                                  Carrier frequency error
                                     :        0.060 1 kHz
                                MODULATION
                                  RMS vector error
                                     :       0.61  % (rms)
                                  Peak vector error
                                     :       3.46  %
                                  Origin offset
                                     :     -52.07  dB

                                 ------ PARAMETERS ------
                                 Frequency   :
                                       900.000 000 MHz
                                 RF level    :    22 dBm
```

- **Direct measurement with broadband power sensor**

The tester has a high-performance power meter comparable to the Anritsu ML4803A. A broadband amorphous-element power sensor is coupled directly for high-precision measurement.

- **Internal calibration signal**

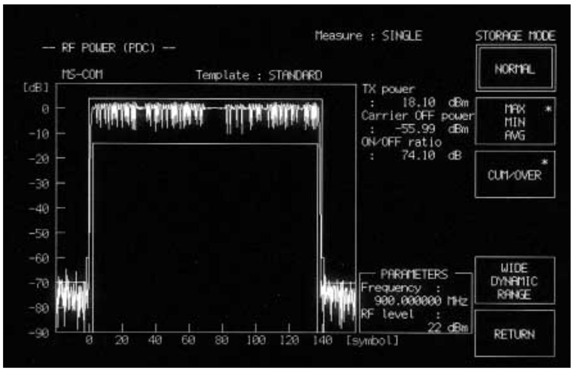
An internal 1 mW calibration signal is provided for calibrating the sensitivity of the power sensor automatically by pressing the CAL ADJUST key.

- **High-power measurements**

Antenna power up to 10 W max (burst average power) can be measured directly using the internal high-power attenuator. This high-power attenuator is pre-calibrated for accurate measurement of transmitter power levels.

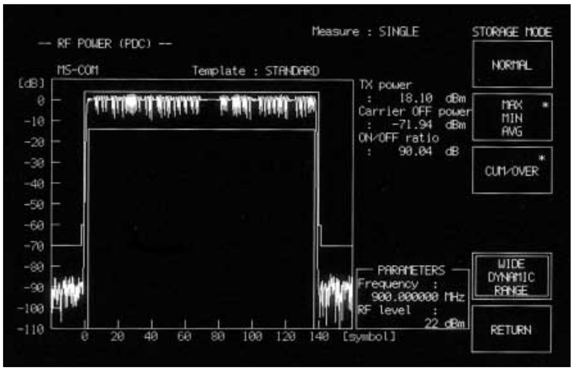
- **Measurement of antenna power and leakage power during carrier-off**

At measurement of burst signal antenna power, the power-on intervals are auto-detected based on the modulated wave, so an external synchronization trigger is not needed. In addition, the average power during power-on intervals is automatically matched to a template value, simplifying measurement automation. Any template can be set, and three types can be stored. The leakage power during carrier-off can be measured as either an absolute value or as an on/off ratio. When the carrier-off power is low, measurements can be performed in a wide-dynamic-range mode (during single-mode measurements with synchronizing word).



— RF POWER (PDC) —
MS-COM
Measure : SINGLE
Template : STANDARD
TX power : 18.10 dBm
Carrier OFF power : -55.99 dBm
ON/OFF ratio : 74.10 dB
PARAMETERS
Frequency : 900.000000 MHz
RF level : 22 dBm

Normal mode (PDC)



— RF POWER (PDC) —
MS-COM
Measure : SINGLE
Template : STANDARD
TX power : 18.10 dBm
Carrier OFF power : -71.94 dBm
ON/OFF ratio : 90.04 dB
PARAMETERS
Frequency : 900.000000 MHz
RF level : 22 dBm

Wide dynamic range mode (PDC)

- **Application software**

The application software extends the analysis function of the MS8604A by using PTA (Personal Test Automation) functions. The application software provides sophisticated analysis of digital modulation signals. The MX3512A uses π/4 DQPSK analysis software. The MX3513A uses M16QAM analysis software. The MX3518A/3519A/3520A are adjacent channel power and spurious measurement software for GSM, DCS1800 (PCM), DECT, and CT2 systems.

Applicable system	Measurement software	Application software (supplied by PMC)
PDC	Option 11	MX3512A
PHS	Option 12	
NADC	Option 13	
Digital MCA	Option 14	MX3513A
GSM	Option 15	MX3518A
DCS1800 (PCN)		
DECT		MX3519A
CT2		MX3520A
General-purpose GMSK		–
WCPE	Option 16	–
RCR STD-39		
PACS		
TETRA		
General-purpose π/4 DQPSK		

Specifications

- **MS8604A**

General	Frequency range	100 Hz to 8.5 GHz
	Max. input level (continuous wave average power)	+40 dBm (10 W)
	Reference oscillator	Frequency: 10 MHz Starting characteristics: ≤5 x 10^{-8}/day (option: ≤2 x 10^{-8}/day after 30 min. warm-up) *After 10 min. of warm-up, compared to the frequency after 24-hour warm-up Aging rate: ≤2 x 10^{-8}/day (option: ≤5 x 10^{-9}/day), ≤1 x 10^{-7}/year (option: ≤5 x 10^{-8}/year) *Compared to the frequency after 24-hour warm-up Temperature characteristics: 5 x 10^{-8} (option: 3 x 10^{-8}) *0° to 50°C, relative to the frequency at 25°C
Spectrum analyzer	Frequency	Setting range: 100 Hz to 8.5 GHz (resolution: 1 Hz), 0 to 2 GHz (freq. band: 0), 1.7 to 7.5 GHz (freq. band: 1–), 6.5 to 8.5 GHz (freq. band: 1+) Preselector range: 1.7 to 8.5 GHz (bands: 1–/1+) Display accuracy: ± (display freq. x reference freq. accuracy + span x span accuracy) Span Setting range: 0 Hz, 100 Hz to 8.5 GHz Accuracy: ±2.5% (span ≥1 kHz), ±5% (100 Hz ≤span <1 kHz) RBW Setting range: 10 Hz to 3 MHz (3 dB), 1-3 sequence Accuracy: ±20% Selectivity (60/3 dB); ≤15:1 (100 kHz to 3 MHz), ≤12:1 (10 Hz to 30 kHz) VBW: 1 Hz to 3 MHz, off, 1-3 sequence Signal purity (SSB, 1 MHz to 4 GHz): ≤–100 dBc/Hz (10 kHz offset), ≤–115 dBc/Hz (50 kHz offset), ≤–120 dBc/Hz (100 kHz offset)

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Spectrum analyzer	Amplitude	Level measurement	Level measuring range: Average noise level to +40 dBm Average noise level: ≤–112 dBm (10 MHz to 8.5 GHz, RBW 10 Hz, VBW 1 Hz, input att. setting 20 dB) Residual response: ≤–75 dBm (1 MHz to 8.5 GHz, input att. setting 20 dB)
		Reference level	Setting range: –80 to +40 dBm Accuracy: ±0.5 dB (–30 to +20 dBm), ±0.75 dB (–40 to –30 dBm, +20 to +40 dBm), ±1.5 dB (–60 to –40 dBm) *After calibration and at freq. 100 MHz, span ≤2 MHz, and in auto mode for input att., RBW, VBW and sweep time settings RBW switching error (after calibration): ±0.3 dB (RBW: ≤300 kHz), ±0.7 dB (RBW: ≥1 MHz) LOG/LIN switching error: ±0.3 dB (after calibration) Input attenuator Setting range: 20 to 75 dB in 5 dB steps Switching error: ±0.3 dB (referred to input att. 30 dB, at 100 MHz)
		Frequency response	±0.5 dB (100 MHz to 2 GHz, band: 0), ±1 dB (1.7 to 8.5 GHz, bands: 1–/1+) *Referred to at 100 MHz, input att. 30 dB, temperature 18° to 28°C (after tuning preselector at bands 1–/1+)
		Linearity (after calibration)	LOG: ±0.3 dB (0 to –20 dB, RBW: ≤1 MHz), ±1 dB (0 to –60 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –80 dB, RBW: ≤10 kHz) LIN: ±5% (to reference level)
		Dynamic range	2nd harmonics: ≤–70 dBc (5 to 800 MHz, band: 0, mixer input level: –30 dBm), ≤–80 dBc (800 to 850 MHz, band: 0, mixer input level: –30 dBm), ≤–90 dBc (850 MHz to 2.1 GHz, bands: 1–, mixer input level: –10 dBm) Two-signal third-order intermodulation distortion: ≤–70 dBc (10 to 50 MHz), ≤–85 dBc (50 MHz to 2.1 GHz) *Frequency difference between two signals ≥50 kHz, mixer input level: –30 dBm
		Spurious	Image response: ≤–70 dBc Multiple-response: ≤–70 dBc (bands: 1–/1+)
		Sweep	Sweep time Setting range: 20 ms to 1000 s (TRACE-FREQ., data points: NORMAL), 50 ms to 1000 s at other conditions Accuracy: ±10% (20 ms to 200 s), ±15% (200 to 1000 s) Sweep mode: CONTINUOUS, SINGLE Trigger: FREE RUN, TRIGGERED Trigger source: VIDEO, LINE, EXT (±10 V), EXT (TTL) Gate mode (OFF, random sweep mode) GATE DELAY: 0 to 65.5 ms (in 1 µs steps) GATE LENGTH: 20 µs to 65.5 ms (in 1 µs steps, GATE END: INT) GATE END: INT/EXT
		Time domain waveform display	Sweep time: 50, 100 to 900 µs (data point: NORMAL, One most significant digit can be set.) 1 ms to 1000 s (data point: NORMAL, Two most significant digits can be set.) 100, 200 to 800 µs (data point: DOUBLE, One most significant digit can be set as even number.) 1 ms to 1000 s (data point: DOUBLE, Two most significant digits can be set as even number.) Delay time Pre-trigger: –time span to 0 s (in 1 point steps) Post trigger: 0 to 65.5 ms (in 1 µs steps) Amplitude display resolution: 50 µs to 49 ms, 10 bits (0.1% of full scale) 50 ms to 1000 s, 14 bits (0.01% of full scale)
		Detection mode	POS PEAK, SAMPLE, NEG PEAK
		Number of points	NORMAL: 501 points, DOUBLE: 1002 points
		AM/FM demodulation	Demodulated waveform display and monitoring demodulated audio signal with internal speaker
		Auxiliary inputs/ outputs	IF output 21.4 MHz: –10 dBm ±2 dB (at top of screen, with output terminated by 50 Ω terminator), BNC connector Y output: 0 to 0.5 V ±0.1 V (at range between top and bottom of screen, LOG: 10 dB/div., LIN: 10%/div., 100 MHz and with output terminated by 75 Ω terminator), BNC connector External trigger input Input 1: Max. ±10 V (in 0.1 V steps, rising/falling edges selectable and pulse width ≥10 µs), BNC connector Input 2: TTL level (rising/falling edges selectable and pulse width ≥10 µs), BNC connector
Power meter	Frequency range		100 kHz to 5.5 GHz
	Level range		–20 to +20 dBm
	Instrumentation accuracy		±0.5%
	Zero set		±0.5% of full scale at most sensitive range (100 µW range)
	Zero shift between ranges		±0.2% of full scale zero setting at most sensitive range
	Calibration oscillator		Freq: 50 MHz, Output: 1.00 mW, Accuracy: ±1.2%
	Applicable power sensor		MA4601A

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Others	Display		640 x 400 dot, 9-inch EL
	Inputs/outputs on rear panel		Reference input: 10 MHz ±10 Hz, 2 to 5 Vp-p, ≥50 Ω, BNC connector Reference buffer output: 10 MHz, 2 to 3 Vp-p (with the output terminated by 200 Ω terminator), BNC connector Separate video output: Compatible with 8-pin DIN connector
	External memory		One slot for can be connected.
	Save/recall		Internal memory (4 sets of spectrum and Tx test conditions), can save/recall setting conditions at external memory (PMC)
	Direct plotting		Can hard-copy screen via GPIB 2
	External control	GPIB 1 (IEEE 488.2)	As device controlled by host, all functions except power switch Controls other instruments as controller using PTA SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0 (C1, C2, C3 and C24 with PTA)
		GPIB 2 (IEEE 488.1)	Controls other instruments as controller SH1, AH1, T6, L4, SR0, RL0, PP0, DC0, DT0, C1, C2, C3, C4, C28
		I/O port	Output port A/B: 8-bit (TTL level), Input/Output port C/D: 4-bit (TTL level), Exclusive port: 3-bit (TTL level) Control signal: 4 (TTL level), +5 V output: Max. 50 mA
		RS-232C (Option 02)	Controls other instruments as controller
	PTA	Language	PTL: High level language interpreter based on BASIC
		Programming	Using external keyboard
		Program memory	On PMC or FD Upload/download from/to PC
		Programming capacity	900 KB
Operating temperature			0° to 50°C
Power			85 to 132/170 to 250 Vac, 47.5 to 63 Hz, ≤500 VA
Dimensions and mass			426 (W) x 221.5 (H) x 451 (D) mm, ≤27 kg

• Option 11: Measurement software (for PDC)

The following specifications are guaranteed if the internal level is optimized using the auto range of the MS8604A calibration function.

Modulation/ frequency measurement	Frequency range	400 kHz to 2.1 GHz
	Input level	–10 to +40 dBm (average power of burst signal) *When using the low power input connector, measurement to levels 20 dB lower than the above values is possible.
	Frequency accuracy	± (accuracy of reference oscillator +1 Hz)
	Modulation accuracy	± (2% of indicated value +0.5%)
	Origin offset accuracy	±0.5 dB to signal level of –30 dBc
	Transmission rate accuracy	±1 ppm
	Measuring range of transmission rate	42 kbps ±100 ppm
	Waveform display	Constellation display
	Measurement time	≤1 s(except transmission rate measurement), ≤3 s(transmission rate measurement)
Amplitude measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Transmission power accuracy	±10% (using high power input after calibration with MA4601A Power Sensor)
	Carrier-off power	Measurement range in Normal mode: ≥65 dB (to average power of burst signal) Average noise level in Wide dynamic range mode: ≤–60 dBm (100 MHz ≤frequency ≤2.1 GHz) *Measurement range is ≥95 dB for 3 W input level of average power of burst signal.
	Rise/fall edge characteristic	Display rising/falling edges while synchronizing with modulation characteristics data of measured signal
	Measurement time	≤1 s
	Impedance	50 Ω (VSWR: ≤1.2)
Occupied bandwidth measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Standard mode (spectrum analyzer mode)	Measurement: Displays results of occupied bandwidth measurement after measuring signal with spectrum analyzer Measurement time: Approx. 12 s in full rate when number of data points set to Normal
	High-speed mode	Measurement: Displays results of occupied bandwidth measurement after FFT of measured signal Measurement time: ≤1 s

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Adjacent channel power	Frequency range	100 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Measurement	Standard mode: Displays results of leakage power of adjacent channel measurement after measuring signal with spectrum analyzer; measurement time: approx. 13 s when number of data points set to Normal-All High-speed mode: Displays results of leakage power of adjacent channel measured after passing signal through internal root-Nyquist filter; measurement time: ≤1.5 s
	Measurement range	Standard mode: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset) High-speed mode: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset) *Ratio of average power of burst signal to average value of leakage power of adjacent channel at burst-on time
Spurious measurement	Frequency range	10 MHz to 8.5 GHz (except frequency range ±1 MHz of carrier frequency)
	Input level range (transmission power)	+10 to +40 dBm (average power of burst signal)
	Measurement range	≥65 dB (10 MHz to 1.7 GHz), ≥75 dB (1.7 to 8.5 GHz) *At carrier frequency range 800 MHz to 1.7 GHz
I/Q input (Option 03)		Input level range: 0.3 to 1.5 Vp-p Input impedance: 5 kΩ, AC/DC coupling (switchable) Measurement items: Modulation, amplitude, occupied bandwidth

- **Option 12: Measurement software (for PHS)**

The following specifications are guaranteed if the internal level is optimized using the auto range of the MS8604A calibration function.

Modulation/ frequency measurement	Frequency range	10 MHz to 2.1 GHz
	Input level	–10 to +40 dBm (average power of burst signal) *When using the low power input connector, measurement to levels 20 dB lower than the above values is possible.
	Frequency accuracy	± (accuracy of reference oscillator +10 Hz)
	Modulation accuracy	± (2% of indicated value +0.7%)
	Origin offset accuracy	±0.5 dB to signal level of –30 dBc
	Transmission rate accuracy	±1 ppm
	Measuring range of transmission rate	384 kbps ±100 ppm
	Waveform display	Constellation display
	Measurement time	≤1 s (except transmission rate measurement), ≤2 s (transmission rate measurement)
Amplitude measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Transmission power accuracy	±10% (using high power input after calibration with MA4601A Power Sensor)
	Carrier-off power	Measurement range in Normal mode: ≥55 dB (to average power of burst signal) Average noise level in Wide dynamic range mode: ≤–50 dBm (100 MHz ≤frequency ≤2.1 GHz) *Measurement range is ≥69 dB for 80 mW input level of average power of burst signal.
	Rise/fall edge characteristics	Display rising/falling edges while synchronizing with modulation data of measured signal
	Measurement time	≤1 s
	Impedance	50 Ω (VSWR: ≤1.2)
Occupied bandwidth measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Standard mode (spectrum analyzer mode)	Measurement: Displays results of occupied bandwidth measurement after measuring signal with spectrum analyzer Measurement time: Approx. 4 s when number of data points of spectrum analyzer set to Normal
	High-speed mode	Measurement: Displays results of occupied bandwidth measurement after FFT of measured signal Measurement time: ≤1 s
Adjacent channel power	Frequency range	100 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Measurement	Standard mode: Displays results of leakage power of adjacent channel measurement after measuring signal with spectrum analyzer; measurement time: approx. 5 s when number of data points set to Normal-All High-speed mode: Displays results of leakage power of adjacent channel measured after passing signal through internal root-Nyquist filter; measurement time: ≤1.5 s
	Measurement range	Standard mode: ≥60 dB (600 kHz offset), ≥60 dB (900 kHz offset) High-speed mode: ≥60 dB (600 kHz offset), ≥60 dB (900 kHz offset) *Ratio of average power of burst signal to average value of leakage power of adjacent channel at burst-on time
Spurious measurement	Frequency range	10 MHz to 8.5 GHz (except frequency range ±50 MHz of carrier frequency)
	Input level range (transmission power)	+10 to +40 dBm (average power of burst signal)
	Measurement range	≥60 dB (10 MHz to 1.7 GHz), ≥70 dB (1.7 to 8.5 GHz) *At carrier frequency range 800 MHz to 2 GHz
I/Q input (Option 03)		Input level range: 0.3 to 1.5 Vp-p Input impedance: 5 kΩ, AC/DC coupling (switchable) Measurement items: Modulation, amplitude, occupied bandwidth

• Option 13: Measurement software (for NADC)

The following specifications are guaranteed optimizing the internal level using the auto range of the MS8604A calibration function.

Modulation/ frequency measurement	Frequency range	400 kHz to 2.1 GHz
	Input level	–10 to +40 dBm (burst average power) ∗When using the low power-input connector, measurement to levels 20 dB lower than the above values is possible.
	Frequency accuracy	± (accuracy of reference oscillator +1 Hz)
	Modulation accuracy	± (2% of indicated value +0.5%)
	Origin offset accuracy	±0.5 dB to signal level of –30 dBc
	Transmission rate accuracy	±1 ppm
	Measuring range of transmission rate	48.6 kbps ±100 ppm
	Waveform display	Constellation display
	Measurement time	≤1 s (except transmission rate measurement), ≤3 s (transmission rate measurement)
Amplitude measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Transmission power accuracy	±10% (using high-power input after calibration with MA4601A Power Sensor)
	Carrier-off power	Measurement range in Normal mode: ≥65 dB (to average power of burst signal) Average noise level in Wide dynamic range mode: ≤–60 dBm (100 MHz ≤frequency ≤2.1 GHz) ∗Measurement range is ≥96 dB for +36 dBm input level of average power of burst signal.
	Rise/fall edge characteristics	Display rising/falling edges while synchronizing with modulation data of measured signal
	Measurement time	≤1 s
	Impedance	50 Ω (VSWR: ≤1.2)
Occupied bandwidth measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Standard mode (spectrum analyzer mode)	Measurement: Displays results of occupied bandwidth measurement after measuring signal with spectrum analyzer Measurement time: Approx. 12 s in full rate when number of data points set to Normal
	High-speed mode	Measurement: Displays results of occupied bandwidth measurement after FFT of measured signal Measurement time: ≤1 s
Adjacent channel power	Frequency range	100 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Measurement	Standard mode: Displays results of leakage power of adjacent channel measurement after measuring signal with spectrum analyzer; measurement time: approx. 13 s when number of data points set to Normal-All High-speed mode: Displays results of leakage power of adjacent channel measured after passing signal through internal root-Nyquist filter; measurement time: ≤2 s
	Measurement range	High-speed mode: ≥30 dB (30 kHz offset), ≥60 dB (60 kHz offset), ≥65 dB (90 kHz offset) ∗Ratio of average power of burst signal to average value of leakage power of adjacent channel at burst-on time
Spurious measurement	Frequency range	10 MHz to 8.5 GHz (except frequency range ±1 MHz of carrier frequency)
	Input level range (transmission power)	+10 to +40 dBm (average power of burst signal)
	Measurement range	≥65 dB(10 MHz to 1.7 GHz), ≥75 dB (1.7 to 8.5 GHz) ∗At carrier frequency range 800 MHz to 1.7 GHz
I/Q input (Option 03)		Input level range: 0.3 to 1.5 Vp-p Input impedance: 5 kΩ, AC/DC coupling (switchable) Measurement items: Modulation, amplitude, occupied bandwidth

• Option 14: Digital MCA measurement software (for Digital MCA)

The following specifications are guaranteed if the internal level is optimized using the auto range of the MS8604A calibration function.

Maximum input level		10 W (average power), 50 W (peak power: ≤1 ms)
Modulation/ frequency measurement	Frequency range	400 kHz to 2.1 GHz
	Input level range	–10 to +40 dBm (average power of burst signal) ∗When using the low power input connector, measurement to levels 20 dB lower than the above is possible.
	Carrier frequency (phase trace method)	Accuracy: ± (accuracy of reference oscillator +5 Hz)
	Modulation accuracy	Accuracy: ±3% (normal slot), ±4% (sub slot)
	Transmission rate	Range: ±100 ppm, Accuracy: ±2 ppm (normal slot)
	Waveform display	Constellation display
	Measurement time	≤2 s (except transmission rate measurement), ≤10 s (transmission rate measurement)
Amplitude measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Antenna power measurement	Accuracy: ±10% (using high power input connector after calibration with MA4601A Power Sensor)
	Leakage power at carrier-off	Measurement range in Normal mode: ≤55 dB Average noise level in Wide dynamic range mode: ≤–60 dBm (100 MHz ≤frequency ≤2.1 GHz)
	Amplitude waveform display	Displays amplitude waveform while synchronizing with modulation data (synchronous symbol) of measured signal Display time: 108 ms (displays frame), 18 ms (displays slot), 3.6 ms (displays rising/falling)
	Measurement time	≤2 s
	Impedance	50 Ω, VSWR: ≤1.2

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Occupied frequency bandwidth measurement	Frequency range	10 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm (average power of burst signal)
	Measurement method	Standard mode: Displays results of occupied bandwidth measurement after measuring signal with spectrum analyzer; measurement time: approx. 50 s High speed mode: Displays results of occupied bandwidth measurement after FFT of measured signal; measurement time: ≤1 s
Adjacent channel power	Frequency range	100 MHz to 2.1 GHz
	Input level range	+10 to +40 dBm
	Measurement method	Standard mode: Displays results of leakage power of adjacent channel measurement after measuring signal with spectrum analyzer; measurement time: approx. 50 s High speed mode: Displays results of leakage power of adjacent channel measurement after measuring signal passed through internal filter (bandwidth: 18 kHz); measurement time: ≤2 s
	Measurement range	High-speed mode: Ratio of average power of burst signal to value of leakage power of adjacent channel at burst-on time ≤58 dB (standard mode, high speed mode)
Spurious measurement	Frequency range	10 MHz to 8.5 GHz (except frequency range ±1 MHz of carrier frequency)
	Input level range (transmission power)	+10 to +40 dBm (burst average power)
	Measurement range	≤65 dB (10 MHz to 1.7 GHz), ≤75 dB (1.7 to 8.5 GHz) *For carrier frequency range 850 MHz to 1.7 GHz
I/Q input (Option 03)		Input level range: 0.3 to 1.5 Vp-p Input impedance: 5 kΩ, AC/DC coupling (switchable) Measurement items: Modulation, amplitude, occupied bandwidth

- **Option 15: Measurement software (for GMSK)**

The following specifications are guaranteed if the internal level is optimized using the auto range of the MS8604A calibration function.

Maximum input level		+40 dBm
General GMSK	Frequency	10 MHz to 3 GHz
	Input level	–10 to +40 dBm (high power input), –30 to +20 dBm (low power input)
	Setting	Bit rate: 100 bps to 1.25 Mbps (resolution: 0.1 bps) BT: 0.2 to 1.0 (bit rate: 100 bps to 160 kbps), 0.2 to 0.5 (bit rate: 160 kbps to 1.25 Mbps) Analysis bit number: 50 to 1000 bits Frame length: Analysis bit number – 4000 bits (continuous signal), (analysis bit number x 2) – 4000 bits (burst signal) Measurement signal: Continuous signal, burst signal
	Modulation/frequency measurement (phase trace method)	Measurement item: Carrier frequency, phase error Waveform display: Eye pattern, trellis, phase error vs. bit number, amplitude error vs. bit number, I/Q diagram
	Amplitude measurement	Measurement item: Transmission power (average power of burst signal) Waveform: Displays amplitude waveform while synchronizing with modulation data (rise/fall, slot, and frame changeable) Impedance: 50 Ω, VSWR: ≤1.2 (high power input connector)
	FM deviation measurement	Measurement item: Maximum frequency deviation Waveform: FM demodulation waveform (continuous demodulation or eye pattern changeable), display range = standard frequency deviation x 2
	Occupied bandwidth measurement	Displays results of occupied bandwidth measurement (99%) after FFT of measurement signal
GSM, DCS1800 (PCN)	Modulation/frequency measurement (phase trace method)	Frequency: 10 MHz to 2.1 GHz Input level: –10 to +40 dBm (high power input), –30 to +20 dBm (low power input) Carrier frequency measurement accuracy: ±(reference oscillator accuracy +10 Hz) Phase error measurement (residual phase error): ≤0.5° rms, ≤2° peak Waveform display: Eye pattern, trellis, phase error vs. bit number, amplitude error vs. bit number, I/Q diagram Measurement time: ≤1 s (measured at mobile station), ≤1 s (measured at base station)
	Amplitude measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Transmission power measurement accuracy: ±0.4 dB (±10%) *After calibration using MA4601A Power Sensor, at high power input connector; linearity: +0.3 dB (at 0 to –30 dB) Leakage power during carrier-off Measurement range in Normal mode: ≥55 dB (ratio between transmission power and average noise level) Average noise level in Wide dynamic range mode: ≤–50 dBm (100 MHz ≤frequency ≤2.1 GHz, at high power input) Waveform: Displays amplitude waveform while synchronizing with modulation data Measurement time: ≤1 s (measured at mobile station), ≤2 s (measured at base station)
	FM deviation measurement	Same as general GMSK measurement
	Occupied bandwidth measurement	Same as general GMSK measurement
	Output RF spectrum	Available, combined with the MX3518A
	Spurious emissions	Available, combined with the MX3518A

Continued on next page

DECT	Modulation/frequency measurement (phase trace method)	Same as general GMSK measurement
	Amplitude measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Transmission power measurement accuracy: ±0.4 dB (±10%) *After calibration using MA4601A Power Sensor, at high power input connector; input level: ≥+15 dBm Leakage power during carrier-off Measurement range in Normal mode: ≥50 dB (ratio between transmission power and average noise level) Average noise level in Wide dynamic range mode: ≤–45 dBm (100 MHz ≤frequency ≤2.1 GHz, at high power input) Waveform: Displays amplitude waveform while synchronizing with modulation data Measurement time: ≤2 s (except for double slot measurement)
	FM deviation measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Maximum frequency deviation: Measurement of section specified by marker Residual FM: ≤±5 kHz peak Average frequency measurement: Measurement of section specified by marker Waveform: FM demodulation waveform (continuous demodulation or eye pattern changeable) Measurement time: ≤2 s (except for double slot measurement)
	Occupied bandwidth Measurement	Same as general GMSK measurement
	Emissions due to modulation	Available, combined with the MX3519A
	Emissions due to transmitter transients	Available, combined with the MX9516A
	Spurious emissions	Available, combined with the MX9516A
CT2	Modulation/frequency measurement (phase trace method)	Same as general GMSK measurement
	Amplitude measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Transmission power measurement accuracy: ±0.4 dB (±10%) *After calibration using MA4601A Power Sensor, at high power input connector Leakage power during carrier-off Measurement range in Normal mode: ≥60 dB (ratio between transmission power and average noise level) Average noise level in Wide dynamic range mode: ≤–50 dBm (100 MHz ≤frequency ≤2.1 GHz, at high power input) Waveform: Displays amplitude waveform while synchronizing with modulation data Measurement time: ≤1 s (except for multiplex-3 measurement)
	FM deviation measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Maximum frequency deviation: Measurement of section specified by marker Residual FM: ≤±200 Hz peak (10 MHz ≤frequency ≤2.1 GHz) Average frequency measurement: Measurement of section specified by marker Waveform: FM demodulation waveform (continuous demodulation or eye pattern changeable) Measurement time: ≤1 s (except for multiplex-3 measurement)
	Occupied bandwidth measurement	Same as general GMSK measurement
	Adjacent channel power	Available, combined with the MX3520A
	Out of band power arising from transmitter transients	Available, combined with the MX3520A
	Spurious emissions	Available, combined with the MX3520A
I/Q input (Option 03)		Input level range: 0.3 to 1.5 Vp-p Input impedance: 5 kΩ, AC/DC coupling (switchable) Measurement items: Modulation, amplitude, occupied bandwidth

- **Option 16: Measurement software (for π/4 DQPSK)**

The following specifications are guaranteed if the internal level is optimized using the auto range of the MS8604A calibration function.

Maximum input level		+40 dBm
General-purpose π/4 DQPSK	Frequency	10 MHz to 4 GHz
	Input level	–10 to +40 dBm (high power input), –30 to +20 dBm (low power input)
	Setting	Symbol rate: 1 to 600 k symbol/s (2 to 1200 kb/s), setting resolution: 0.1 symbol/s α (roll-off factor): 0.2 to 1.0 (symbol rate: 1 to 320 k symbol/s), 0.2 to 0.5 (symbol rate: 320 to 600 k symbol/s), setting resolution: 0.01 Number of analysis symbols: 48 to 1000 symbols Frame length: Number of analysis symbols — 5800 symbols (continuous signal), (number of analysis symbols x 2) — 5800 symbols (burst signal) Measurement signal: Continuous signal, burst signal
	Modulation/frequency measurement (phase trace method)	Measurement item: Carrier frequency, modulation accuracy Waveform: Displays constellation, eye pattern, vectors error vs. symbol number, phase error vs. symbol number, amplitude error vs. symbol number
	Amplitude measurement	Measurement item: Transmission power (average power of burst signal) Waveform: Displays amplitude waveform while synchronizing with modulation data (rise/fall, slot, and frame changeable) Impedance: 50 Ω, VSWR; ≤1.2 (high power input connector)
	Occupied bandwidth measurement	Displays results of occupied bandwidth measurement (99%) after FFT of measurement signal

Continued on next page

WCPE	Modulation/frequency measurement (phase trace method)	Frequency: 10 MHz to 2.1 GHz Input level: 0 to +40 dBm (high power input), –20 to +20 dBm (low power input) Carrier frequency measurement accuracy: ±(reference oscillator accuracy +10 Hz) Modulation accuracy (residual vector error): ≤1%rms, ≤3%peak Waveform: Displays constellation, eye pattern, vectors error vs. symbol number, phase error vs. symbol number, amplitude error vs. symbol number Measurement time: ≤2 s
	Amplitude measurement	Frequency: 10 MHz to 2.1 GHz Input level: +15 to +40 dBm (high power input), –5 to +20 dBm (low power input) Transmission power measurement accuracy: ±0.4 dB (±10%) *After calibration using MA4601A Power Sensor, at high power input connector Leakage power during carrier-off Measurement range in Normal mode: ≥55 dB (ratio between transmission power and average noise level) Average noise level in Wide dynamic range mode: ≤–50 dBm (100 MHz ≤frequency ≤2.1 GHz, at high power input) Waveform: Displays amplitude waveform while synchronizing with modulation data Measurement time: ≤2 s
	Occupied bandwidth measurement	Same as general-purpose π/4 DQPSK measurement
RCR STD-39 (π/4 DQPSK digital mobile communication system for public works)	Modulation/frequency measurement (phase trace method)	Frequency: 400 kHz to 2.1 GHz Input level: –10 to +40 dBm (high power input), –30 to +20 dBm (low power input) Carrier frequency measurement accuracy: ±(reference oscillator accuracy +1 Hz) Modulation accuracy (residual vector error): ≤0.5%rms, ≤2%peak Waveform: Displays constellation, eye pattern, vectors error vs. symbol number, phase error vs. symbol number, amplitude error vs. symbol number Measurement time: ≤1 s
	Amplitude measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Transmission power measurement accuracy: ±0.4 dB (±10%) *After calibration using MA4601A Power Sensor, at high power input connector Leakage power during carrier-off Measurement range in Normal mode: ≥65 dB (ratio between transmission power and average noise level) Average noise level in Wide dynamic range mode: ≤–60 dBm (100 MHz ≤frequency ≤2.1 GHz, at high power input) Waveform: Displays amplitude waveform while synchronizing with modulation data Measurement time: ≤1 s
	Occupied bandwidth measurement	Same as general-purpose π/4 DQPSK measurement
PACS	Modulation/frequency measurement (phase trace method)	Frequency: 10 MHz to 2.1 GHz Input level: –10 to +40 dBm (high power input), –30 to +20 dBm (low power input) Carrier frequency measurement accuracy: ±(reference oscillator accuracy +10 Hz) Modulation accuracy (residual vector error): ≤1%rms, ≤3%peak Waveform: Displays constellation, eye pattern, vectors error vs. symbol number, phase error vs. symbol number, amplitude error vs. symbol number Measurement time: ≤1 s
	Amplitude measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Transmission power measurement accuracy: ±0.4 dB (±10%) *After calibration using MA4601A Power Sensor, at high power input connector Leakage power during carrier-off Measurement range in Normal mode: ≥55 dB (ratio between transmission power and average noise level) Average noise level in Wide dynamic range mode: ≤–50 dBm (100 MHz ≤frequency ≤2.1 GHz, at high power input) Waveform: Displays amplitude waveform while synchronizing with modulation data and CRC data (mobile station measurement) Measurement time: ≤1 s
	Occupied bandwidth measurement	Same as general-purpose π/4 DQPSK measurement
TETRA	Modulation/frequency measurement (phase trace method)	Frequency: 400 kHz to 2.1 GHz Input level: –10 to +40 dBm (high power input), –30 to +20 dBm (low power input) Carrier frequency measurement accuracy:±(reference oscillator accuracy +1 Hz) Modulation accuracy (residual vector error): ≤0.5%rms/≤2%peak (symbol time), ≤0.7%rms/≤3%peak (1/2 symbol time) Waveform: Displays constellation, eye pattern, vectors error vs. symbol number, phase error vs. symbol number, amplitude error vs. symbol number Measurement time: ≤1 s
	Amplitude measurement	Frequency: 10 MHz to 2.1 GHz Input level: +10 to +40 dBm (high power input), –10 to +20 dBm (low power input) Transmission power measurement accuracy: ±0.4 dB (±10%) *After calibration using MA4601A Power Sensor, at high power input connector Leakage power during carrier-off Measurement range in Normal mode: ≥65 dB (ratio between transmission power and average noise level) Average noise level in Wide dynamic range mode: ≤–60 dBm (100 MHz ≤frequency ≤2.1 GHz, at high power input) Waveform: Displays amplitude waveform while synchronizing with modulation data Measurement time: ≤1 s
	Occupied bandwidth measurement	Same as general-purpose π/4 DQPSK measurement
I/Q input (Option 03)		Input level range: 0.3 to 1.5 Vp-p Input impedance: 5 kΩ, AC/DC coupling (switchable) Measurement items: Modulation, amplitude, occupied bandwidth

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MS8604A	Digital Mobile Radio Transmitter Tester
	Standard accessories
J0114A	Coaxial cord (UG-21D/U · RG-9A/U · UG-21D/U), 1 m: 1 pc
	Power cord, 2.5 m: 1 pc
P0005	PMC (32 KB): 1 pc
MA4601A	Power Sensor: 1 pc
J0370N	Power sensor connector cable, 0.5 m: 1 pc
F0014	Fuse, 6.3 A: 2 pcs
W0682AE	MS8604A operation manual: 1 copy
	Options
MS8604A-01	Reference quartz oscillator (aging rate: $\leq 5 \times 10^{-9}$/day)
MS8604A-02	RS-232C interface (for external control)
MS8604A-03	I/Q input
MS8604A-11	Measurement software Ver. 3 (PDC, added to the MS8604A firmware at the factory)
MS8604A-12	Measurement software Ver. 3 (PHS, added to the MS8604A firmware at the factory)
MS8604A-13	Measurement software Ver. 3 (NADC, added to the MS8604A firmware at the factory)
MS8604A-14	Measurement software Ver. 2 (Digital MCA, added to the MS8604A firmware at the factory)
MS8604A-15	Measurement software Ver. 2 (GMSK, added to the MS8604A firmware at the factory)
MS8604A-16	Measurement software (π/4 DQPSK, added to the MS8604A firmware at the factory)
W0722AE	Measurement software operation manual (supplied with Option 14)
W0876AE	Measurement software operation manual (supplied with Option 15)
W0973AE	Measurement software operation manual (supplied with Option 16)
	Application software (supplied with PMC)
MX3512A	π/4 DQPSK Analysis Software (for MS8604A-11/12/13)
MX3513A	Digital MCA Analysis Software (for MS8604A-14)
MX3518A	GSM Application Software (for MS8604A-15)
MX3519A	DECT Application Software (for MS8604A-15)
MX3520A	CT2 Application Software (for MS8604A-15)
	Peripheral equipments and parts
MC3305A	JIS Type PTA Keyboard
MC3306A	ASCII Type PTA Keyboard
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
P0006	PMC, 64 KB
P0007	PMC, 128 KB
P0008	PMC, 256 KB
P0009	PMC, 512 KB
MA4001A	Range Calibrator
MP59B	50 Ω Coaxial Switch (DC to 3 GHz, 50 Ω)
MP640A	Branch (DC to 1.7 GHz, 40 dB)
MP654A	Directional Coupler (0.8 to 3 GHz, 30 dB)
MP520C	CM Directional Coupler (25 to 500 MHz, 50 Ω, N type)
MP520D	CM Directional Coupler (100 to 1700 MHz, 50 Ω, N type)
J0395	Fixed attenuator for high-power (30 dB, 30 W, DC to 9 GHz)
J0055	Coaxial adapter (NC-P · BNC-J)
562	DC block (10 MHz to 12.4 GHz, NARDA product)
B0329D	Front cover
B0331D	Front handle kit (2 pcs/set)
B0332	Joint plate (4 pcs/set)
B0333D	Rack mount kit
B0334D	Hard carrying case (with protective cover and casters)

Previously-purchased MS8604A measurement software options (Option 11, Option 12, Option 13, Option 14 and Option 15) can be upgraded to the latest version (with fee). For details, please contact your sales representative.

DIGITAL MODULATION SIGNAL GENERATOR

MG3681A

250 kHz to 3 GHz

CE GPIB

For Evaluating Next Generation Digital Mobile Communications Systems

The MG3681A uses a wideband vector modulator to output the high-accuracy, high-speed vector modulation signals that are required for R&D and manufacturing of digital mobile communications equipment and related devices. It covers, the frequency band of leading mobile communications systems for the frequency range of 250 kHz to 3 GHz. It uses vector modulator to provide excellent frequency response, distortion and S/N ratio. It can perform accurate receiver sensitivity test and transmitter adjacent channel leakage power test for high-speed modulation communications systems. Expansion units such as MU368040A CDMA Modulation Unit for modulation signals generation of W-CDMA communication system can be installed on the seven expansion slots in the MG3681A. Various modulation signals can be generated with the expansion units and associated software. The MG3681A also has analog modulation functions such as AM and FM for testing of analog communications systems. In addition, its excellent signal purity and various functions such as memory and frequency sweep are useful as a general-purpose signal generator.

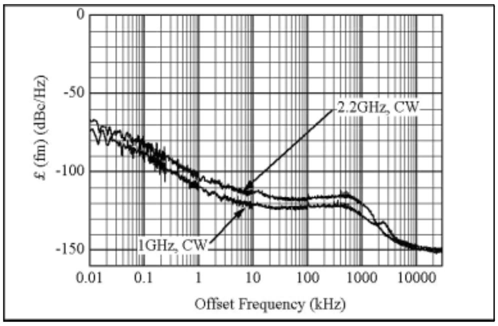
Features

- High-resolution setting of frequency 0.01 Hz and output level 0.01 dB
- 30 MHz wideband and high-accuracy vector modulation
- Excellent adjacent channel leakage power ratio
- Various expansion units

Performance and functions

• Excellent signal purity

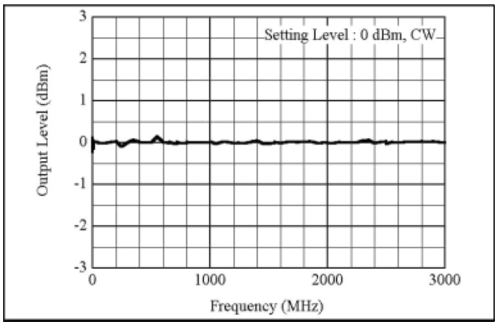
Digital mobile communications evolve into wideband RF frequency bandwidth, and signal generator requires low-noise signal to faraway frequency offset. A unique synthesizer technology achieves low noise floor characteristics of –145 dBc/Hz (typ. at above 5 MHz offset).



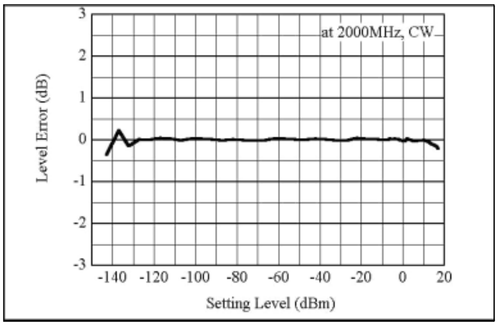
SSB phase noise characteristics

• Excellent level accuracy signal

The frequency response is excellent by calibrating output level across the entire output RF frequency range. Even low level can be output with high-accuracy due to use of a high-precision, high-reliability step attenuator calibrated.



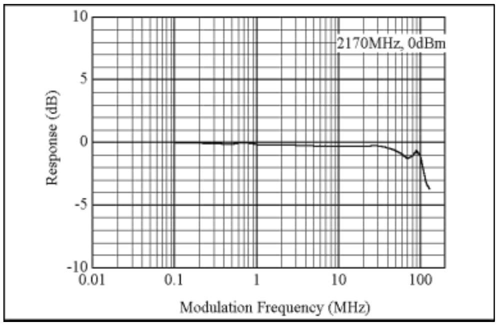
Output level frequency response



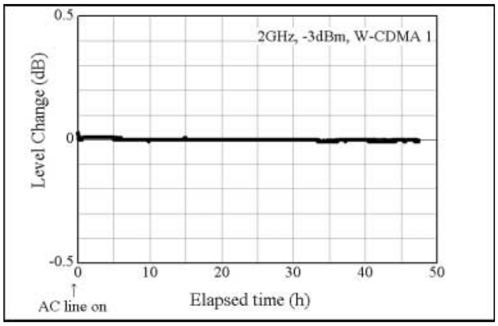
Output level accuracy

• Wideband vector modulation

The modulation frequency response of ±3 dB at the modulation frequency from DC to 30 MHz is achievable by the high-speed baseband signal processor and wideband vector modulator, permitting wideband vector modulation supporting high-speed data communications including W-CDMA system. Accurate wideband vector modulation is also available by using the external I/Q signals as well as internal modulation using the optional modulation units installed. In addition, a unique Automatic Level Control (ALC) technology assures stable output level at vector modulation.



Vector modulation frequency response



Output level stability at W-CDMA system modulation

• Expansion units for up to seven slots

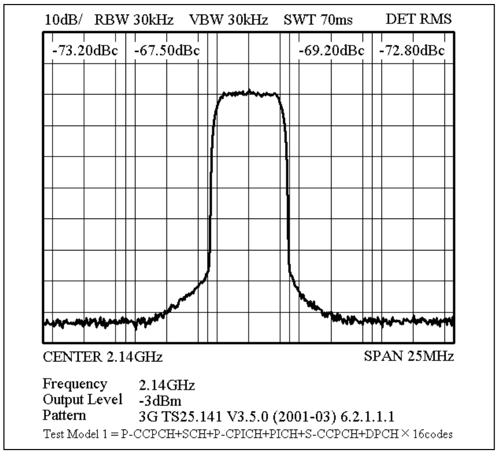
Seven slots for expansion units have 14 bits high-speed waveform data bus each In-phase and Quadrature signals. The excellent expansible platform covers future communication systems by addition of expansion units.

Note: Some expansion units require installation of dedicated software to enable functionality.

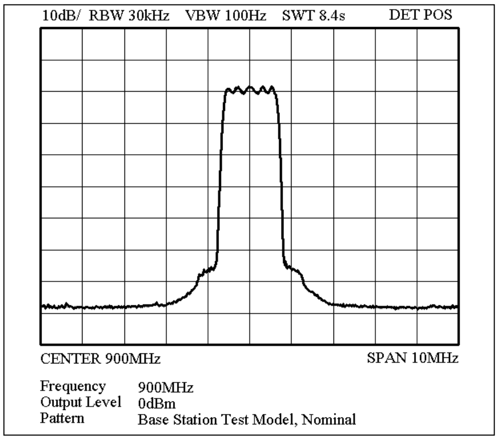
• Excellent adjacent channel leakage power ratio

The adjacent channel leakage power ratio of the digital modulation signal generator is an important factor in distortion testing of device and interference testing of receiver.

The MG3681A achieves an excellent adjacent channel leakage power ratio by an optimized circuit design. The typical adjacent channel leakage power ratio for W-CDMA system is –68 dBc/3.84 MHz and the secondary adjacent channel leakage power ratio is –75 dBc/3.84 MHz.



W-CDMA system adjacent channel leakage power ratio at 16 code multiplex



IS-95 system adjacent channel power ratio at 9 code multiplex

Configuration of communication system software and expansion units

Communication system	Applicable software	Expansion units
PDC	MX368011A PDC Software	MU368010A TDMA Modulation Unit
GSM	MX368012A GSM Device Test Software	
W-CDMA/3GPP (FDD)	MX368041B W-CDMA Software	MU368040A CDMA Modulation Unit
cdmaOne	MX368042A IS-95 Device Test Software	
cdma2000® 1X*1 cdma2000® 1xEV-DO*2 GSM/EDGE*3 PDC*3, NADC*3, PHS*3	MX368031A Device Test Signal Generation Software	MU368030A Universal Modulation Unit
cdma2000® 1xEV-DO	MX368033A cdma2000® 1xEV-DO Signal Generation Software	
PDC packet	MX368034A PDC Packet Software	
PHS	MX368035A PHS Signal Generation Software	
W-CDMA/3GPP cdma2000®	–	MU368060A AWGN Unit

*1: Since coding format of the Reverse is performed, it is utilizable for receiver sensitivity test (RC1 & 3) in base station production. Since coding format of the Forward is not performed, it is not utilizable for receiver sensitivity test.

*2: For the Forward, only 16QAM modulation is available, 8PSK and QPSK modulation is not available. Since coding format of the Forward and the Reverse is not performed, it is not utilizable for receiver tests.

*3: It is a continuous modulation signal based on the communication system.

Specifications

- **MG3681A main frame**

<table>
<tr><td rowspan="6">Frequency</td><td>Range</td><td>250 kHz to 3000 MHz, Resolution: 0.01 Hz</td></tr>
<tr><td>Accuracy</td><td>Depends on installed reference oscillator, Reference frequency accuracy: ± (5% of FM setting deviation + 5 Hz) for frequency modulation</td></tr>
<tr><td>Internal reference oscillator</td><td>Aging rate: ±1 x 10^{-6}/year, Temperature stability: ±1 x 10^{-6} (0˚ to 50˚C)*1</td></tr>
<tr><td>External reference input</td><td>10 MHz/13 MHz auto-switching, ±10 ppm, ≥0.7 V(p-p)/50 Ω (AC coupled), BNC connector (rear panel)</td></tr>
<tr><td>Buffer output</td><td>10 MHz, TTL level (DC coupled), BNC connector (rear panel)</td></tr>
<tr><td>Switching time</td><td>≤20 ms (response time from final command to ±500 Hz of set frequency on GPIB at CW, ALC on, except when setting frequency is crossing over 600 MHz and 1010 MHz)</td></tr>
<tr><td rowspan="10">Output level</td><td>Range</td><td>–143 to +13 dBm (settable range: –143 to +17 dBm)</td></tr>
<tr><td>Unit</td><td>dBm, W, dBµV, V (dBµV, V selected terminate/open voltage display)</td></tr>
<tr><td>Resolution</td><td>0.01 dB (dBm, dBµV units), 3 digit (W, V units)</td></tr>
<tr><td>Frequency response</td><td>±1 dB (CW, ALC on, 0 dBm)</td></tr>
<tr><td>Accuracy</td><td>CW, ALC on
<table>
<tr><td>Frequency
Level</td><td>≤1 GHz</td><td>>1 GHz</td></tr>
<tr><td>≤+13 dBm, ≥–127 dBm</td><td>±1 dB</td><td>±2 dB</td></tr>
<tr><td><–127 dBm</td><td>±2 dB</td><td>±3 dB</td></tr>
</table></td></tr>
<tr><td>Output connector</td><td>50 Ω, N-type connector (front panel)</td></tr>
<tr><td>Switching time</td><td>≤50 ms (normal mode), ≤100 ms (safety mode), ≤10 ms (continuous mode)
*Response time from final command to ±0.5 dB of final level on GPIB at CW, ALC on</td></tr>
<tr><td>Special setting mode</td><td>Continuous mode:
Level continuously adjustable in set value range of ±10 dB (dBm, dBµV units only)
For vector modulation by optional digital modulation unit, continuous mode variance depends on modulation setting
Safety mode: Mechanical attenuator decreases level to prevent generation of high-level signal spikes</td></tr>
<tr><td>ALC mode</td><td>ALC on
Usage: Continuous wave or pulse modulation wave (burst wave) with RF On time of 10 µs or more
ALC time constant: Auto, 500 ns, 2.4 µs, 5 µs, 24 µs, 50 µs, 240 µs, 500 µs selectable
At Auto, automatically selected depending on frequency, AM and vector modulation [when digital modulation unit (option) is used]
The ALC time constant is automatically selected, depending on the set frequency, regardless of the time constant selected on the front panel
ALC off
Usage: Pulse modulation wave (burst wave) whose RF on time is less than 10 µs
Restrict item: Without AM
ALC calibration: Automatic during ALC Calibration operation and at frequency/level setting change</td></tr>
<tr><td rowspan="2">Signal purity</td><td>Spurious</td><td>Harmonics: <–30 dBc
Non harmonic:
<table>
<tr><td>Frequency</td><td>15 kHz to 300 MHz offset</td><td>>300 MHz offset</td><td>Fixed frequency spurious</td></tr>
<tr><td>≤2500 MHz</td><td><–60 dBc</td><td><–30 dBc</td><td>–50 dBc (660, 1320 MHz)</td></tr>
<tr><td>>2500 MHz</td><td colspan="2"><–30 dBc</td><td>–</td></tr>
</table>
Those related power: <–40 dBc *CW, ≤0 dBm</td></tr>
<tr><td>SSB phase noise</td><td><–118 dBc/Hz (≥10 MHz, ≤1010 MHz), <–112 dBc/Hz (>1010 MHz) *At CW, 20 kHz offset</td></tr>
<tr><td rowspan="5">AM</td><td>Range</td><td>0 to 100% (cannot set internal/external modulation independently), Resolution: 0.1%</td></tr>
<tr><td>Modulation frequency response</td><td>≤0 dBm, ALC on, in band of ±1.5 dB based on modulation frequency of 1 kHz
<table>
<tr><td rowspan="3">Frequency</td><td rowspan="3">Lower limit frequency</td><td colspan="3">Upper limit frequency</td></tr>
<tr><td colspan="2">Vector modulation and wideband AM off</td><td>Vector modulation or wideband AM on</td></tr>
<tr><td>AM: 30%</td><td>AM: 80%</td><td>AM: 30%</td></tr>
<tr><td>≥0.4 MHz, <2 MHz</td><td rowspan="3">DC (Internal modulation, External modulation DC coupled), 20 Hz (External modulation AC coupled)</td><td>3 kHz</td><td>1 kHz</td><td rowspan="3">1 kHz</td></tr>
<tr><td>≥2 MHz, <10 MHz</td><td>10 kHz</td><td>10 kHz</td></tr>
<tr><td>≥10 MHz</td><td>10 kHz</td><td>10 kHz</td></tr>
</table></td></tr>
<tr><td>Internal modulation</td><td>Depends on AF synthesizer (Option 21)</td></tr>
<tr><td>External modulation</td><td>2 V(p-p) approx., 600 Ω, AC/DC coupled switchable, BNC connector (front panel)</td></tr>
<tr><td>Modulation signal polarity</td><td>Positive/negative switchable</td></tr>
<tr><td rowspan="6">FM</td><td>Range</td><td>0 to 1000 kHz (≥10 MHz, ≤1010 MHz), 0 to 2000 kHz (>1010 MHz)
*Cannot set internal/external modulation independently.</td></tr>
<tr><td>Resolution</td><td>10 Hz (0 to 10 kHz deviation), 100 Hz (10.1 to 100 kHz deviation), 1 kHz (101 to 1000 kHz deviation), 10 kHz (1010 to 2000 kHz deviation)</td></tr>
<tr><td>Modulation frequency response</td><td>DC to 20 kHz (internal modulation, external modulation DC coupled), 20 Hz to 20 kHz (external modulation AC coupled)
*In band of ±1 dB based on modulation frequency of 1 kHz</td></tr>
<tr><td>Internal modulation</td><td>Depends on AF synthesizer (Option 21)</td></tr>
<tr><td>External modulation</td><td>2 V(p-p) approx., 600 Ω, AC/DC coupled switchable, BNC connector (front panel)</td></tr>
<tr><td>Modulation signal polarity</td><td>Positive/negative switchable</td></tr>
</table>

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øM	Range	0 to 6.28 rad (≥10 MHz, ≤1010 MHz), 0 to 12.56 rad (>1010 MHz) ∗Cannot set internal/external modulation independently.
	Unit	rad, deg
	Resolution	rad unit: 0.01 rad, deg unit: 1 deg
	Modulation frequency response	DC to 20 kHz (internal modulation, external modulation DC coupled), 20 Hz to 20 kHz (external modulation AC coupled) ∗In band of ±1 dB based on modulation frequency of 1 kHz
	Internal modulation	Depends on AF synthesizer (Option 21)
	External modulation	2 V(p-p) approx., 600 Ω, AC/DC coupled switchable, BNC connector (front panel)
	Modulation signal polarity	Positive/negative switchable
Wideband AM	Modulation frequency response	DC to 15 MHz (±2 dB bandwidth), DC to 30 MHz (±3 dB bandwidth) ∗External modulation, input level: 0.9 V(p-p), ≥100 MHz, ≤0 dBm, modulation frequency of 1 kHz
	Internal modulation	Depends on installed digital modulation unit (option)
	External modulation	≤1 V(p-p), 50 Ω, BNC connector (front panel), sensitivity: 1 V(p-p) = 100%
Pulse modulation	On/off ratio	>60 dB
	Rise/fall time	<100 ns (external modulation)
	Minimum pulse width	<500 ns (external modulation)
	Pulse repetition frequency	DC to 1 MHz (external modulation, ALC off)
	Internal modulation	Depends on installed digital modulation unit (option)
	External modulation	TTL level, positive logic, 50 Ω, BNC connector (front panel)
Vector modulation	Modulation frequency response	DC to 15 MHz (±2 dB bandwidth), DC to 30 MHz (±3 dB bandwidth) ∗External modulation, input level: 0.5 V(rms), ≥100 MHz, ≤0 dBm, modulation frequency of 1 kHz
	Vector error	≤2.5%(rms) ∗External modulation, input level: 0.5 V(rms), ≥100 MHz, ≤0 dBm, 3.84 Msps QPSK modulation
	Internal modulation	Depends on installed digital modulation unit (option)
	External modulation	$\sqrt{(I^2+Q^2)}$ = 0.5 V(rms), I/Q = ±1.5V(peak), 50 Ω, BNC connector (front panel)
	Quadrature degree adjustment function	Adjustment range: ≥±1 deg
	I/Q change	I, Q signal changeable (RF spectrum invert)
Simultaneous modulation		Modulation depth and deviation same for combinations below: AM (internal/external), FM (internal/external), øM (internal/external) Frequency and waveform of modulation signal source same for combinations below: AM (internal)/FM (internal), AM (internal)/øM (internal) Simultaneous modulation impossible as below: FM/øM, wideband AM/vector modulation, vector (internal)/Vector (external) modulation
AF signal output		Depends on AF synthesizer (Option 21)
I/Q signal output[*2]	Output level	Depends on installed digital modulation unit (option)
	Signal source	Depends on installed digital modulation unit (option)
	Output connector	50 Ω, BNC connector (front panel)
Memory function	Basic parameter memory	512 sets of frequency and level
	All parameter memory	All parameters including 100 sets maximum of analog modulation and digital modulation units (option)
Sweep function	Sweep parameter	Basic parameter memory address
	Sweep pattern	Start address → stop address
	Sweep time	1 ms to 600 s (per memory; memory recall time restricts lower limit, resolution: 1 ms)
	Sweep mode	Auto (repetition sweep), single (single sweep)
Special display	Relative display	Frequency, output level (dBm, dBµV units only)
	Offset display	Frequency (offset range: –3 to +3 GHz), output level (offset range: –55 to +55 dB, dBm, dBµV units only)
Display	Size	7.2 inch, 480 x 640 dots, color D-STN
	On/off setting	Panel display on/off
Backup function		All items reset at power-on except following: Input data contents, remote condition, contents of GPIB data being transferred, RPP operation condition, screen condition, main function selections
Panel lock function	Panel lock	Disable operation of all keys except front panel power key, panel lock key, local key and contrast key
	Knob hold	Disable rotary knob on front panel operation
External interface	GPIB	Remote control: All functions except power switch, local key, and contrast key Interfaces: SH1, AH1, T5, L4, TE0, SR1, RL1, DP0, PP0, DC1, DT1, C1, E2 Connector: Rear panel
	RS-232C	Remote control: All functions except power switch, local key, and contrast key Communications method: Async (start-stop), half-duplex Communications control method: X on/off by command Baud rate: 1200, 2400, 4800, 9600, 19200, 38400 bps Data bits; 7 or 8 Parity: Odd, even, none Start bit: 1 Stop bit: 1 or 2 Connector: D-sub 9 pins, rear panel

Continued on next page

External interface	PC card	Memory card (memory backup, screen hard copy) Connector: JEIDA Ver 4/4.1 PCMCIA Rel 2.0, 1 slot (rear panel)
	Trigger	Executes item specified by command-input signals (3 bits) from following items: Frequency step-up/step-down, output level step-up/step-down, basic parameter recall address up/down, output level on/off Interface: TTL level Connector: D-sub 9-pin, female (rear panel)
Reverse power protection		≤50 W (≤1 GHz), ≤25 W (>1 GHz), ±50 V (DC)
Power		AC 100 to 120/200 to 240 V (–15/+10%, 250 V max, automatic selection), 47.5 to 63 Hz, ≤300 VA
Temperature		Operating: 0˚ to 50˚C, Storage: –20˚ to 60˚C
Dimensions and mass		426 (W) x 177 (H) x 451 (D) mm, ≤25 kg (excluding option)
EMC		EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD		EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

∗1: Aging rates down to 5 x 10^{-10}/day are available as reference crystal oscillator (MG3681A Option 01/02).
∗2: Possible to expand the function with MG3681A Option 11

• Options

Option 01 (Reference crystal oscillator)	Frequency: 10 MHz Aging rate: ±5 x 10^{-9}/day Start-up characteristics: 1 x 10^{-7} (After 10 min, compared to frequency after 24 h warm-up) Temperature stability: ±3 x 10^{-8} (0˚ to 50˚C)
Option 02 (Reference crystal oscillator)	Frequency: 10 MHz Aging rate: ±5 x 10^{-10}/day Start-up characteristics: 1 x 10^{-7} (After 10 min, compared to frequency after 24 h warm-up) Temperature stability: ±5 x 10^{-9} (0 to 50˚C)
Option 11 (Additional function of I/Q output)	Functions: Adds level, offset setting, and differential output functions to I/Q output Level Range: 80 to 120% of nominal level, Resolution: 0.1% ∗2 sets of I/$\overline{I}$ and Q/$\overline{Q}$ set independently, 50 Ω termination Offset Range: –0.5 to +1.5 V, Resolution: 0.5 mV ∗4 sets of I, $\overline{I}$, Q, $\overline{Q}$ set independently, 50 Ω termination Quadrature degree variable function Range: ±5 deg, Resolution: 0.5 deg Differential output: I, Q signals (Using front I/Q input connector) Signal source: Depends on installed digital modulation unit (option) Output connector: 50 Ω, BNC connector (front panel)
Option 21 (AF synthesizer)	Frequency: 0.01 Hz to 400 kHz, Resolution: 0.01 Hz, Accuracy : same as reference oscillator Waveform: Sine, triangular, square, sawtooth Frequency response: ±1 dB [sine wave, level: 2 V(p-p), offset: 0 V, 600 Ω termination, reference to 1 kHz, 10 Hz to 100 kHz] Harmonics: ≤–50 dB [sine wave, level: 2 V(p-p), offset: 0 V, 600 Ω termination, 1 kHz] Level Range: 0 to 4 V(p-p), Resolution: 1 mV(p-p), Accuracy: ± [8% of set level + 2 mV(p-p)] ∗600 Ω termination Offset Range: –2 to +2 V, Resolution: 1 mV, Accuracy: ± (8% of set level + 2 mV) ∗600 Ω termination Output connector: 600 Ω, BNC connector (front panel)
Option 42 (RF high level output)	Functions: 8 dB gain of maximum output level in W-CDMA band Frequency: 1900 to 2200 MHz Gain: 8 ±1 dB (from –3 dBm, RF high level output off, 2.1 GHz) Gain frequency response: ±1 dB (at +5 dBm, referenced to 2.1 GHz)

• Expansion units and software

Refer to the individual catalogs for the expansion units and software.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MG3681A	Digital Modulation Signal Generator
	Standard accessories
	Power cord, 2.6 m: 1 pc
B0325	GPIB connector shield cap: 1 pc
F0014	Fuse, 6.3 A: 2 pcs
W1708AE	MG3681A operation manual: 1 copy
	Options
MG3681A-01	Reference oscillator (aging rate: 5 x 10^{-9}/day)
MG3681A-02	Reference oscillator (aging rate: 5 x 10^{-10}/day)
MG3681A-11	Additional function of I/Q output (level and offset setting, differential output)
MG3681A-21	AF synthesizer (0.01 Hz to 400 kHz, resolution: 0.01 Hz)
MG3681A-42	RF high level output (for W-CDMA, 8 dB gain)
	Maintenance service
MG3681A-90	Extended three years warranty service
MG3681A-91	Extended five years warranty service
	Expansion units
MU368010A	TDMA Modulation Unit*1,*2
MU368030A	Universal Modulation Unit*1,*2
MU368040A	CDMA Modulation Unit*1,*2
MU368060A	AWGN Unit*1
	Standard accessories
W1835AE	MU368010A operation manual: 1 copy
W1973AE	MU368030A operation manual: 1 copy
W1758AE	MU368040A operation manual: 1 copy
W1955AE	MU368060A operation manual: 1 copy
	Maintenance service
MU368010A-90	Extended three years warranty service
MU368010A-91	Extended five years warranty service
MU368030A-90	Extended three years warranty service
MU368030A-91	Extended five years warranty service
MU368040A-90	Extended three years warranty service
MU368040A-91	Extended five years warranty service
MU368060A-90	Extended three years warranty service
MU368060A-91	Extended five years warranty service

*1: Refer to the individual catalogs for the expansion units, software and band pass filter.

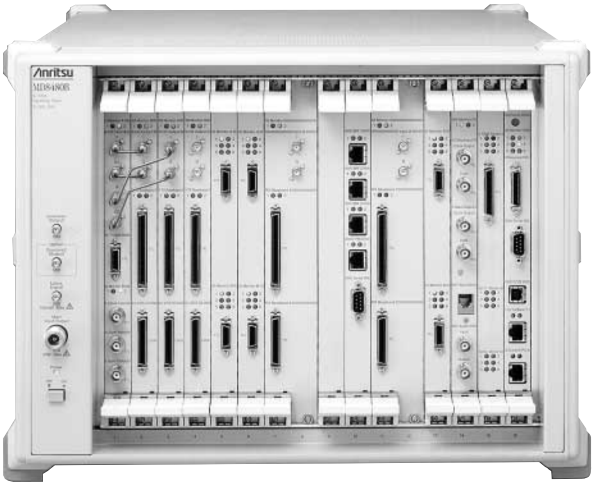
*2: When using the MU368010A, MU368030A and MU368040A, dedicated software must be installed.

Model/Order No.	Name
	Softwares*1
MX368011A	PDC Software (for MU368010A)
MX368012A	GSM Device Test Software (for MU368010A)
MX368031A	Device Test Signal Generation Software (for MU368030A)
MX368033A	cdma2000® 1xEV-DO Signal Generation Software (for MU368030A)
MX368034A	PDC Packet Software (for MU368030A)
MX368035A	PHS Signal Generation Software (for MU368030A)
MX368041B	W-CDMA Software (for MU368040A)
MX368041B-10	3GPP Release 5 signal pattern
MX368042A	IS-95 Device Test Software (for MU368040A)
	Standard accessories
W1836AE	MX368011A operation manual: 1 copy
W1837AE	MX368012A operation manual: 1 copy
W1974AE	MX368031A operation manual: 1 copy
W2072AE	MX368033A operation manual: 1 copy
W2073AE	MX368034A operation manual: 1 copy
W2167AE	MX368035A operation manual: 1 copy
W2089AE	MX368041B operation manual: 1 copy
W1838AE	MX368042A operation manual: 1 copy
	Optional accessories
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127C	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 0.5 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0329C	Front cover (1MW4U)
B0331C	Front handle (2 pcs/set)
B0332	Joint plate (4 pcs/set)
B0333C	Rack mount kit
B0334C	Carrying case (Hard type, with front cover and casters)
MA2512A	Band Pass Filter*1 (for W-CDMA, pass band: 1.92 to 2.17 GHz)

W-CDMA SIGNALLING TESTER
MD8480B

CE

One Unit Supporting Development of 3G W-CDMA Mobile Stations



The MD8480B has a full lineup of advanced functions for testing third-generation W-CDMA mobile stations. Its air interface meets the 3GPP specifications and it can be used as a base station simulator. The test functions include mobile station modulation and demodulation processing, protocol sequence tests such as location registration, origination, termination, handover (option), disconnection from mobile station/network, various applications such as voice and packet communications as well as communications between two mobile stations (two sets of MD8480B are required).
Moreover, the addition of the function (option) of GSM/GPRS can perform the handover test between W-CDMA to GSM/GPRS.
In summary, the MD8480B is the ideal instrument for developing 3G W-CDMA mobile stations and application software.

Features

- Modulation/demodulation function tests for W-CDMA, GSM/GPRS mobile station
- Protocol sequence tests for W-CDMA, GSM/GPRS mobile station
- Flexible settings of test parameters and sequences for protocol sequences
- Voice and packet communications test, and communications testing between two mobile stations

Functions

Demodulation test channels

Channel	Logical	Transport	Physical	Symbol rate
Common	BCCH	BCH	P-CCPCH	15 ksps
			P-SCH	
			S-SCH	
			(P-) CPICH	15 ksps
			(S-) CPICH	15 ksps
			PICH	15 ksps
			AICH	15 ksps
	PCCH	PCH	S-CCPCH	60, 120 ksps
	CCCH/DCCH/DTCH	FACH		
Dedicated			DPCCH	15, 30, 60, 120, 240, 480, 960 ksps
	DCCH + DTCH	DCH	DPDCH	15, 30, 60, 120, 240, 480, 960 ksps
	DCCH + DTCH		DPDCH	
	DCCH + DTCH		DPDCH	

Modulated test channels

Channel	Logical	Transport	Physical	Symbol rate
Common			PRACH (preamble)	
			PRACH (control)	
	CCCH/DCCH/DTCH	RACH	PRACH (message)	15, 30, 60, 120 ksps
Dedicated			DPCCH	15 ksps
	DCCH/DTCH	DCH	DPDCH	15, 30, 60, 120, 240, 480, 960 ksps

Supported service

Service		Data rate	Physical channel downlink (1 symbol = 2 bits)	Physical channel uplink (1 symbol = 1 bit)
(Protocol)	(Standalone DCCH)		1 x DPCH (15 ksps)	1 x DPDCH (15 ksps)
Voice (GSM-AMR)		12.2 kbps (VAD Option 01)	1 x DPCH (30 ksps)	1 x DPDCH (60 ksps)
ISDN 1B		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
Packet		32 kbps	1 x DPCH (60 ksps)	1 x DPDCH (120 ksps)
		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
		128 kbps	1 x DPCH (240 ksps)	Not currently supported
		384 kbps	3 x DPCH (240 ksps)	1 x DPDCH (960 ksps)
Audio and video		32 kbps	1 x DPCH (60 ksps)	1 x DPDCH (120 ksps)
		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
Reference measurement channel		DCCH	1 x DPCH (15 ksps)	1 x DPDCH (15 ksps)
		12.2 kbps	1 x DPCH (30 ksps)	1 x DPDCH (60 ksps)
		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
		144 kbps	1 x DPCH (240 ksps)	1 x DPDCH (480 ksps)
		384 kbps	1 x DPCH (480 ksps)	1 x DPDCH (960 ksps)
		BTFD	1 x DPCH (30 ksps)	1 x DPDCH (60 ksps)
Multicall	Voice + Packet	12.2 kbps + 32 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
		12.2 kbps + 64 kbps	1 x DPCH (120 ksps)	Not currently supported
		12.2 kbps + 384 kbps	3 x DPCH (240 ksps)	1 x DPDCH (960 ksps)
	Voice + ISDN 1B	12.2 kbps + 64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)

Specifications

General	Frequency range	Tx: 2110 to 2170 MHz, Rx: 1920 to 1980 MHz (W-CDMA) Tx: 300 to 3000 MHz, Rx: 350 to 550 MHz, 700 to 1100 MHz, 1400 to 2200 MHz (GSM)
	I/O connector	Main N-type, Impedance: 50 Ω, VSWR: ≤1.3 Downlink 1 SMA-type, Impedance: 50 Ω, VSWR: ≤2.0 Downlink 2 SMA-type, Impedance: 50 Ω, VSWR: ≤2.0 Uplink SMA type, Impedance: 50 Ω, VSWR: ≤2.0
	Reference oscillator	Frequency: 10 MHz Startup characteristics: ≤5 x 10^{-8}/day (10 minutes after power-on, reference to 24 hours after power-on) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (reference to 24 hours after power-on) Temperature characteristics: ≤5 x 10^{-8} (0° to 50°C, reference to 25°C) External reference input: 10 MHz, 2 to 5 Vp-p
Transmitter (W-CDMA)	Frequency	Range: 2110 to 2170 MHz (100 kHz steps)
	Output level	Maximum output level Main: –25 dBm (each channel), –16 dBm (overall) Downlink: –10 dBm (each channel), –1 dBm (overall) Setting resolution: 0.1 dB Accuracy: ±1.5 dB (+18° to +28°C)
	Spreading	Codes: Scrambling, channelization, synchronization Chip rate: 3.84 MHz
	Modulation	Method: QPSK Modulation band limit: Root Nyquist filter ($\alpha = 0.22$) EVM: ≤10% rms
	AWGN	Setting resolution: 0.1 dB
Receiver (W-CDMA)	Frequency	Range: 1920 to 1980 MHz, Step: 100 kHz
	Input level	Range: –30 to +40 dBm (main), –50 to +20 dBm (uplink)
	Sync.	Rake receive: None, Capture range: ±200 chip (DPCCH), ±100 chip (PRACH preamble)
Transmitter (GSM)	Frequency	Range: 300 to 3000 MHz (200 kHz steps)
	Output level	Maximum output level Main: –15 dBm, Downlink: 0 dBm Setting resolution: 0.1 dB Accuracy: ±1.5 dB (+18° to +28°C)
	Symbol rate	270.833 kHz
	Modulation	Method: GMSK, Phase error: ≤5.0° RMS
Receiver (GSM)	Frequency	Range: 350 to 550 MHz, 700 to 1100 MHz, 1400 to 2200 MHz (200 kHz steps)
	Input level	Range: –30 to +35 dBm (main), –50 to +15 dBm (uplink)
Power		100 to 120/200 to 240 Vac (250 V max.), automatic switching, 47.5 to 63 Hz, ≤430 VA
Ambient temperature		0° to +50°C (operating), –40° to +70°C (storage)
Dimensions and mass		426 (W) x 310 (H) x 500 (D) mm, ≤35 kg
EMC		EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)
LVD		EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

Options

- **Hardware**

ISDN (MU848055A)
It is the option which makes the ISDN interface usable, and can respond to the data rate of a maximum of 6 B (384 kbps). Moreover, RS-232C interface with which this option is equipped is used, and a PPP packet test can be performed.

Additional base station (MU848057A, MU848058A, MU848053A)
The standard composition of MD8480B has one transmission/reception function. By adding these options, it is possible to have the transmission function (an equivalent for three base stations) of a maximum of 3 base stations and two reception functions by one-set of MD8480B. The examination of soft handover is possible by this option (see the table of "Option functions" for details).

Additional RF unit (MD8480A-01)
It is an option corresponding to two different frequency (transmission and reception) in MD8480B. The hard handover (handover between two base stations of different frequencies) is attained combining the above-mentioned additional base station option.

TDMA (MU848060B)
It is the option which makes the function of GSM/GPRS usable. As the GSM/GPRS functions, location registration, mobile station origination/termination, disconnection from mobile station/network and handover (intra-system) are possible. And various applications such as voice and data communications are supported. It combines with additional RF unit (MD8480A-01) and compressed mode (MX848001A-02, after-mentioned), and the examination of the handover between W-CDMA and GSM/GPRS is enabled.

- **Software**

Tx diversity (MX848001A-01)
As the option for corresponding to the function of Tx diversity, it corresponds to TSTD, STTD, the closed loop model 1, and the closed loop model 2. The MU848057A and MU848058A (two sets) become indispensable as an additional base station option.

Compressed mode (MX848001A-02)
As the option corresponding to a compressed mode function, it corresponds to SF/2, Puncturing, and Higher Layer Scheduling.

Ciphering (MX848041A)
As the option which adds the function of authentication and ciphering, it corresponds to KASUMI (authentication and ciphering algorithm of the standard in 3GPP).

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MD8480B	W-CDMA Signalling Tester	
	Units (incorporated in the main frame)	
MU848051A	CPU:	1 pc
MU848052A	Frame Decoder:	1 pc
MU848053A	Rx Baseband:	1 pc
MU848056A	Voice Codec:	1 pc
MU848057A	Frame Coder:	1 pc
MU848058A	Tx Baseband:	1 pc
MU848059B	Timing Generator 2:	1 pc
	Standard accessories	
MX848000A	W-CDMA Signalling Tester Control Software (CD-ROM):	1 pc
MX848001A	W-CDMA Signalling Tester Firmware (CD-ROM):	1 pc
MX848002A	W-CDMA Signalling Tester FPGA (CD-ROM):	1 pc
MX848003A	W-CDMA Signalling Tester ISDN/PPP (CD-ROM):	1 pc
MX848005B	GSM/GPRS:	1 pc
J0892	Twisted pair cable, 5 m:	1 pc
G0091	Monitor board:	2 pcs
J1005	Monitor cable, 80-pin:	1 pc
J1006	Monitor cable, 20/50-pin:	1 pc
	Power cord, 2.6 m:	1 pc
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m:	1 pc
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m:	1 pc
J1010	U-link (50 mm):	2 pcs
J0654A	RS-232C cable (cross), 2 m:	1 pc
F0014	Fuse, 6.3 A:	2 pcs
W1964AE	MD8480B operation manual (CD-ROM):	1 copy
A0010	Blank board (at option uninstalled):	1 to 6 pcs
A0011	Bridge board (at option uninstalled):	1 to 2 pcs
	Option units	
MU848053A	Rx Baseband (hardware)	
MU848055A	ISDN (hardware)	
MU848057A	Frame Coder (hardware)	
MU848058A	Tx Baseband (hardware)	
MU848060B	TDMA (hardware)	
MD8480A-01	Additional RF unit (hardware)	
MD8480B-90	Extended three year warranty service	
MD8480B-91	Extended five year warranty service	
MX848001A-01	W-CDMA signalling tester Tx diversity (software, license document)	
MX848001A-02	W-CDMA signalling tester compressed mode (software, license document)	
MX848041A	W-CDMA Signalling Tester Ciphering (software, CD-ROM)	
MX848041A-01	Tx diversity for ciphering (software, license document)	
MX848041A-02	Compressed mode for ciphering (software, license document)	

MD8480B requires PC[*1] and Microsoft Visual C++ Version 6.0[*2] or .net.

[*1] PC is for controlling the MD8480B. The following is the required spec;
OS: Windows 95/98/2000, Windows NT4.0 Workstation
CPU: 200 MHz or better with minimum of 32 MB of memory, 10Base-T and RS-232C interfaces (D-Sub 9-pin), and CD-ROM drive

[*2] Microsoft Visual C++ Version 6.0 or .net is a registered trademark of Microsoft Corporation in USA and other countries.
Microsoft Visual C++ Version 6.0 or .net is standard edition available.

Option functions

Additional functions	MU848057A	MU848058A	MU848055A	MU848053A	MU848060B	MD8480A-01	MX848001A-01	MX848001A-02	MX848041A
2SB soft handover	√	√							
3SB soft handover	√	√*1							
ISDN			√						
Tx diversity (1RF output)	√	√*1					√		
Tx diversity (2RF output)	√	√*1				√	√		
Hard handover	√	√		√		√		√	
Inter-system (GSM/GPRS) handover					√	√		√	
Ciphering									√*2

*1: Requires two equipment sets
*2: When using with the MX848001A-01 or MX848001A-02, requires the MX848041A-01 or MX848041A-02.

The options are all shared functions.

- Requires MD8480B + MU848057A + MU848058A + MU848058A for 3BS soft handover function.
  This configuration also supports 2BS soft handover function.
- Requires MD8480B + MU848057A + MU848058A + MU848058A + MD8480A-01 + MX848001A-01 for Tx diversity (2RF output).
  This configuration also supports the 2BS soft handover function, 3BS soft handover function and Tx diversity (1RF output) function.

Bluetooth™ TEST SET

MT8850A

2.4 GHz Reference *Bluetooth* Transceiver

Test Bluetooth Modules and Products with a Bluetooth Interface

MT8850A makes RF measurements on Bluetooth modules and Bluetooth products, quickly and at low cost. All measurements are made in accordance with the Bluetooth RF Test Specification.

MT8850A establishes a Bluetooth link with the EUT (Equipment Under Test) using standard signalling. MT8850A is the Master, establishing the link by Paging the EUT. The EUT BT address can be entered manually or through the GPIB port. If the EUT BT address is not known, you can use Inquiry or read the address directly through the EUT HCI interface (RS 232).

Test Mode is then activated in the EUT and RF measurements performed. When the EUT is in Test Mode, the MT8850A has complete control over its operation. The EUT can be put into loopback or TX test mode, frequency hopping can be disabled or the EUT sent to defined TX and RX frequencies as required by the test specification.

The MT8850A runs a selected test script. A test script comprises of all (or a user selected subset) of the available RF measurements. The user can modify the measurements by editing test frequencies, number of bits/packets tested, hopping On or Off, whitening On or Off, and Pass/Fail limits. Pre programmed "qualification" and "quick test" scripts plus user-defined scripts. Script results can be viewed on the screen and accessed over the GPIB. In addition any individual measurement can be run continuously.

Features

- **Fast - 5 second test time**

The rapid "Quick Test" measurement script is pre-configured for ease of operation. Production test scripts can run in as little as 5 seconds, measuring power, frequency, modulation and receiver sensitivity (BER).

- **One touch testing**

Once the MT8850A has been configured, each device is tested with a single keystroke. Press RUN to initiate a link, activate Test Mode, perform the measurements and report the results.

- **Authoritative**

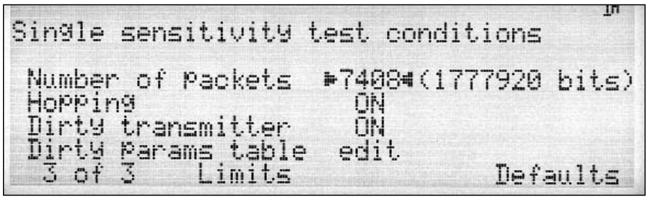
Tests are made exactly as defined in the Bluetooth RF Test Specification. All measurements are traceable to International Standards so that you can be totally confident in both your production testing and design proving.

- **Reference Bluetooth transceiver**

A custom design transceiver offers <1 kHz frequency accuracy at the start of any packet and full compliance with the requirements for the "Dirty Transmitter" for true receiver sensitivity measurements. In addition to the standard dirty transmitter table, you can define customised stress conditions with user settable values of Carrier Frequency Offset, Modulation Index, Symbol Timing Error and simulated carrier frequency drift.

- **Editing tests**

Define your own test scripts to customise the test measurements to your specific requirements. Each test can be enabled or disabled and within any test, parameters such as hopping can be enabled or disabled, the number of measured packets defined and the specific frequencies of testing set up.

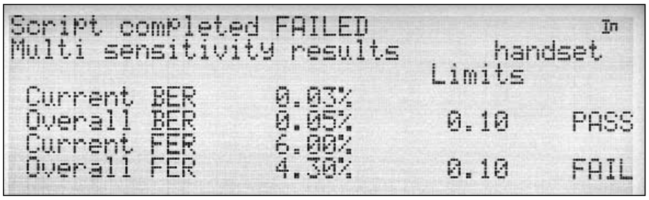


```
Single sensitivity test conditions

 Number of packets   ▸7408◂(1777920 bits)
 Hopping                ON
 Dirty transmitter      ON
 Dirty params table   edit
  3 of 3     Limits                Defaults
```

- **Single test mode**

A single test can be run continuously so that, for example, the BER of a link can be monitored as additional interfering Bluetooth devices are activated or the distance between the EUT and the MT8850A increased.



```
Script completed FAILED
Multi sensitivity results          handset
                              Limits
 Current BER      0.03%
 Overall BER      0.05%        0.10     PASS
 Current FER      6.00%
 Overall FER      4.30%        0.10     FAIL
```

- **Remote control**

Both GPIB and RS 232 interfaces are offered as standard. Creating test programs has been simplified by the MT8850A's capability for initiating a test using a single command and then having results returned in a single string.

- **Small size and weight**

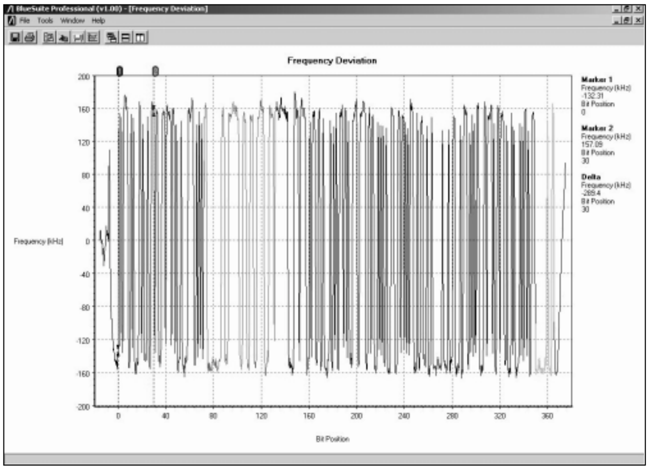
MT8850A takes up minimal space in your test system, thanks to its half-rack size and light weight. Where Bluetooth interfaces are being introduced into existing products, the disturbance to the test system is minimised.

- **Field upgradeable**

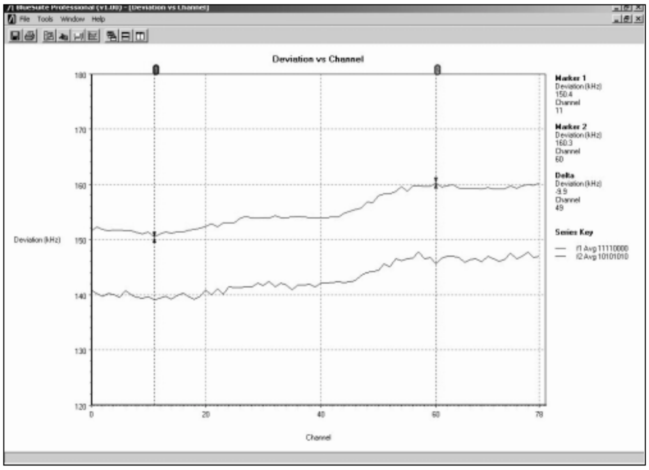
The Bluetooth protocol stack is held in FPGA so that future releases of the core Bluetooth specification can be installed locally. The instruments main program is held in flash memory; consequently, product enhancements can be downloaded in the field.

BlueSuite support software

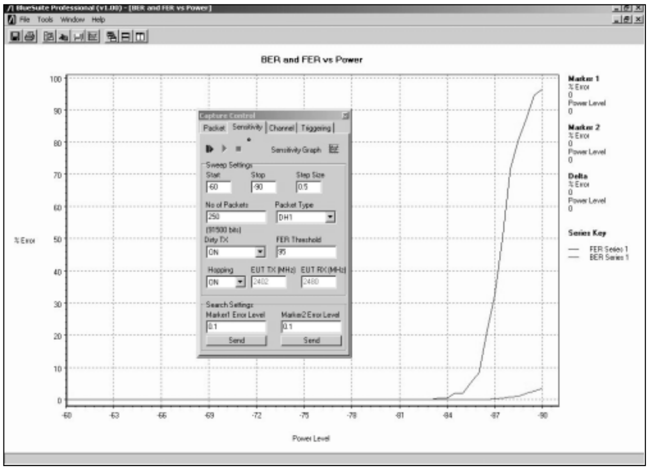
The standard BlueSuite software package, supplied at no charge with every MT8850A, gives PC control of the MT8850A/MT8852A for advanced design proving measurements on Bluetooth radios. Use BlueSuite to view packet modulation, power burst profiles and modulation eye diagrams. The standard BlueSuite software also offers a PC user interface for defining custom test scripts and reading script results into the PC. For interoperability testing during protocol development, BlueSuite offers a LMP message log capture facility. This can be used to view LMP messages between the MT8850A and the EUT during the initialisation of the link and while tests are running.
Upgrade to BlueSuite Pro to display graphs of the output power, deviation, carrier drift and sensitivity on each of the 79 channels. BlueSuite Pro also includes automated sensitivity search software for automatic measurements of BER and FER against receiver input level.
To help track down the cause of occasional rogue packets, BlueSuite Pro can be configured to only capture a packet trace when the packet fails any specific measurement.



Bluetooth DH1 packet deviation viewed with BlueSuite. Trace is colour coded such that; red is pre-amble, light blue is access code, brown is header, dark blue is payload and green is CRC.



BlueSuite Pro measures deviation for 10101010 and 11110000 payloads on each channel.

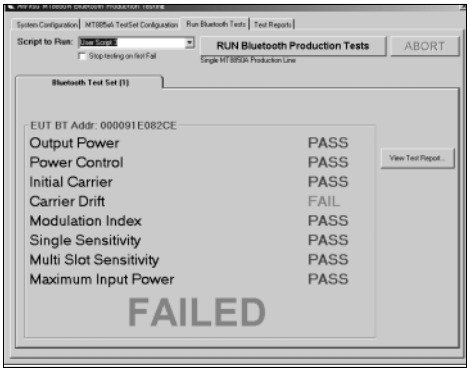


Sweep Settings
Start: -60
Stop: -90
Step Size: 0.5
No of Packets: 250
(91500 bits)
Packet Type: DH1
Dirty TX: ON
FER Threshold: 95
Hopping: ON
EUT TX (MHz): 2402
EUT RX (MHz): 2480
Search Settings
Marker1 Error Level: 0.1
Marker2 Error Level: 0.1

Automatic sensitivity search measured with BlueSuite Pro. Blue trace shows FER and red trace BER.

BlueTest production test software

The BlueTest PC software package controls up to 16 MT8850A/MT8852A Bluetooth Test Sets. It is designed for users requiring rapid testing of multiple devices such as modules. BlueTest software offers a simple interface for configuring scripts, triggering multiple instruments to start testing and reading script results back into the PC. The results are stored into a database from which they can be printed or archived for future analysis.
BlueTest software is supplied as standard with all MT8850A/MT8852As.



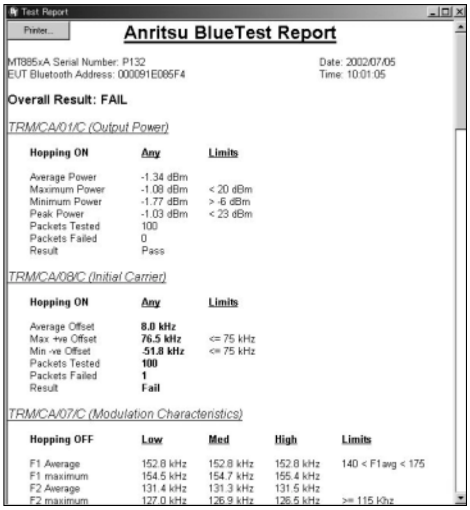
☐ Stop testing on first Fail

EUT BT Addr: 000091E082CE

Output Power	PASS
Power Control	PASS
Initial Carrier	PASS
Carrier Drift	FAIL
Modulation Index	PASS
Single Sensitivity	PASS
Multi Slot Sensitivity	PASS
Maximum Input Power	PASS

FAILED

Results screen for BlueTest software.



Anritsu BlueTest Report

MT885xA Serial Number: P132
EUT Bluetooth Address: 000091E085F4
Date: 2002/07/05
Time: 10:01:05

Overall Result: FAIL

TRM/CA/01/C (Output Power)

Hopping ON	Any	Limits
Average Power	-1.34 dBm	
Maximum Power	-1.08 dBm	< 20 dBm
Minimum Power	-1.77 dBm	> -6 dBm
Peak Power	-1.03 dBm	< 23 dBm
Packets Tested	100	
Packets Failed	0	
Result	Pass	

TRM/CA/08/C (Initial Carrier)

Hopping ON	Any	Limits
Average Offset	8.0 kHz	
Max +ve Offset	76.5 kHz	<= 75 kHz
Min -ve Offset	-51.8 kHz	<= 75 kHz
Packets Tested	100	
Packets Failed	1	
Result	Fail	

TRM/CA/07/C (Modulation Characteristics)

Hopping OFF	Low	Med	High	Limits
F1 Average	152.8 kHz	152.8 kHz	152.8 kHz	140 < F1avg < 175
F1 maximum	154.5 kHz	154.7 kHz	155.4 kHz	
F2 Average	131.4 kHz	131.3 kHz	131.5 kHz	
F2 maximum	127.0 kHz	126.9 kHz	126.5 kHz	>= 115 Khz

Typical BlueTest test report.

Note: For MT8850A specifications and ordering information, see pages 252 – 256.

Bluetooth™ TEST SET

MT8852A

2.4 GHz Reference *Bluetooth* Transceiver

For RF and Audio Measurements on Bluetooth Radios

The new MT8852A Bluetooth test set offers all the functionality of the MT8850A plus the ability to make measurements on audio Bluetooth channels. Consumer products such as headsets, audio gateways and in-car consoles that offer voice over Bluetooth will require audio measurements as well as radio layer measurements. The MT8852A offers full audio test capability. It is fully compliant with all the functionality defined in the Bluetooth audio specification. MT8852A supports all three codec air interfaces (µ-law, A-law and CVSD) on up to three SCO audio channels. Rear-panel jack-plug connectors provide analog inputs and outputs for all three audio channels to give a convenient interface to audio signal sources and analyzers.
The MT8852A Bluetooth Test Set performs audio measurements by establishing a Synchronous Connection Oriented (SCO) link between the MT8852A and the EUT. A SCO link is a full duplex link between a Bluetooth master and slave.

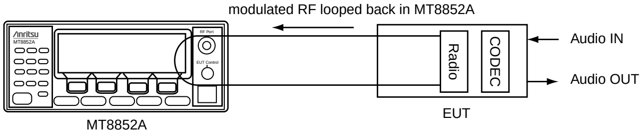
Note: It should be noted that SCO is an optional feature within the Bluetooth specification. The MT8852A can be used to establish a SCO link and transmit HV packets to, or from, the EUT. To perform audio measurements, an audio signal source and audio analyzer are also required.

There are four basic scenarios in which audio measurements may be made. The four test scenarios are:

- Testing the EUT's audio performance using remote loopback on the MT8852A.
- Testing the audio performance of the EUT transmit path.
- Testing the audio performance of the EUT receive path.
- Putting the EUT into remote loopback.

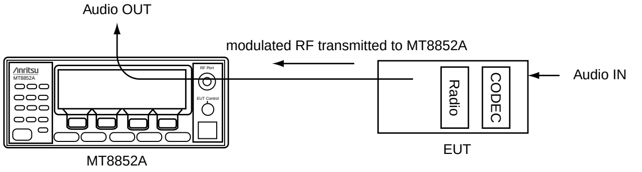
Testing the EUT's Audio Performance Using Remote Loopback on the MT8852A

The EUTs audio performance can be tested using the set-up below. The MT8852A is put into remote loopback and the audio path tested without passing the signal through the MT8852A CODEC. The audio is looped back in the MT8852A baseband and so there is no audio distortion introduced by the tester.



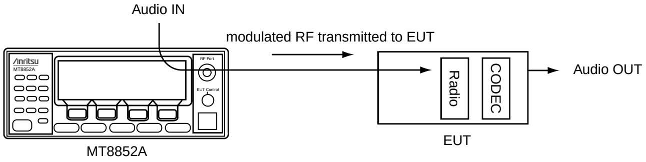
Testing the Audio Performance of the EUT Transmit Path

The performance of the EUT transmitter can be tested in isolation with the set-up shown below.



Testing the Audio Performance of the EUT Receive Path

The performance of the EUT receiver can be tested in isolation with the set-up shown below.
As a replacement for the external audio IN, it is also possible to use an internally generated tone. Use of this tone is ideal for quick tests and as it is generated internally, it does not pass through the MT8852A CODEC. The tone is fixed at 1kHz. For measurement at other frequencies use of external audio is required.



Specifications

Output power	General	MT8850A/MT8852A measures average and peak power according to the Bluetooth RF Test Specification. Measurement of output power is made with the EUT in test mode, loopback enabled and hopping on. MT8850A/MT8852A transmits the longest supported packets and longest supported payload length, with a PRBS 9 payload. Power is measured at three defined frequencies. MT8850A/MT8852A identifies the position of p0 and measures the power of every bit in the packet.	
	Link conditions	Hopping	ON – measure at Defined, All, or Any frequencies
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	PRBS 9
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Average power, peak power
		Number of measurement frequencies	User selectable, Defined (3), All, or Any
		Measurement range	+22 dBm to -35 dBm average power (+23 dBm peak power)
		Resolution	0.1 dB
		Accuracy	+20 dBm to -35 dBm, ±1 dB +22 dBm to +20 dBm, ±1.5 dB
		Speed	Greater than 300 DH1 packets/sec. with hopping mode set to "Any".
Modulation characteristics	General	MT8850A/MT8852A measures modulation characteristics according to the Bluetooth RF Test Specification. Measurement of modulation characteristics is made with the EUT in test mode, loopback enabled and hopping off. MT8850A/MT8852A transmits longest supported packets, with the defined payload to the EUT. Modulation characteristics are measured at three defined frequencies.	
	Link conditions	Hopping	OFF
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	11110000 and 10101010
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Supported measurements: Frequency deviation. Δf1max, Δf2max, Δf1avg, Δf2avg and Δf2avg/Δf1avg plus % of Δf2max < 115 kHz
		Number of measurement frequencies	Three, default to qualification specification or user defined
		RF input measurement range	+20 dBm to -35 dBm
		Deviation measurement range	0 Hz to 350 kHz peak
		Deviation resolution	1 kHz
		Accuracy	1 kHz
Power control	General	MT8850A/MT8852A measures power control according to the Bluetooth RF Test Specification. Measurement of power control is made with the EUT in test mode, loopback enabled and hopping off. MT8850A/MT8852A transmits DH1 packets, with a PRBS 9 payload. Power control is measured at three defined frequencies. MT8850A/MT8852A uses standard LMP commands to set the EUT power. MT8850A/MT8852A identifies the position of p0 and measures the power of every bit in the packet.	
	Link conditions	Hopping	OFF
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	PRBS 9
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Maximum power, minimum power, maximum step size, minimum step size, and power at each power step.
		Number of measurement frequencies	Three, default to qualification specification or user defined
		Measurement range	+22 dBm to -35 dBm average power (+23 dBm peak power)
		Resolution	0.1 dB
		Accuracy	+20 dBm to -35 dBm, ±1 dB +22 dBm to +20 dBm, ±1.5 dB

Continued on next page

Initial carrier frequency tolerance	General	MT8850A/MT8852A measures initial carrier frequency tolerance according to the Bluetooth RF Test specification. Measurement of initial carrier frequency is made with the EUT in test mode, TX mode and hopping on and/or off. MT8850A/MT8852A transmits DH1 packets, with a PRBS 9 payload. Initial carrier frequency is measured at three defined frequencies. MT8850A/MT8852A identifies the position of p0 and measures the average frequency of the 4 preamble bits.	
	Link conditions	Hopping	OFF or ON – measure at Defined, All, or Any frequencies
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	PRBS 9
		Packet type	DH1
	Measurement	Supported measurements	Initial carrier frequency error
		Number of measurement channels	User selectable, Defined (3), All, or Any
		RF input measurement range	+20 dBm to -35 dBm
		Initial frequency error measurement range	0 Hz to ±150 kHz
		Frequency resolution	1 kHz
		Accuracy	1 kHz
		Speed	Greater than 300 DH1 packets/sec. with hopping mode set to "Any".
Carrier frequency drift	General	MT8850A/MT8852A measures carrier frequency drift according to the Bluetooth RF Test Specification. Measurement of frequency drift is made with the EUT in test mode, with either loopback or transmitter test mode enabled. EUT transmits longest supported packets, with a 10101010 payload to the EUT. Measurements are made with hopping off and then with hopping on. Frequency drift is measured at three defined frequencies with hopping off and every frequency with hopping on.	
	Link conditions	Hopping	OFF or ON – measure at Defined, All, or Any frequencies
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	10101010
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Carrier frequency drift
		Number of measurement frequencies	User selectable, Defined (3), All, or Any
		RF input measurement range	+20 dBm to -35 dBm
		Frequency drift measurement range	0 Hz to 200 kHz, and > 2000/50 µs
		Frequency resolution	1 kHz
		Accuracy	Accuracy
Sensitivity - single slot packets	General	MT8850A/MT8852A measures single slot sensitivity according to the Bluetooth RF Test Specification. BER and FER are measured with the EUT in test mode and loopback on. MT8850A/MT8852A transmits DH1 packets, with a PRBS 9 payload to the EUT. The user can select to run the measurement with hopping on or off. Dirty transmitter conditions as defined in the *Bluetooth* test specifications can be enabled.	
	Link conditions	Hopping	OFF or ON, user selectable
		Test mode	ON
		Loopback	ON
		Payload	PRBS 9
		Packet type	DH1
		Dirty transmitter (as defined in RF test spec)	ON or OFF, user selectable

Continued on next page

<table>
<tr><td rowspan="20">Sensitivity - single slot packets</td><td rowspan="20">Measurement</td><td>Supported measurements</td><td colspan="4">BER, total number of bit errors and FER</td></tr>
<tr><td>Number of measurement frequencies</td><td colspan="4">Three with hopping off, or hopping on</td></tr>
<tr><td>Number of measured bits</td><td colspan="4">1 to 32,768 packets (216 to 7,077,888 bits)</td></tr>
<tr><td>MT8850A/MT8852A transmitter output range</td><td colspan="4">0 to –90 dBm, resolution 0.1 dB</td></tr>
<tr><td>BER/FER measurement range</td><td colspan="4">0.00% to 100%</td></tr>
<tr><td>BER/FER resolution</td><td colspan="4">0.01%</td></tr>
<tr><td rowspan="14">Dirty transmitter specification</td><td colspan="4">MT8850A/MT8852A transmits for the first 20 ms with the first set of measurement conditions, the second 20 ms with the second set of measurement conditions up to the tenth set of conditions. The cycle is then repeated until the test is complete.</td></tr>
<tr><td>Measurement conditions</td><td>Carrier frequency offset</td><td>Modulation index</td><td>Symbol</td></tr>
<tr><td>1</td><td>75 kHz</td><td>0.28</td><td>–20 ppm</td></tr>
<tr><td>2</td><td>14 kHz</td><td>0.30</td><td>–20 ppm</td></tr>
<tr><td>3</td><td>–2 kHz</td><td>0.29</td><td>+20 ppm</td></tr>
<tr><td>4</td><td>1 kHz</td><td>0.32</td><td>+20 ppm</td></tr>
<tr><td>5</td><td>39 kHz</td><td>0.33</td><td>20 ppm</td></tr>
<tr><td>6</td><td>0 kHz</td><td>0.34</td><td>–20 ppm</td></tr>
<tr><td>7</td><td>–42 kHz</td><td>0.29</td><td>–20 ppm</td></tr>
<tr><td>8</td><td>74 kHz</td><td>0.31</td><td>–20 ppm</td></tr>
<tr><td>9</td><td>–19 kHz</td><td>0.28</td><td>–20 ppm</td></tr>
<tr><td>10</td><td>–75 kHz</td><td>0.35</td><td>+20 ppm</td></tr>
<tr><td colspan="4">In addition to the above measurement conditions, MT8850A/MT8852A transmits with a sine wave, frequency modulation, with a deviation of ±25 kHz, rate 1.6 kHz, synchronized to zero phase at the packet start.</td></tr>
<tr><td>Dirty transmitter user control</td><td colspan="3">Any entry in the dirty transmitter table can be edited within the following ranges:
• Carrier frequency offset: 0 Hz to 100 kHz, 1 kHz resolution
• Modulation index 0.25 to 0.38, 0.01 resolution
• Symbol timing error: 0 ppm, +20 ppm or 20 ppm</td></tr>
<tr><td rowspan="14">Sensitivity - multi-slot packets</td><td>General</td><td colspan="5">MT8850A/MT8852A measures multi-slot sensitivity according to the Bluetooth RF Test Specification. BER and FER are measured with the EUT in test mode and loopback on. MT8850A/MT8852A transmits DH5 packets (or DH3 packets if DH5 not supported by EUT), with a PRBS 9 payload to the EUT. The user can select to run the measurement with hopping on or off. Dirty transmitter conditions as defined in the Bluetooth test specifications can be enabled.</td></tr>
<tr><td rowspan="6">Link conditions</td><td>Hopping</td><td colspan="4">OFF or ON, user selectable</td></tr>
<tr><td>Test mode</td><td colspan="4">ON</td></tr>
<tr><td>Loopback</td><td colspan="4">ON</td></tr>
<tr><td>Payload</td><td colspan="4">PRBS 9</td></tr>
<tr><td>Packet type</td><td colspan="4">DH3, DH5</td></tr>
<tr><td>Dirty transmitter
(as defined in RF test spec)</td><td colspan="4">ON or OFF, user selectable</td></tr>
<tr><td rowspan="7">Measurement</td><td>Supported measurements</td><td colspan="4">BER, total number of bit errors and FER</td></tr>
<tr><td>Number of measurement frequencies</td><td colspan="4">Three with hopping off, or hopping on</td></tr>
<tr><td>Number of measured bits</td><td colspan="4">1 to 32,768 packets (for DH3, 1,464 to 47,972,352 bits), (for DH5, 2,712 to 88,866,816 bits)</td></tr>
<tr><td>MT8850A/MT8852A transmitter output range</td><td colspan="4">0 to –90 dBm, 0.1 dB resolution</td></tr>
<tr><td>BER/FER measurement range</td><td colspan="4">0.00% to 100%</td></tr>
<tr><td>BER/FER resolution</td><td colspan="4">0.01%</td></tr>
<tr><td>Dirty transmitter specification</td><td colspan="4">As for single-slot sensitivity section except; in addition to the measurement condition table, MT8850A/MT8852A transmits with a sine wave, frequency modulation, with a deviation of ±40 kHz, rate 500 Hz (3 slots) or 300 Hz (5 slots), synchronized to zero phase at the packet start.</td></tr>
</table>

Continued on next page

Maximum input level	General	MT8850A/MT8852A measures BER and FER at the EUT maximum input level according to the *Bluetooth* RF Test Specification. Measurement is made with the EUT in test mode, loopback enabled and hopping off. MT8850A/MT8852A transmits the DH1 packets with a PRBS 9 payload. The MT8850A/MT8852A transmitter level is set so that the EUT receiver input level is -20 dBm. BER and FER are measured at three defined frequencies.	
	Link conditions	Hopping	OFF
		Test mode	ON
		Loopback	ON
		Payload	PRBS 9
		Packet type	DH1
	Measurement	Supported measurements	BER and FER for -20 dBm at receiver input
		Number of measurement frequencies	Three, default to qualification specification or user defined
		Number of measured bits	1 to 32,768 packets (216 – 7,077,888 bits)
		Transmitter power settable range	0 to –90 dBm
		Resolution	0.1 dB
EUT control interface		The EUT control interface provides HCI commands to EUT through a standard RS232 interface. Interface meets requirements of *Bluetooth* V1.1 specification for HCI UART transport layer. Cable supplied.	
Audio Specifications (MT8852A only)		Number of SCO channels supported	3
		Codec air interfaces supported	CVSD, A-Law, µ-Law
		Frequency response	(-3dB) measured CODEC in to CODEC out: 160Hz -3.5kHz. Measured with 50Ω source impedance and 10MΩ load impedance.
		Maximum input / output signal level	3.4 Vpk-pk = 1.2 V RMS.
		Distortion/noise	Greater than –40 dB relative to 1 kHz, 1 V RMS input/output.
		Input/Output connectors	3.5 mm audio jack plugs (one for each SCO channel)
		Input impedance	20 kΩ
		Minimum output load	600 Ω
		Internal audio source	1kHz fixed frequency
Frequency standard		Frequency	10 MHz
		Accuracy	±0.5 ppm at +25˚C
		Temperature Stability	±0.5 ppm, –10˚ to +85˚C
		Aging (1st year)	±1.0 ppm
		Aging (over 10 years)	±2.5 ppm, including year 1
Rear panel connectors		External frequency standard input	Rear panel BNC socket, 50 Ω 1 volt
		Output 1	TTL high when MT8850A TX on
		Output 2	TTL high when MT8850A RX active
		Input 1	For service use only
GPIB		IEEE 488.2. Offers full instrument control as standard. User can also read the 4 x over-sampled magnitude and frequency values of each data bit in the last measured packet.	
RS 232		RS 232 interface offering full instrument control as standard	
Power requirements		Supply	85 to 264 Volts AC 47 to 63 Hz 150 VA MAX
Environmental		Operating temperature	5 to +40ºC
		Operating humidity	20% to 75%
		Safety	Complies with IEC 1010-1
		EMC	Conforms to the protection requirements of EEC Council Directive 89/336/EEC.
Size and weight		Dimensions	216.5 x 88 x 380 mm
		Weight	<3.45 kg

Continued on next page

MT8850A/MT8852A signal generator		
Frequency	Frequency range	2.40 to 2.5 GHz
	Frequency resolution	1 kHz
	Frequency accuracy	As frequency standard ± 25 Hz
	Settling time (when hopping)	<160µs to ± 75 kHz during the establishing of a link. When a link has been established and the EUT been placed into test mode, the MT8850A/MT8852A transmitter is pre-tuned to ±1 kHz of the nominal channel frequency at the beginning of its data burst for both fixed frequency or hopping measurements.
Level	Amplitude range	0 to –90 dBm
	Amplitude accuracy	±1 dB to –80 dBm
	Amplitude resolution	±0.1 dB
	Output impedance	50 Ω (nominal)
	Output VSWR	1.5:1 (typically 1.3) Adjacent channels 3 or higher –40 dBc
	Spurious	30 MHz to 1 GHz: –36 dBc 1 to 12 GHz: –30 dBc 1.8 to 1.9 GHz: –47 dBc 5.15 to 5.3 GHz: –47 dBc or –80 dBm, whichever is greater
Modulation	Modulation	GFSK
	Modulation index	Variable, 0.25 to 0.38 (125 kHz to 190 kHz)
	Mod index resolution	0.01
	Mod index accuracy	1 kHz
	Baseband filter	BT=0.5
MT8850A/MT8852A measuring receiver		
Frequency	Range	2.40 to 2.5 GHz
	Resolution	1 kHz
	Settling time	<160 µs to 75 kHz during the establishment of a link. When a link has been established and the EUT has been placed into test mode, the MT8850A/8852A receiver is pre-tuned to ±1 kHz of the nominal channel frequency.
	Accuracy	As frequency standard ±25 Hz
	Measurement channel bandwidth	2 MHz 3dB bandwidth, flat response Fc ± 550 kHz, or 1.3 MHz 3dB bandwidth, flat response Fc ± 550 kHz.
Level	Range	+22 dBm to –35 dBm average power
	Power measurement accuracy	±1 dB (+20 dBm to –35 dBm)
	Input VSWR	1.5:1
	Damage level	+25 dBm
	Resolution	0.1 dB
Modulation	Modulation	GFSK
	Deviation measurement range	0 to 350 kHz peak
	Accuracy	1 kHz

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MT8850A	*Bluetooth* Test Set
MT8852A	*Bluetooth* Test Set with Audio
	Standard accessories
	Power cord for destination country
	EUT control interface lead
	RS232 cable for firmware updates
	Operation Manual
	Remote programming manual
	Certificate of Calibration
	LabVIEW™ Driver
	BlueSuite software (standard version)
	BlueTest production test software
	3.5 mm jack plug x 3 (MT8852A only)

Model/Order No.	Name
	Options and accessories
MT8850A-01	Rack mount, single instrument
MT8850A-03	Rack mount, side-by-side
MT8850A-06	Rear mount RF and EUT connectors
MT8850A 10	*Bluetooth* antenna and adapter
MT8850A-20	Spare EUT/RS232 cable
MT8850A-30	Extra operation and programming Manual
D41310	Soft carry case with shoulder strap
2300-259	BlueSuite Pro software

WLAN TEST SET

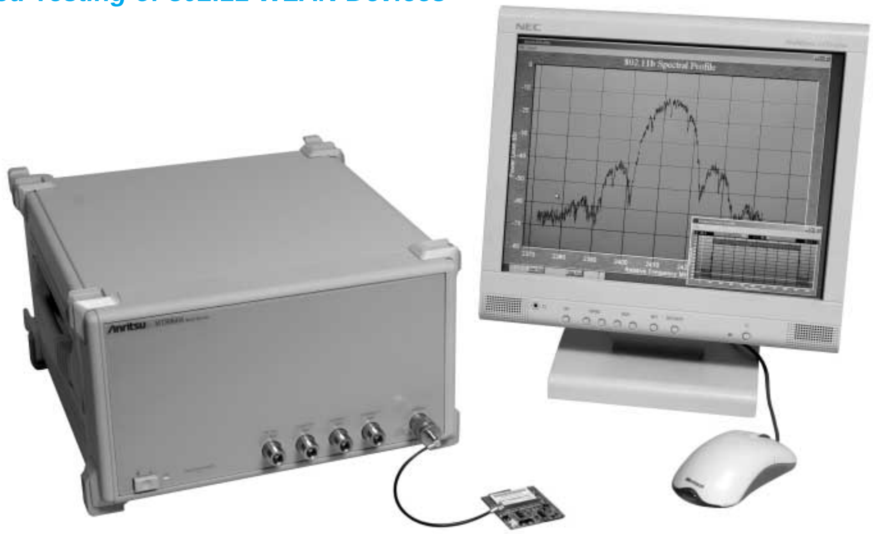
MT8860A

2.4 to 2.5 GHz and 4.8 to 6 GHz

GPIB

For High Speed Testing of 802.11 WLAN Devices

NEW



The MT8860A WLAN Test Set from Anritsu is an integrated test set dedicated to testing WLAN devices in the 2.4 GHz and 4.8 to 6 GHz Industrial Scientific and Medical (ISM) frequency bands.
MT8860A provides a high-speed measurement solution that is suitable for both production testing and design proving. The user interface is implemented through the supplied *LANLook* software package. *LANLook* runs on a standard PC and uses a conventional Windows interface for both instrument configuration and results displays. *LANLook* communicates with the MT8860A through a GPIB interface.

Features

- 802.11b transmitter and receiver measurements
- High speed transmitter power, frequency, carrier suppression and harmonic measurements
- Graphical display of power burst profile and spectral mask
- Automated receiver FER measurements
- Optional EVM measurements with constellation and eye diagrams
- *LANLook* Windows style user interface runs on a standard PC
- Built in Reference Radio
- Advanced triggering and gating features
- Inputs for external Golden radio and interfering signal sources
- Upgradeable to 802.11a and 802.11g standards

802.11b Measurements

The IEEE 802.11 WLAN standards have become established as the preferred interface for wireless connectivity between a PC and a network. A PC can connect to a WLAN network either through the use of a PC card accessory or, more recently, using integrated WLAN technology.
To ensure a high quality link between the PC and the LAN access point, manufacturers need to validate that the performance of each product meets the 802.11 standard.
MT8860A supports the following 802.11b measurements. Each measurement can be performed on the 14 frequency channels and at all specified power levels.

Transmitter measurements

- Carrier frequency
- Carrier frequency error
- Transmitter power (average)
- Transmitter power (peak)
- Transmitter power control
- Spectrum mask compliance
  - – Including first and second adjacent channel power
- Carrier suppression
- 2nd and 3rd harmonic power
- Power burst profile
- Tx-Rx, Rx-Tx turnaround time
- With option 01
  - – Error Vector Magnitude (EVM)
  - – Constellation diagram
  - – Modulation eye diagram

Receiver measurements

- Sensitivity (FER)
- Receiver saturation (max input power)
- Adjacent channel rejection*
- Non-Adjacent channel rejection*

* requires separate interfering signal source

Measurement Modes

DUT transmitter measurements
The DUT transmitter can be tested either using 802.11b test modes, or by establishing a link between the MT8860A and the DUT.

Measurements using Test Modes
When testing the DUT using test modes, the DUT is controlled through the host interface using software supplied by the chip set developer. This may require proprietary control software from the chip set developer. 802.11b test mode commands can be used to configure the DUT to transmit continuously, or in a bursted manner, on any defined channel. The MT8860A receiver is tuned to that channel and triggers continuously or from the power burst rising edge.

Measurements when forming an ad-hoc connection to the MT8860A Reference Radio
In this mode, the MT8860A forms an ad-hoc connection to the device being tested and performs measurements on the packets transmitted to the MT8860A from the DUT.
In this case, the packets measured are complete 802.11b packets. Triggers and gates can be set to measure a defined part of the packet.

Parallel measurements
MT8860A performs the power, frequency and spectral mask measurements of DUT in parallel. A high speed spectral processor performs the measurements in a much shorter time than swept tuned spectrum analyzers giving reduced total test time. Stepping to the frequency of the second and third harmonics and then measuring average power performs harmonic measurements. This power is then compared with the carrier power to calculate the harmonic power. MT8860A displays carrier power, and relative harmonic powers in a numeric format.

DUT receiver sensitivity measurements
All DUT receiver measurements are based on the measurement of Frame Error Rate (FER). The definition of a frame error is (1-(Number of frames correctly received/Number of frames sent))x100%. The 802.11b specification does not define a common method for the measurement of FER. As a result, chip set developers have developed proprietary software to facilitate this measurement. The MT8860A allows for a variety of test methods to measure FER.

FER measurements in an ad-hoc connection with the MT8860A Reference Radio
The MT8860A can establish an ad-hoc connection with the DUT and transmit a user definable number of frames to the DUT. Under ideal link conditions, the DUT sends an Acknowledge frame in return for each received frame. The frame error rate can be calculated from the ratio of transmitted frames to received Acknowledge frames.
When linked to the DUT the receiver sensitivity measurement can be run at either a fixed input level, or using a swept input level for a true sensitivity search.

FER measurements without forming a link to the DUT
The MT8860A can transmit a user definable number of frames on a fixed channel without first establishing a link with the DUT. These frames have standard 802.11b frame structure. To measure FER the DUT must be able to enter a "Permissive" receive mode. In this mode, the DUT receives and counts all incoming frames. It is necessary to be able to read the DUT received frame counter register to calculate the FER.

Receiver sensitivity and saturation measurements
The MT8860A signal source has a calibrated output power range of –100 dBm to 0 dBm. The 802.11b specification requires a DUT FER of <10% at a receiver input level of –76 dBm. MT8860A can measure the FER at a fixed level, or perform a power sweep and so plot FER vs. receiver input level.
To ensure that the DUT receiver does not saturate when receiving a high signal level, the FER must also be measured with a receiver input of –10 dBm. This simulates the operation of the DUT in close proximity to, for example an access point.

Receiver adjacent and non-adjacent channel rejection measurements
Two inputs are provided on the front panel of the MT8860A so that an external signal source can be coupled onto the output of the MT8860A signal source. This facilitates the measurement of FER in the presence of interfering signals. The path loss of the coupled input is calibrated so that a precise signal level can be set for the interferer. Two inputs are offered so that both adjacent channel and intermodulation rejection measurements can be performed.

Power vs. Time measurements
The burst profile and Tx-Rx or Rx-Tx turnaround time can also be viewed. This provides a simple display of the DUT transmitter rising and falling edge, as well as validating the relative timing of the transmitter and receiver.

Option 1, extended modulation measurements
Option 1 adds the measurements of transmitter Error Vector Magnitude (EVM) to the MT8860A. EVM can be measured on either a single bit, or on the average of a user definable number of bits. In this way the variation of EVM across the frame can be measured.
Displays of constellation diagram and modulation eye diagram are available for detailed analysis. Colour coding of the elements of the packet give easy indication of the element of the packet that is failing a given limit.

Planned future enhancements
The MT8860A hardware has been designed such that it can support measurements of the 802.11g and 802.11a standards.

Specification 802.11b measurement suite

Connectivity	MT8860A mode	Ad-hoc connections	
	Linking to the DUT	Active scanning, Passive scanning	
	Data exchange	Both two and four step; Request to send, Clear to send, Send, Acknowledge.	
Reference Radio transmitter	Frequency range	802.11b channels 1 to 14	
	Output power	0 dBm to –100 dBm	
	Accuracy	± 1 dB	
	Resolution	0.1 dB	
	Output VSWR	1.5:1 (typically 1.3)	
	Output impedance	50 Ω (nominal)	
	Modulation	Quadrature Phase Shift Keying (QPSK)	
	Modulation accuracy	5% EVM	
Reference Radio receiver	Frequency range	802.11b channels 1 to 14	
	Frequency accuracy	± 1 ppm	
	Maximum input	+30 dBm	
	Damage level	+35 dBm	
	Sensitivity	–50 dBm	
Measurement Controls	Triggers	Free run	Continuous triggering
		Reference radio RX on	Triggers when packet received
		RF edge	On rising or falling edge detected at RF input
		IF edge	On rising or falling edge detected at IF stage
		External	BNC on rear panel
	Gates	Two gates for power measurements	

Continued on next page

Measurements	Power	Definition	DUT channel Average and Peak power with power control step values
		Range	+30 dBm to –60 dBm
		Accuracy	± 0.5 dB
		Linearity	± 0.2 dB
		Resolution	0.1 dB
	Frequency	Definition	DUT channel frequency and frequency error
		Accuracy	50 Hz ± 2 ppm
		Resolution	1 Hz
	Spectral mask	Definition	First and second upper and lower sideband relative channel power
		Range	+30 dBm to –60 dBm
		Dynamic range	60 dB, for input signal of 0 dBm or greater
		Accuracy	± 0.5 dB
		Linearity	± 0.2 dB
		Resolution	0.1 dB
		Receiver bandwidth	Equivalent to 100 kHz gausian
		Channel width	Full channel width or 80% of channel
	Carrier suppression	Definition	Relative level of the carrier to highest sideband, for a 10101010 test pattern
		Range	+30 dBm to –60 dBm
		Dynamic range	60 dB, for input signal of 0 dBm or greater
		Accuracy	± 1 dB
		Resolution	0.1 dB
	Harmonic distortion	Definition	Relative level of second and third harmonics to carrier level
		Range	+30 dBm to –60 dBm
		Dynamic range	60 dB, for input signal of 0 dBm or greater
		Accuracy	± 1 dB
		Resolution	0.1 dB
	Receiver sensitivity	Definition	Frame Error Rate (FER) at defined input level
		Number of frames	1 to 10,000 user defined or continuous
		Payload length	1024 bytes (or user defined payload length)
	Error Vector Magnitude (requires option 1)	Definition	Magnitude of vector error between a measured constellation point and the ideal constellation point. EVM for each bit or frame average available.
		Accuracy	0.5%
	Power burst profile	Definition	Display of the power in each bit of the measured frame verses time.
		Range	+30 dBm to –60 dBm
		Dynamic range	60 dB, for input signal of 0dBm or greater.
		Power accuracy	± 1 dB
		Resolution	0.1 dB
		Time window	1 µs to 100 ms
		Time resolution	0.1 µs
Front panel inputs and outputs	Test port – connection to DUT or signal source output, N type (f) External Gold Radio – input from external Golden Radio, N type (f) External interferer 1, input, N type (f) External interferer 2, input, N type (f) Measurement receiver input, N type (f)		
Rear panel connectors	GPIB Ethernet RJ45 (not supported at launch) USB (not supported at launch) RS 232 (not supported at launch) Definable digital input 1, BNC (f) Definable digital input 2, BNC (f) Definable digital output 1, BNC (f) Definable digital output 2, BNC (f) 10 MHz reference input		

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
MT8860A	**Main frame** WLAN test set **Included accessories** Power cord for destination country Operation manual Certificate of calibration

Model/Order No.	Name
	Options
MT8860A-01	Rack mount kit
MT8860A-10	2.4 GHz antenna and adapter

Bluetooth™ PREQUALIFICATION TEST SET SYSTEM (PQTS)

ME7865A

9 kHz to 3 GHz (20 GHz with option)

For Prequalification Testing of all 16 RF Bluetooth Test Cases

The Anritsu ME7865A *Bluetooth* Prequalification Test System (PQTS) addresses the 16 test cases defined in the *Bluetooth* RF test specification.

Developed in partnership with CETECOM, (Centro de Tecnologia de las Comunicaciones S.A.) the ME7865A offers an integrated solution including all the necessary test instruments and test case software to rapidly characterise *Bluetooth* radios.

Applications

- **Prequalification testing of chip sets**

For *Bluetooth* chip set developers the ME7865A provides a test system that enables comprehensive testing of the radio performance before submission to a *Bluetooth* Qualification Test Facility (BQTF). This gives the developer a high degree of confidence that the chip set will achieve qualification first time.

All measurements are made in accordance with the *Bluetooth* RF test specification. The ME7865A generates test reports that are ideal for documenting the results from an EUT. Reports can include both numeric results as well as graphical traces of the measured packets.

- **Module testing**

After integrating a *Bluetooth* chip set onto a module, it is necessary to revalidate the RF performance. Module manufacturers will typically design a module that is based on a reference design from the chip set supplier.

When the module design is complete, the implementation must be tested and characterised. The ME7865A is the ideal test system for proving the performance of new module designs.

- **Module selection**

Selecting the appropriate module for integration into an end user product requires a complete understanding of the characteristics of each *Bluetooth* module.

The ME7865A provides a test system for comparative testing of chip sets and modules. This facilitates the selection of a *Bluetooth* module that is best suited to the specific product being developed.

- **Selective test in volume production**

The MT8850A Bluetooth Test Set has been developed for high speed testing of all products manufactured with a *Bluetooth* interface. MT8850A measures key radio parameters such as power, frequency, modulation and sensitivity in a test time of typically under 5 seconds. Volume manufacturers who wish to continuously monitor the quality of output often chose to selectively test a sample of the output more rigorously. ME7865A is designed to be integrated into a high volume production test facility and used alongside the MT8850A for sample testing. The PC is supplied with a network interface so that results can be archived onto a company network.

- ***Bluetooth* Qualification Test Facilities**

Full qualification of a *Bluetooth* radio requires submission to a *Bluetooth* Qualification Test Facility (BQTF). The qualification process can be costly and time consuming. The ME7865A provides a solution for companies who wish to have a faster and lower cost analysis of their device before proceeding to full qualification.

The ME7865A reports generated will give the developer a full understanding of the performance of their device.

BQTFs can use ME7865A to offer a Prequalification test service.

Test management software

ME7865A software runs on an integrated rack mounted PC. The PC is supplied with a CD drive to facilitate software upgrades. A networking interface is also standard so that the ME7865A can easily be integrated into a company network. Free standing flat panel 15 inch TFT display, keyboard, and mouse are also supplied.

The ME7865A software consists of the following modules:

- **Executable test cases**

The RF test case software will control all of the instruments to perform the measurements automatically.

- **ICS/IXIT modules**

These modules contain the characteristics of the Equipment Under Test (EUT) for the selection of the applicable test cases. The data can be manually entered or read from the EUT supported features register.

- **Configuration manager**

The configuration manager is used to develop the test cases dependant on the contents entered into the IXIT module.

- **Test case manager**

The test case manager starts and finishes the test cases.

It also performs the verdict handling. The test case manager is also responsible for test case selection and the management of system files.

- **Database and report generator**

This module displays the results of test cases and generates reports in Microsoft Word format.

Transmitter measurements

- **Output power**

Output power measurements are made within the MT8850A *Bluetooth* Test Set. MT8850A identifies the position of P0 and measures the power in each of the bits within the packet. The average power across all the bits and the peak power are recorded.

- **Power density**

The power density measurement provides the peak power density in a 100 kHz bandwidth.
The measurement is made using the spectrum analyser. In the frequency domain a sweep over the ISM band is performed. The channel with the highest power is identified and this is set as the analyser's new centre frequency. A new one-minute single sweep is performed in the time domain. The power density is defined as the peak value of this trace.

- **Power control**

Power control tests allow for testing or calibration to be performed on the level control circuitry of the EUT.
This test is only performed on devices that support power control. The measure is performed in the same way as the average power measurement. The test verifies if power control step sizes are within the specified range.

- **Transmit output spectrum tests**

The transmit output spectrum measurements analyse the power levels in the frequency domain to ensure that out-of–channel emissions are minimised. The spectrum analyser performs these measurements. The *Bluetooth* specifications split the test into three parts; frequency range, –20 dB bandwidth, and adjacent channel power.
The frequency range measurement uses peak detection and validates that there is no spectral content outside the ISM band.
The –20 dB bandwidth test verifies the individual channel occupancy.
The adjacent channel power measurement uses average detection to validate the power spectral density over of all channels in the ISM band with a given wanted channel.

- **Modulation tests**

Modulation measurements reflect the performance of the modulator circuitry as well as local oscillator stability, and consist of modulation characteristics, initial carrier frequency tolerance and carrier frequency drift. Verification of modulation characteristics requires the ability to demodulate the *Bluetooth* signal so that the frequency of each bit can be determined.
For modulation characteristics, two sets of a repeating 8-bit sequence are used in the payload to check both the modulator performance and the pre-modulation filtering. Initial frequency error is measured by measuring the average frequency of the four preamble bits. Frequency drift is measured by comparing preamble bits with payload data. The maximum drift rate is also calculated in the payload.

Receiver measurements

BER is the parameter used to determine receiver performance. These tests perform BER analysis under various different conditions.

- **Sensitivity tests**

Sensitivity is tested by transmitting impaired signals (using a defined dirty transmitter) to the receiver. The transmitted power is fixed, with impairments defined in the test procedure, which include carrier frequency offset, modulation index variation and symbol timing error.

- **Carrier-to-interference performance**

C/I performance is measured by sending co-channel or adjacent channel *Bluetooth* modulated signals in parallel with the wanted signal and measuring the receiver's BER. One MT8850A delivers the wanted signal and a second MT8850A provides the PRBS15 interferer.

- **Blocking performance**

Blocking performance is measured by sending an out of band CW interfering carrier with the wanted signals in parallel and measuring the receiver's BER. One MT8850A delivers the wanted signal and a second source provides the CW interferer.

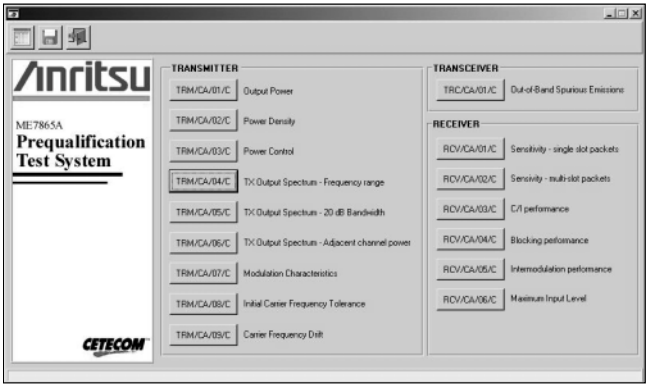
- **Intermodulation performance**

Intermodulation performance measures the effect of unwanted frequency components resulting from interaction between two interfering signals passing through receiver non-linear circuits. The test is performed by measuring receiver BER in the presence of an interfering modulated signal and a CW signal that generate an intermodulation product on the receiver operating frequency.

- **Maximum input level**

This test measures the BER performance when EUT input signal is at maximum input power level specified of –20 dBm.

Support services



Results for: *TRM/CA/04/C: Tx Output Spectrum - Frequency Range (1).*

Europe / USA / Japan

Low center frequency: 2.402 GHz

Low frequency (Fl): 2.401513 GHz

High center frequency: 2.480 GHz

High frequency (Fh): 2.480571 GHz

TEST Parameters
DATE: 11-27-2001 **TIME:** 09:18:23
Resolution B/W: 100 kHz
Video B/W: 300 kHz
Sweep time: 2 s
Number of sweeps: 10
Video reference level: 0.00 dBm
Frequency span:
for Low center frequency: 6 MHz
for High center frequency: 10 MHz

EUT Parameters
Power Class: 3
Longest packet type: DH3
EUT address: 00e0037918b4

Temperature: Nominal
Voltage: Nominal

TEST Result
PASS

- **Software support and maintenance**

The system support package provides customer technical support by email, fax, and telephone. Support staff are based in a European time zone and support response is guaranteed within one working day.
Following the release of the base line software, software upgrades will automatically be issued to customers on a maintenance contract. The ME7865A will be continually developed to follow changes to the RF Test Specification and to follow errata in the *Bluetooth* core specification.

System calibration

The ME7865A is supplied with an integrated power meter. Automated software routines calibrate the path losses from each measuring instrument port to the common EUT test port.
This path loss data is held in system files and corrected for during all measurements.

Supported measurements

Test case	Description
TRM/CA/01/C	Output Power
TRM/CA/02/C	Power Density
TRM/CA/03/C	Power Control
TRM/CA/04/C	TX Output Spectrum frequency range
TRM/CA/05/C	TX Output Spectrum 20 dB Bandwidth
TRM/CA/06/C	TX Output Spectrum Adjacent channel power
TRM/CA/07/C	Modulation Characteristics
TRM/CA/08/C	Initial Carrier Frequency Tolerance
TRM/CA/09/C	Carrier Frequency Drift
TRC/CA/01/C	Out-of-Band Spurious Emissions (conducted measurements to 3 GHz, manual measurement)
RCV/CA/01/C	Sensitivity – single slot packets
RCV/CA/02/C	Sensitivity – multi-slot packets
RCV/CA/03/C	C/I performance
RCV/CA/04/C	Blocking performance (3 GHz standard, 12.75 GHz with option 12 or 14)
RCV/CA/05/C	Intermodulation Performance
RCV/CA/06/C	Maximum Input Level

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
ME7865A	**Main frame** Bluetooth Prequalification Test System (comprises the following items integrated in a 12U rack). **Test management software** MT8850A *Bluetooth* Test Set (System *Bluetooth* controller version) MT8850A *Bluetooth* Test Set (System *Bluetooth* interferer version) MS2661C Spectrum Analyser with following options; Option 01 – reference crystal oscillator Option 02 –narrow resolution bandwidth filters Option 12 – quasi peak detector Option 20 – tracking generator ML2437A Power Meter MA2472A Power Sensor Combiner Network Unit Rack mount PC Microsoft Windows 2000 Operating System Microsoft Word 15 inch TFT PC display PC keyboard and mouse
	Options and accessories
Option 10	Replaces the 12U rack with a 34U rack on casters. This option adds a pull out EUT support shelf and space to integrate option 14.
Option 12	Free standing MG3692A CW signal generator, 10 MHz to 20 GHz RF test cable. For automated blocking measurements to 12.75 GHz
Option 14	(Only available with option 10) Rack mounted MG3692A CW signal generator, 10 MHz to 20 GHz. RF test cable. For automated blocking measurements to 12.75 GHz
Option 22	Software support and maintenance

RADIO COMMUNICATION ANALYZER
MT8820A
30 MHz to 2.7 GHz

CE GPIB

The One Box Type Tester Supporting W-CDMA, GSM/GPRS/EGPRS, cdma2000® 1X, cdma2000® 1xEV-DO, PDC, PHS

The MT8820A hardware platform covers a frequency range of 30 MHz to 2.7 GHz. When dedicated measurement software and hardware (options) are installed, this single platform supports evaluation of all the main transmission/reception test items for W-CDMA, GSM/GPRS/EGPRS, cdma2000® 1X (IS-2000), cdma2000® 1xEV-DO, PDC and PHS terminals.
Advanced DSP (Digital Signal Processing) and parallel-measurement technology greatly reduce the time required for the production and testing of mobile terminals.
Combinations of parameters for batch measurements are freely selectable, and the number of repeat measurements for each measurement can be set independently. The selected items for measurement can be batch-processed through one-touch operation, enabling easy, high-speed Pass/Fail evaluation on major test items including transmission frequency, modulation accuracy, transmission power, adjacent channel power and BER.
The standard GPIB interface enables for the MT8820A to be configured in existing automated production lines or to configure automatic test systems in maintenance site.

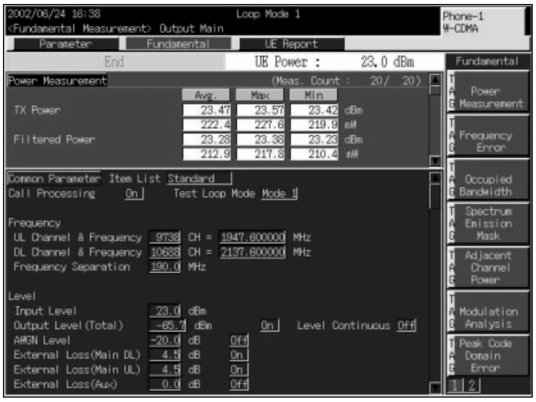
Measurement software	System	Description
MX882000B	W-CDMA	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-01 and MX882051A)
MX882001A	GSM/GPRS	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-02)
MX882001A-11	EGPRS	Tx and Rx measurements of mobile stations without call processing(requires MX882001A)
MX882002A	cdma2000® 1X	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-03)
MX882003A	cdma2000® 1xEV-DO	Tx measurements of access terminals including call processing (requires MT8820A-03, MT8820A-04 and MX882002A)
MX882004A	PDC	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-02)
MX882005A	PHS	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-02)

*: For W-CDMA terminal connectivity, contact Anritsu sales representative.
Please refer to an individual catalogue for details.

Transmitter measurements

- **Output power**

The MT8820A enables transmission power measurement of mobile equipment.
When the number of repeat measurements is set to two or more, the max., mean, and min. values of the result are displayed, providing evaluation of the terminal randomness. This repeat measurement function is also used for other measurements.



2002/06/24 16:38 Loop Mode 1
<Fundamental Measurement> Output Main
Phone-1
W-CDMA

End UE Power : 23.0 dBm

Power Measurement (Meas. Count : 20/ 20)

	Avg.	Max	Min	
TX Power	23.47	23.57	23.42	dBm
	222.4	227.6	219.9	mW
Filtered Power	23.28	23.38	23.23	dBm
	212.9	217.8	210.4	mW

Common Parameter Item List Standard
Call Processing On Test Loop Mode Mode 1

Frequency
UL Channel & Frequency 9738 CH = 1947.600000 MHz
DL Channel & Frequency 10688 CH = 2137.600000 MHz
Frequency Separation 190.0 MHz

Level
Input Level 23.0 dBm
Output Level (Total) -65.7 dBm On Level Continuous Off
AWGN Level -20.0 dB Off
External Loss(Main DL) 4.5 dB On
External Loss(Main UL) 4.5 dB On
External Loss(Aux) 0.0 dB Off

Example of transmission power measurement (W-CDMA)

- **Modulation analysis**

The MT8820A enables modulation analysis of mobile equipment. For example in GSM, simultaneous measurement and display of frequency, frequency error (in kHz and ppm), phase error and peak phase error is performable. Amplitude error at the burst-on section can also be measured.

- **Occupied frequency bandwidth**

This test measures the occupied frequency bandwidth of the W-CDMA terminal. The ratio of the frequency bandwidth to the total power can be changed in the range of 80.0% to 99.9%.

- **Adjacent channel power**

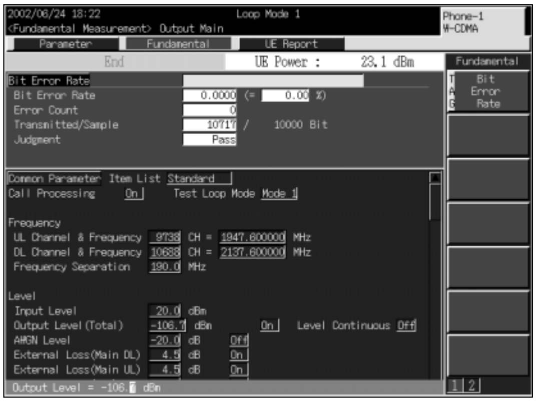
Adjacent channel power is measured according to each communication system.
In W-CDMA, the power can be measured in ±5 MHz, ±10 MHz from center frequency. In GSM, the power of 25 points can be measured in ±2 MHz from center frequency.

- **Spectrum waveform display**

MT8820A has the spectrum waveform display function by W-CDMA. This function monitors the existence of the frequency ingredient with the spectrum exceeding the standard line defined by 3GPP standards.

Receiver measurement

Measurement of the error rate conforming to the standard of each communication system is performable. For example, in W-CDMA, the bit error rate can be measured by the loopback test mode specified in the 3GPP standards.



2002/06/24 18:22 Loop Mode 1
<Fundamental Measurement> Output Main
Phone-1
W-CDMA

UE Power : 23.1 dBm

Bit Error Rate
Bit Error Rate 0.0000 (= 0.00 %)
Error Count 0
Transmitted/Sample 10717 / 10000 Bit
Judgment Pass

Common Parameter Item List Standard
Call Processing On Test Loop Mode Mode 1

Frequency
UL Channel & Frequency 9738 CH = 1947.600000 MHz
DL Channel & Frequency 10688 CH = 2137.600000 MHz
Frequency Separation 190.0 MHz

Level
Input Level 20.0 dBm
Output Level (Total) -106.7 dBm On Level Continuous Off
AWGN Level -20.0 dB Off
External Loss(Main DL) 4.5 dB On
External Loss(Main UL) 4.5 dB On
Output Level = -106.7 dBm

Example of error rate measurement (W-CDMA)

External packet data

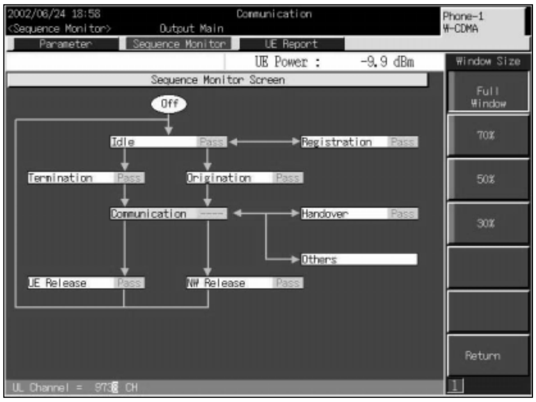
- **Test function for packet communication data transfer**

The External Packet Data option enables data transfer to/from external equipment by using the Ethernet port on the rear of MT8820A. Installing the MX882051A-02/882001A-02/882002A-02/882003A-02 enables End-to-End data transfer between an application server connected to the MT8820A and W-CDMA (GPRS, cdma2000® 1X, cdma2000® 1xEV-DO) terminal or a client PC connected to a W-CDMA (GPRS, cdma2000® 1X, cdma2000® 1xEV-DO) terminal. And enables various application software.

Call processing function

- **Connection tests**

The call processing function performs various connection tests such as registration, origination, termination, handover, disconnection from terminal and disconnection from network. In addition, the voice signal from the terminal can be echoed-back during conversation to perform a simple voice communications test.



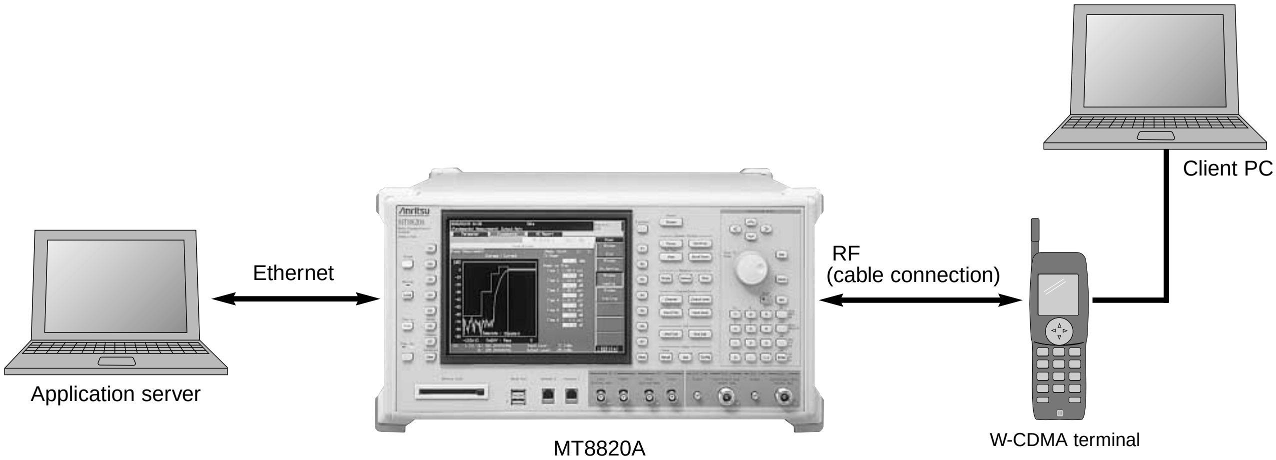
2002/06/24 18:58 Communication
<Sequence Monitor> Output Main
Phone-1
W-CDMA

UE Power : -9.9 dBm
UL Channel = 9738 CH

Example of sequence monitor (W-CDMA)

- **Mobile terminal report monitor**

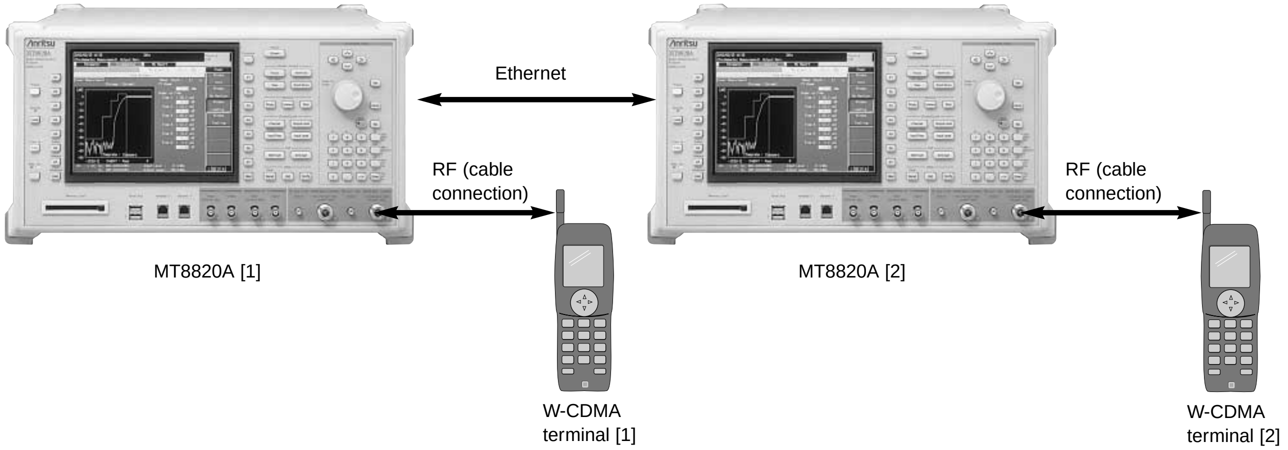
A monitoring screen can display the state of terminal reported periodically. The monitoring of RX Level can tell how much level of downlink signal the terminal receives.



Sample MT8820A connection (W-CDMA)

- **W-CDMA video phone test**

The MX882051A-03 W-CDMA Video Phone Test Option enables data transfer between two MT8820A units by using their Ethernet ports. Installing the MX882051A-03 enables End-to-End test between the videophone-compatible W-CDMA terminals connected to each of the two MT8820A units.



Sample MT8820A connection (W-CDMA)

GPIB control

- **Measurement results batch read command**

All the results of a batch measurement can be read using the single “ALLMEAS?” command. Specific measurement results can be selected and reported by specifying the measurement items, for example “ALLMEAS? MOD” (for modulation analysis). The load on the GPIB bus of both the MT8820A and the control PC has been lightened and measurement throughput is increased by reducing the number of GPIB commands. Moreover, the number of steps in the control program has been reduced, facilitating to write comprehensible and maintainable remote control programs.

Options

- **W-CDMA measurement hardware (MT8820A-01)**

This option enables the measurement of the main transmission/reception characteristic about W-CDMA of the 3rd generation conforming to 3GPP standard in combination with MX882000A W-CDMA Measurement Software.

- **TDMA measurement hardware (MT8820A-02)**

This option enables the measurement of the major transmission/reception characteristic about GSM which is most spread in the world in combination with MX882001A GSM Measurement Software.
And this option can measure the major transmission/reception characteristics on the second-generation PDC (PHS) system, the most common terminal in Japan, in combination with the MX882004A (MX882005A) PDC (PHS) Measurement Software.

- **CDMA measurement hardware (MT8820A-03)**

This option can measure the major transmission/reception characteristics on the third-generation cdma2000® 1X terminals conforming to 3GPP2, in combination with the MX882002A cdma2000® Measurement Software.

- **Audio board (MT8820A-11)**

This option enable to add a real-time audio encoding/decoding function to W-CDMA (GSM) measurement software, enabling the end-to-end communication test with Handset, when it it mounted in a main frame in combination with MX882000A-01 W-CDMA (MX882001A-01 GSM) voice codec. Beside the testing with Handset, the audio signal input from an AF input connector and the audio signal output to an AF output connector are supported.

Specifications

- **MT8820A (main frame)**

General	Frequency range: 30 to 2700 MHz Max. input level: +35 dBm (MAIN 1) MAIN 1 I/O Impedance: 50 Ω VSWR: ≤1.2 (<1.6 GHz), ≤1.25 (1.6 to 2.2 GHz), ≤1.3 (>2.2 GHz) Connector: N type AUX 1 output Impedance: 50 Ω VSWR: ≤1.3 (at SG Output level: ≤–10 dBm) Connector: SMA type Reference oscillator Frequency: 10 MHz Level: TTL Startup characteristics: ≤±5 x 10^{-8} (at 10 min after startup referenced to frequency 24 h after startup) Aging rate: ≤±2 x 10^{-8}/day, ≤±1 x 10^{-7}/year (referenced to frequency 24 h after startup) Temperature characteristics: ≤±5 x 10^{-8} Connector: BNC type External reference input Frequency: 10 MHz or 13 MHz (±1 ppm) Level: ≥0 dBm Impedance: 50 Ω Connector: BNC type

Continued on next page

RF signal generator	Frequency Frequency range: 30 to 2700 MHz (setting range: 0.4 to 2700 MHz) Setting resolution: 1 Hz Accuracy: Due to reference oscillator accuracy Output level Level range: –140 to –10 dBm (MAIN 1), –130 to 0 dBm (AUX 1) Resolution: 0.1 dB Accuracy: ±1.0 dB (–120 to –10 dBm, MAIN 1, after calibration), ±1.0 dB (–110 to 0 dBm, AUX 1, after calibration) Signal purity Non-harmonic spurious: ≤–50 dBc (offset frequency: ≥100 kHz, except Uplink frequency – Downlink frequency + 4.1825 GHz), ≤–40 dBc [spurious of (4.8 – Fout) GHz at ≥2.1 GHz] Harmonics: ≤–25 dBc Uninterrupted level variation Variable range: 0 to –30 dB Setting resolution: 1 dB
Others	Display: Color 8.4" TFT LCD, 640 x 480 dots External control GPIB: Control from external host with main unit as device (excluding some functions such as power-on), no external device control Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Power supply	100 to 120/200 to 240 Vac (–15/+15%, 250 V max.), 47.5 to 63 Hz, ≤300 VA (with Option 01)
Dimensions and mass	426 (W) x 221.5 (H) x 498 (D) mm (excluding projections), ≤23 kg
Environmental conditions	Operating temperature and humidity: 0˚ to +50˚C, ≤95% (no condensation) Storage temperature and humidity: –20˚ to +60˚C, ≤95% (no condensation) EMC EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A) LVD EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

- **MT8820A-01 W-CDMA measurement hardware and MX882000B W-CDMA Measurement Software, MX882051A W-CDMA Call Processing Software**

Modulation analysis	Frequency: 300 to 2200 MHz Input level: –30 to +35 dBm (MAIN) Carrier frequency accuracy: Reference oscillator accuracy + 10 Hz Modulation accuracy (residual vector error): ≤2.5% (at input of 1-DPCCH and 1-DPDCH)
RF power	Frequency: 300 to 2200 MHz Input level: –65 to +35 dBm (MAIN) Measurement accuracy: ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) *After calibration Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, PRACH
Occupied bandwidth	Frequency: 300 to 2200 MHz Input level: –10 to +35 dBm (MAIN)
Adjacent channel leakage power	Frequency: 300 to 2200 MHz Input level: –10 to +35 dBm (MAIN) Measurement points: ±5 MHz, ±10 MHz Measurement range: ≥50 dB (at ±5 MHz), ≥55 dB (at ±10 MHz)
RF signal generator	Output frequency: 300 to 2200 MHz (1 Hz step) Channel level (CPICH, P-CCPCH, SCH, PICH, DPCH, S-CCPCH, AICH): Off, –30.0 to 0.0 dB [0.1dB step, relative level for Ior (total level)] Channel level (OCNS): Off, Auto-setting Channel level accuracy: ±0.2 dB (relative level accuracy for Ior) AWGN level: Off, –20 to +5 dB (0.1 dB step) AWGN level accuracy: ±0.2 dB (relative level accuracy for Ior)
Bit error rate measurement	Functions: Insert PN9 or PN15 pattern in DTCH Measurement items: BER, BLER Measurement objective: Loop-back data imposed on uplink DTCH (BER, BLER), serial data inputted from rear-panel call processing I/O port (BER)
Call processing	Origination control: Registration, origination, termination, handover, disconnection from network, disconnection from mobile station (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile station control: Output level, loop-back (executes each mobile function control conforming to 3GPP standards)

• MT8820A-02 TDMA measurement hardware and MX882001A GSM Measurement Software

Frequency/modulation measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst, RACH Carrier frequency accuracy: Reference oscillator accuracy + 10 Hz at normal burst measurement Reference oscillator accuracy + 20 Hz at RACH measurement Residual phase error: ≤0.5° rms, ≤2° peak
Amplitude measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst, RACH Measurement accuracy: ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) (After calibration) Linearity: ±0.2 dB (0 to –40 dB, ≥–30 dBm) Carrier-off power: ≥65 dB (≥–10 dBm), ≥45 dB (–30 to –10 dBm) Burst waveform display: Rise, fall, time slot, burst-on
Output RF spectrum measurement	Frequency: 300 to 2200 MHz Input level: –10 to +40 dBm (average power of burst signal, MAIN connector) Measurement item: Normal burst Measurement points: ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1400 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Measurement range due to modulation: ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) *10 times average Measurement range due to switching: ≤–57 dB (≥400 kHz offset)
RF signal generator	Output frequency: 300 to 2200 MHz (1 Hz steps) Phase error: ≤1° rms, ≤4° peak Output patterns: CCH, TCH, CCH + TCH Channel coding: FS, EFS, HS0, HS1 TCH data: PN9, PN15, ALL 0, ALL 1
Error rate measurement	Function: Error rate measurement of frame, bit and CRC Measurement items GSM: Loop-back data inserted in up-link TCH Serial data inputted through the call processing I/O port on the rear panel GPRS: The number of blocks received from the terminal and inserted in up-link TCH The number of USF reception blocks of a terminal
Call processing	Call controlling GSM: Location registration, terminal call origination, network call origination, network disconnect, terminal disconnect GPRS: Connection, disconnection, data transfer Terminal controlling GSM: Output level, time slot, timing advance, loop-back on/off GPRS: Test Mode A, Test Mode B, BLER
Channel coding	FS, EFS, HS0, HS1, AFS, AHS0, AHS1, CS-1, CS-2, CS-3, CS-4
Frequency bands	GSM450, GSM480, GSM850, P-GSM, E-GSM, R-GSM, DCS1800, PCS1900

• MT8820A-02 TDMA Measurement Hardware, MX882004A PDC Measurement Software

Frequency/modulation measurement	Frequency: 300 to 2200 MHz Input level range: –30 to +40 dBm (measurement object: TCH), –30 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave Carrier frequency accuracy: ± (reference oscillator accuracy + 1 Hz) Modulation accuracy: ± (2 % of indicated value + 0.7 %) rms Origin offset accuracy: ±0.5 dB (relative to signal of –30 dBc) Transmission rate: ±1 ppm (measurement range: 42 kbps ±100 ppm)
Amplitude measurement	Frequency range: 300 to 2200 MHz Input level range: –30 to +40 dBm (measurement object: TCH), –30 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave Measurement accuracy: ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) *After calibration Linearity: ±0.2 dB (0 to –40 dB, ≥–30 dBm) Power measurement range at carrier off: ≥65 dB (input level: ≥–10 dBm), ≥ (Amplitude measurement value [dBm] + 80) dB (wide dynamic range power measurement)
Occupied bandwidth measurement	Frequency range: 300 to 2200 MHz Input level range: –10 to +40 dBm (measurement object: TCH), –10 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave
Adjacent channel power measurement	Frequency range: 300 to 2200 MHz Input level range: –10 to +40 dBm (measurement object: TCH), –10 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave Measurement range: ≤–60 dB (50 kHz offset), ≤–65 dB (100 kHz offset)
RF signal generator	Output frequency: 300 to 2200 MHz, 1 Hz step Modulation accuracy: ≤3 %rms Modulation data Continuous wave output: PN9, PN15 and repetition of arbitrary 4-bit data Burst wave output: PN9, PN15
Error rate measurement	Function: Bit error rate measurement Measurement items: Serial data inputted from the Call Proc. I/O terminal of a back panel

Continued on next page

Call processing	Call control: Location registration, call origination, call termination, communication, network-side termination, phone-side termination Phone control: Output level, time slot, time alignment
Channel coding	Full rate, Half rate
Frequency band	800 MHz-1, 800 MHz-2, 800 MHz-3, 1.5 GHz

• MT8820A-03 cdma2000® Measurement Hardware, MX882002A cdma2000® Measurement Software

Amplitude measurement	Frequency: 300 to 2200 MHz Input level: –65 to +35 dBm (Main connector) Measurement accuracy: ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) ∗After calibration, at filtered power measurement Linearity: ±0.2 dB (0 to –40 dB, ≥–55 dBm), ±0.4 dB (0 to –40 dB, ≥–65 dBm)
Frequency/modulation measurement	Frequency: 300 to 2200 MHz Input level: –30 to +35 dBm Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) Residual waveform quality: >0.999 Residual EVM: <2 % rm
Occupied bandwidth	Input level: –10 to +35 dBm
Code domain power	Can be measured at Reverse RC3/RC4. Frequency: 300 to 2200 MHz Input level: –30 to +35 dBm Measurement accuracy: ±0.2 dB (code power: ≥–15 dBc), ±0.4 dB (code power: ≥–23 dBc)
RF signal generator	Output frequency: 300 to 2200 MHz (1 Hz step) Channel level [Relative level to Ior (total level)] Pilot Ch: –30 to 0 dB, 0.25 dB step or off FCH, SCH: –30 to 0 dB, 0.1 dB step or off SYNC, PCH: –30 to 0 dB, 0.25 dB step or off OCNS: Auto, 0.01 dB step or off QPCH channel level (relative level to pilot channel): –5 to +2 dB (1 dB step) or off Channel level accuracy: <±0.2 dB typ. (≥–20 dB) PN offset: 0 to 511 settable Waveform quality: >0.99 (pilot only, AWGN off) AWGN AWGN level: –20 to +12 dB (relative level to CDMA signal) or off Maximum CDMA signal output level at AWGN On: –28 dBm (at MAIN output), –18 dBm (at AUX output)
Error rate measurement	FER (Frame Error Rate) measurement: FER measurement with service Option 2, 9, 55 and 32 (TDSO) Display items: FER, confidence level, sample frame count, error frame count
Call processing	Band class: Conforms to BC 0 to 10 Call control: Location registration, origination, termination, network disconnect, terminal disconnect Paging channel data rate: Full Radio configuration: F-RC1 + R-RC1, F-RC2 + R-RC2, F-RC3 + R-RC3, F-RC4 + R-RC3, F-RC5 + R-RC4 Service option: Conforms to SO 1, 2, 3, 9, 32, 33, 55, 32768. Fwd. FCH data rate: Full, half, quarter, eighth settable Fwd. SCH: Max. 1 channel Fwd. SCH data rate RC3: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC4: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC5: 14.4, 28.8, 57.6, 115.2, 230.4 kbps Access channel: Conforms to access Ch. Rev. closed loop power control mode: closed loop, alternate, All 0 (all up), All 1 (all down) Conformed protocol: IS-95B, J-STD-008C, ARIB T-53, Korean PCS, IS-2000 (SR1)

• MT8820A-11 Audio Board, MX882000B-01 W-CDMA Voice Codec

Voice codec	AMR 12.2 kbps
Codec level adjustment	Encoder input gain: –3.00 to 3.00 dB, in increments of 0.01 dB Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF output	Frequency range: 30 Hz to 10 kHz, 1 Hz resolution Setting range: 0 Vpeak to 5 Vpeak (AF Output connector) Setting resolution: 1 mV (≤5 V peak), 100 µV (≤500 mVpeak), 10 µV (≤50 mVpeak) Accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion: ≤30 kHz band ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1 Ω Max. output current: 100 mA
AF input	Frequency range: 50 Hz to 10 kHz Input voltage range: 1 mVpeak to 5 Vpeak (AF Input connector) Max. allowable input voltage: 30 Vrms Input impedance: 100 k
Frequency measurement	Accuracy: Reference oscillator accuracy + 0.5 Hz
Level measurement	Accuracy: ±0.2 dB (≥10 mVpeak), ±0.4 dB (≥1 mVpeak, ≥1 kHz)
SINAD measurement	Frequency: 1 kHz in ≤30 kHz band ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak)
Distortion rate measurement	Frequency: 1 kHz in ≤30 kHz band ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak)

- **MT8820A-11 Audio Board, MX882001A-01 GSM Voice Codec**

Voice codec	GSM_EFR, GSM_AMR
Codec level adjustment	Encoder input gain: –3.00 to 3.00 dB, in increments of 0.01 dB Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF output	Frequency range: 30 Hz to 10 kHz, 1 Hz resolution Setting range: 0 to 5 Vpeak (AF Output connector) Setting resolution: 1 mV (≤5 V peak), 100 µV (≤500 mVpeak), 10 µV (≤50 mVpeak) Accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion: In ≤30 kHz band, ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1 Ω Max. output current: 100 mA
AF input	Frequency range: 50 Hz to 10 kHz Input voltage range: 1 mVpeak to 5 Vpeak (AF Input connector) Max. allowable input voltage: 30 Vrms Input impedance: 100 kΩ
Frequency measurement	Accuracy: Reference oscillator accuracy + 0.5 Hz
Level adjustment	Accuracy: ±0.2 dB (≥10 mVpeak), ±0.4 dB (≥1 mVpeak, ≥1 kHz)
SINAD measurement	At frequency 1 kHz in ≤30 kHz band, ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak)
Distortion rate measurement	At frequency 1 kHz in ≤30 kHz band, ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MT8820A	Radio Communication Analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
HB28B064C8H	CF card (64 MB): 1 pc
CA68ADP	PC card adapter: 1 pc
W1940AE	MT8820A operation manual (CD-ROM): 1 copy
	Options
MT8820A-01	W-CDMA measurement hardware
MT8820A-02	TDMA measurement hardware
MT8820A-03	cdma2000® measurement hardware
MT8820A-04	1xEV-DO measurement hardware
MT8820A-11	Audio board
MT8820A-21	W-CDMA measurement hardware retrofit
MT8820A-22	TDMA measurement hardware retrofit
MT8820A-23	cdma2000® measurement hardware retrofit
MT8820A-24	1xEV-DO measurement hardware retrofit
MT8820A-31	Audio board retrofit
	Softwares
MX882000B	W-CDMA Measurement Software (requires MT8820A-01 and MX882051A)
MX882000B-01	W-CDMA voice codec (requires MT8820A-11 and MX882000B)
MX882001A	GSM Measurement Software (requires MT8820A-02)
MX882001A-01	GSM voice codec (requires MT8820A-11 and MX882001A)
MX882001A-02	GSM external packet data (requires MX882001A)
MX882001A-11	EGPRS Measurement Software (requires MX882001A)
MX882002A	cdma2000® Measurement Software (requires MT8820A-03)
MX882002A-02	cdma2000® external packet data (requires MX882002A)
MX882003A	1xEV-DO measurement Software (requires MT8820A-04 and MX882002A)
MX882003A-02	1xEV-DO external packet data (requires MX882003A)
MX882004A	PDC Measurement Software (requires MT8820A-02)
MX882005A	PHS Measurement Software (requires MT8820A-02)
MX882022A	cdma2000® Wireless Application Test Software (requires MT8820A-03)
MX882051A	W-CDMA Call Processing Software[*1] (requires MX882000B)
MX882051A-02	W-CDMA external packet data[*1] (requires MX882051A)
MX882051A-03	W-CDMA video phone test[*1] (requires MX882051A)
MX882071A	W-CDMA Ciphering Software[*1] (requires MX882051A)

Model/Order No.	Name
W2161AE	MX882000B operation manual[*2] (attached to MX882000B)
W2026AE	MX882001A operation manual[*2] (attached to MX882001A)
W2104AE	MX882002A operation manual[*2] (attached to MX882002A)
W2201AE	MX882003A operation manual[*2] (attached to MX882003A)
W2159AE	MX882004A operation manual[*2] (attached to MX882004A)
W2228AE	MX882005A operation manual[*2] (attached to MX882005A)
W2247AE	MX882022A operation manual[*2] (attached to MX882022A)
W2220AE	MX88205xA operation manual[*2] (attached to MX88205xA)
W2230AE	MX88207xA operation manual[*2] (attached to MX88207xA)
	Warranty
MT8820A-90	Extended three year warranty service
MT8820A-91	Extended five year warranty service
	Application parts
P0019	TEST USIM001
A0012	Handset
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m
J0127C	Coaxial cord (BNC-P · RG58A/U · BNC-P), 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
MN8110A	I/O Adapter (for call processing I/O)
B0332	Joint plate (4 pcs/set)
B0333G	Rack mount kit
B0499	Carrying case (hard type, with protective cover and casters)
B0499B	Carrying case (hard type, with protective cover, without casters)
W1943AE	MT8820A operation manual (booklet)
W2162AE	MX882000B operation manual (booklet)
W2027AE	MX882001A operation manual (booklet)
W2100AE	MX882002A operation manual panel operation (booklet)
W2101AE	MX882002A operation manual remote control (booklet)
W2202AE	MX882003A operation manual panel operation (booklet)
W2203AE	MX882003A operation manual remote control (booklet)
W2160AE	MX882004A operation manual (booklet)
W2229AE	MX882005A operation manual (booklet)
W2245AE	MX882022A operation manual panel operation (booklet)
W2246AE	MX882022A operation manual remote control (booklet)
W2221AE	MX88205xA operation manual (booklet)
W2231AE	MX88207xA operation manual (booklet)

*1: For W-CDMA terminal connectivity, contact your Anritsu sales representative.
*2: Supplied by CD-ROM

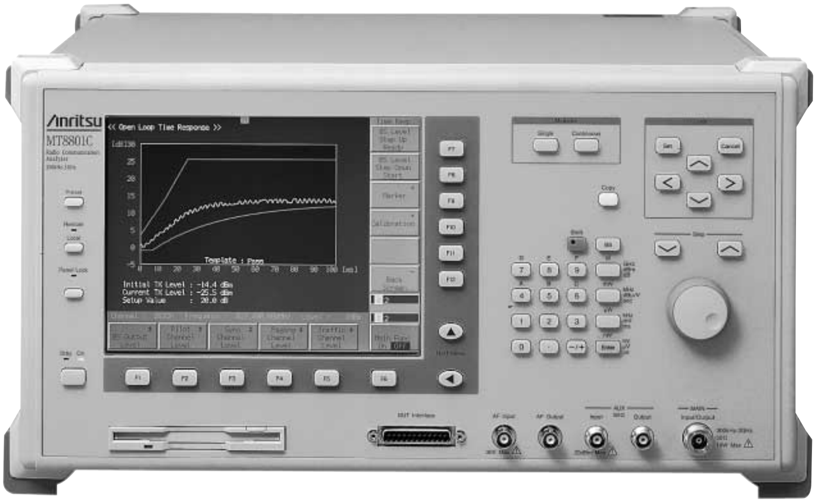
RADIO COMMUNICATION ANALYZER

MT8801C

300 kHz to 3 GHz

CE GPIB

Support for CDMA, GSM, DECT, IS-136A, PDC and PHS



Every major radio communication system in the world including AMPS/PCS1900, GSM400/900/1800/1900, GPRS, HSCSD, DECT, IS-136A, PDC, and PHS can be evaluated using just one MT8801C Radio Communication Analyzer, covering the 300 kHz to 3 GHz frequency band in one hardware platform, and the dedicated measurement software options. The call processing test and sensitivity test using the loopback method are possible for GSM/DCS1800/PCS1900, CDMA, IS-136A and DECT. In addition, connection testing as well as send testing while communicating, are also possible for PDC and PHS measurement by using the call processing function, and the PDC uplink RCH can be monitored (RSSI, estimated error rate) too. FM radio transmission/reception tests are simplified by using the optional analog measurement function, and the optional spectrum analyzer function covering 10 MHz to 3 GHz is very useful for maintaining as well as measuring spurious near carrier on production lines. GPIB and RS-232C interfaces are standard, so MT8801C can be incorporated easily into automated production lines or on-site automated testing systems.

The time required for testing equipment on production lines is greatly reduced using the high-speed adjacent channel power and occupied bandwidth measurement functions based on Anritsu's proprietary measurement algorithm and DSP (Digital Signal Processing). Furthermore, major transmission test items such as transmission frequency, modulation accuracy (phase error), transmission power, rise/fall characteristics of burst wave, adjacent channel power, etc. can be measured and judged pass/fail for the limit value of each item.

Features

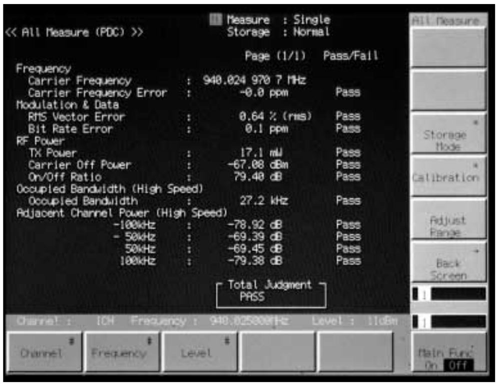
- 1 unit for GSM, DECT, IS-136A, PDC and PHS systems
- All basic transmission and reception measurements performed by 1 unit

System type	Measurement software option	Description
IS-136A	MX880113A	Tx and Rx measurements of IS-136A mobile stations including call processing (requires option 01)
AMPS PCS1900	MX880114A	Tx and Rx measurements of AMPS analog mobile stations and PCS1900 digital mobile telephones including call processing (requires option 01)
GSM400/ 900/1800/ 1900	MX880115A	Tx and Rx measurements of GSM and advanced GSM mobile stations including call processing and multiple timeslot measurements
PDC	MX880116A	Tx and Rx measurements of PDC mobile stations including call processing
	MX880131A	Tx and Rx measurements of PDC mobile stations
PHS	MX880117A	Tx and Rx measurements of PHS mobile stations including call processing
	MX880132A	Tx and Rx measurements of PHS base stations and mobile stations
DECT	MX880118A	Tx and Rx measurements both portable part and fixed part for DECT including call processing (requires option 07)
GSM	Option 11	Audio test of GSM mobile stations including call processing (requires MX880115A and option 01)
CDMA	Option 12	Tx and Rx measurements of mobile stations including call processing (requires option 01)

Transmission test

- **Batch measurements of transmission test items**

Only about 1 second is required to measure all major transmission test items, including frequency, modulation accuracy, origin offset, transmission rate, transmission power, leakage power during carrier-off, rise/fall edge characteristics, occupied bandwidth, and adjacent channel power. Pass/fail decisions for limit value of each test item can also be displayed.



```
                                   Measure  : Single
<< All Measure (PDC) >>            Storage  : Normal

                                   Page (1/1)   Pass/Fail
Frequency
  Carrier Frequency        :  940.024 970 7 MHz
  Carrier Frequency Error  :      -0.0 ppm        Pass
Modulation & Data
  RMS Vector Error         :      0.64 % (rms)    Pass
  Bit Rate Error           :       0.1 ppm        Pass
RF Power
  TX Power                 :      17.1 mW         Pass
  Carrier Off Power        :    -67.08 dBm        Pass
  On/Off Ratio             :     79.40 dB         Pass
Occupied Bandwidth (High Speed)
  Occupied Bandwidth       :      27.2 kHz        Pass
Adjacent Channel Power (High Speed)
                -100kHz    :    -78.92 dB         Pass
                - 50kHz    :    -69.39 dB         Pass
                  50kHz    :    -69.45 dB         Pass
                 100kHz    :    -79.38 dB         Pass

                         ┌ Total Judgment ┐
                            PASS
Channel :    1CH   Frequency :  940.025000MHz    Level :  11dBm
```

Example of linked send measurement items (PDC)

• Calibration functions
A built-in thermocouple power sensor is used for calibration, providing accurate measurement of absolute values such as average power within burst signal and leakage power during carrier-off. There is no need for other instruments; just one press of the CAL key during measurement performs calibration.

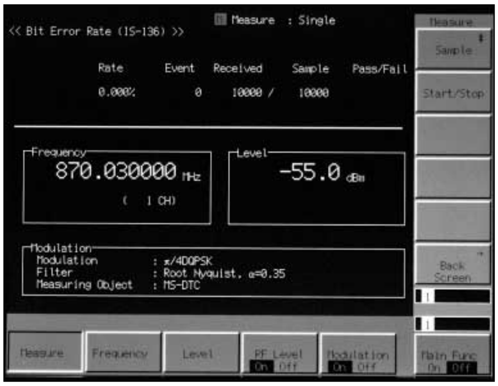
• Wide-band power meter
The power meter with built-in thermocouple power sensor can accurately measure power between 0 and +40 dBm.

• Modulation analysis
The user can display the waveform as either frequency deviation, eye diagram or constellation diagram to easily show any irregularities in the modulation.

• Measurement of antenna power rise/fall edge characteristics
Antenna power rise/fall edge characteristics can be measured simultaneously with antenna power measurements. In addition, the marker points can be moved and the power can be read directly with 1/10 symbol resolution.

• Adjacent channel power measurement
The MT8801C can measure adjacent channel power for each communication system at high speed.

• Receiver sensitivity measurement
This function displays the error count and error rate in the RF input or DATA/CLOCK input measured signal.



<< Bit Error Rate (IS-136) >>

Measure : Single

Rate	Event	Received	Sample	Pass/Fail
0.000%	0	10000 /	10000	

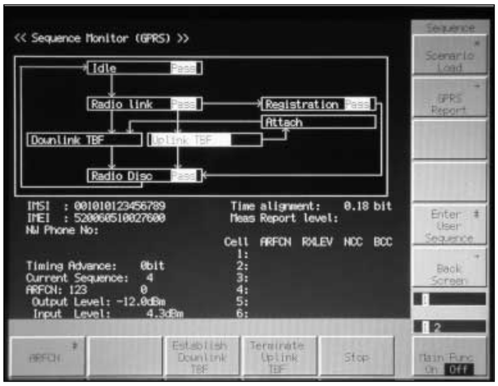
Frequency: 870.030000 MHz (1 CH)

Level: -55.0 dBm

Modulation
Modulation : π/4DQPSK
Filter : Root Nyquist, α=0.35
Measuring Object : MS-DTC

Bit error rate measurement (IS-136A)

• Call processing function
The MT8801C acts as a pseudo base station permitting to judge pass/fail for registration, origination, termination, communication, handover (PHS: TCH switching type only), disconnection from network, and disconnection from mobile station at the sequence monitor screen.



<< Sequence Monitor (GPRS) >>

IMSI : 001010123456789
IMEI : 520060510027600
NW Phone No:

Timing Advance: 0bit
Current Sequence: 4
ARFCN: 123 0
Output Level: -12.0dBm
Input Level: 4.3dBm

Time alignment: 0.18 bit
Meas Report level:

Cell ARFCN RXLEV NCC BCC
1:
2:
3:
4:
5:
6:

Sequence monitor display (GSMGPRS)

Analog measurement

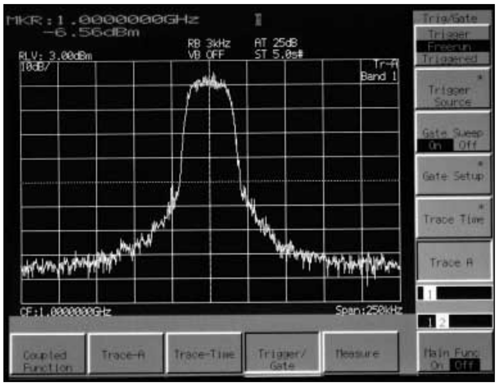
• Analog measurement function (Option 01)
The MT8801C has general analog measurement functions too. Efficient FM TX/RX testing is made easy by built-in signal generator, AF oscillator, RF analyzer (power meter, frequency counter, FM measurement) and audio analyzer functions. This function is especially useful for the IS-136A analog test.

• Transmission measurement
Characteristics such as frequency, power, and frequency deviation can be measured easily.

• Reception measurement
An FM modulated signal is output to permit measurement of the frequency and level of the AF signal from a receiver, as well as SINAD and distortion.

Spectrum analysis

• Spectrum analyzer function (Option 07)
The spectrum analyzer with synthesized local oscillator covers a frequency range of 10 MHz to 3 GHz with a resolution of 1 Hz. In addition to a C/N of –115 dBc (100 kHz offset), the RBW can be set to 300 Hz to 1 MHz, the VBW to 3 to 100 kHz, and the sweep time in the frequency domain to 100 ms to 1000 s (1 ms to 1000 s in time domain). The total level accuracy is an astonishing ±1.5 dB due to the analyzer's excellent linearity and the level calibration function. Moreover, the average noise level is just –85 dBm max (at 10 MHz to 1 GHz), and the secondary harmonic distortion is –60 dB max (100 MHz to 1.5 GHz).



MKR : 1.0000000GHz
–6.56dBm

RLV: 3.00dBm
RB 3kHz
VB OFF
AT 25dB
ST 5.0s#

CF:1.0000000GHz
Span:250kHz

IS-136A modulated wave measurement

Options

• Option 04: AF low impedance output
This option converts the output impedance of the AF oscillator of the Option 01 analog measurement to low impedance. It permits direct driving of an external speaker connected to the AF output connector.

• Option 11: GSM audio test
When using with the MX880115A GSM Measurement Software, speech Tx/Rx characteristics can be measured in accordance with GSM Rec. RPE LTP (Full Rate Speech CODEC).

The audio signal generated by the MT8801C is digitally processed and ideal audio signal is sent. In addition, this option can also be used to digitally process an audio signal sent from a GSM terminal for high-reliability and high-accuracy measurement.

• Option 12: CDMA measurement
The Option 12 can measure the following systems; USA 800-MHz cellular band (TIA/EIA/IS-95A standard), USA 1.9 GHz PCS band (ANSI J-STD-008 standard), Japan 800-MHz cellular band (ARIB STD-T53 standard).

The CDMA and analog dual mode standardized in the IS-95A standard are supported.

Specifications

• MT8801C

Frequency range	300 kHz to 3 GHz
Maximum input level	+40 dBm (10 W, MAIN connector), +20 dBm (100 mW, AUX connector)
Input/output connector	MAIN I/O connector Impedance: 50 Ω, N-type VSWR: ≤1.2 (≤2.2 GHz), ≤1.3 (>2.2 GHz) AUX input/output connector: TNC-type
Reference oscillator	Frequency: 10 MHz Starting characteristics: ≤5 x 10^{-8}/day (after 10 minutes of warm-up, referred to frequency after 24 hours warm-up) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (referred to frequency after 24 hours warm-up) Temperature characteristics: ≤5 x 10^{-8} (0˚ to 50˚C, referred to frequency at 25˚C) External standard input: 10 MHz or 13 MHz (±1 ppm), input level: 2 to 5 Vp-p
Power meter	Frequency range: 300 kHz to 3 GHz Level range: 0 to +40 dBm, –10 to +40 dBm (CDMA measurement) Level accuracy: ±10% (0 to +40 dBm, after zero point calibration), ±10% (–10 to +40 dBm, 18˚ to 28˚C, at average value, after zero point calibration)
Signal generator	Frequency Range: 300 kHz to 3 GHz Resolution: 1 Hz Accuracy: Reference frequency accuracy ±100 mHz Output level Level range (no modulation or analog modulation): –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Level accuracy: ±1 dB (10 MHz to 2.2 GHz, ≥–123 dBm, 18˚ to 28˚C), ±3 dB (10 MHz to 2.2 GHz, ≥–133 dBm), ±2 dB (>2.2 GHz, ≥–123 dBm, 18˚ to 28˚C), ±4 dB (>2.2 GHz, ≥–133 dBm) Radiated interference: 1 µV/50 Ω (carrier frequency measured, 25 mm from front panel with two-turn 25 mm diameter loop antenna) Signal purity Spurious: ≤–50 dBc (at CW, offset frequency 100 kHz to ≤50 MHz; where carrier frequency: other than 1300 MHz to 1400 MHz and 2000 MHz to 2100 MHz), ≤–40 dBc (for all band) Harmonics: ≤–25 dBc (at CW)
Others	Display: Color TFT-LCD, 7.8 inch, 640 x 480 dots Hard copy: Enables data hard copy of the display through a parallel interface (applicable only for EPSON VP series or equivalent) GPIB: This equipment is specified as a device, can be controlled from external controller (excluding power switch and FD ejection key). No controller function Interface: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2) Parallel Conform to the Centronics. Outputs printing data to printer. Data line exclusive for output: 8 Control line: 4 (BUSY, $\overline{\text{DTSB}}$, $\overline{\text{ERROR}}$, PE) Connectors: D-sub 25 pins, female (equivalent to the connector of IBM-PC/AT built-in printer) RS-232C: All functions except power switch controlled by external controller (baud rate: 1200, 2400, 4800, 9600 bps)
Dimensions and mass	426 (W) x 221.5 (H) x 451 (D) mm, ≤22 kg
Power	100 to 120/200 to 240 Vac (automatic voltage switch system), 47.5 to 63 Hz, ≤300 VA
Operating temperature	0˚ to +50˚C
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

• Option 01: Analog measurement

RF signal generator	Frequency range: 10 MHz to 3 GHz Output level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) FM deviation: 0 to 40 kHz (resolution: 10 Hz) Accuracy: Set value ±5% ±1 digit (internal modulation frequency: 1 kHz, excluding residual FM) Internal modulation: 20 Hz to 20 kHz External modulation: 20 Hz to 20 kHz (limited to 1Vpeak into 600 Ω) Flatness: ±0.5 dB (referenced to 1 kHz between 0.3 to 3 kHz with 4 kHz deviation) ±1 dB (referenced to 1 kHz between 20 Hz to 20 kHz with 4 kHz deviation) Distortion: ≤–50 dB (internal modulation frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz, frequency deviation: 5 kHz)
AF Generator	Frequency range: 20 Hz to 20 kHz, Setting resolution: 0.1 Hz, Accuracy: Same as reference oscillator Output Level range: 0.1 mVrms to 3.0 Vrms (EMF, MAIN output impedance: 600 Ω) 0.1 mVrms to 0.3 Vrms (EMF, MAIN output impedance: 50 Ω) Setting resolution: 1 µV (output level: <4 mV), 10 µV (output level: <40 mV) 100 µV (output level: <0.4 V), 1 mV (output level: ≤3 V) Accuracy (bandwidth: <30 kHz) Unbalanced output: ±0.5 dB (frequency: 1 kHz, output level: ≥1 mV), ±1 dB (frequency: 20 Hz to 20 kHz, output level: ≥1 mV) Floating output: ±2 dB (frequency: 1 kHz, output level: ≥1 mV) Output impedance MAIN output: 600 Ω, 50 Ω selectable (unbalanced, BNC connector) DUT interface microphone output: 600 Ω, floating Distortion: <–50 dBc (bandwidth: <30 kHz, frequency: 1 kHz, output level: 1 V) <–45 dBc (bandwidth: <30 kHz, frequency: 20 Hz to 20 kHz, output level: 1 V) Noise generator: White noise passed through a weighting filter (conforming to ITU-T Rec. G.227)

Continued on next page

Transmission measurement	RF power meter	Frequency range: 300 kHz to 3 GHz Input range: 0 to +40 dBm (MAIN connector) Accuracy: ±10% (after zero calibration)
	IF level meter	Frequency range: 10 MHz to 3 GHz Input range: 0 to +40 dBm (MAIN connector) Accuracy: ≤10% (after calibration with internal RF power meter) Linearity: ±0.3 dB (0 to –30 dB)
	Frequency counter	Frequency range: 10 MHz to 3 GHz Input level range: –15 to +40 dBm (MAIN connector), –40 to +20 dBm (AUX connector) Resolution: 1 Hz Accuracy: ±(reference oscillator accuracy + 10 Hz) Method: IF frequency counting (bandwidth: ±30 kHz)
	Modulation	FM Frequency range: 10 MHz to 3 GHz Input level range: –15 to +40 dBm (MAIN connector), –40 to +20 dBm (AUX connector) Filters (3 dB cut-off frequency): HPF (300 Hz, 50 kHz), LPF (3 kHz, 15 kHz) Deviation: 0 to 20 kHz Demodulation frequency: 20 Hz to 20 kHz Accuracy: 1% + residual FM (demodulation frequency: 1 kHz) Frequency response: ±0.5 dB (referenced to 1 kHz) Residual FM: 8 Hz-rms (demodulation frequency: 0.3 to 3 kHz) Distortion: 0.3% (modulation frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz) øM Frequency range: 10 MHz to 3 GHz Input level range: –15 to +40 dBm (MAIN connector), –40 to +20 dBm (AUX connector) Filters (3 dB cut-off frequency): HPF (300 Hz, 50 kHz), LPF (3 kHz, 15 kHz) Deviation: 0 to 10 rad Demodulation frequency: 300 Hz to 3 kHz Accuracy: 1% + residual øM (modulation frequency: 1 kHz) Frequency response: ±0.5 dB (referenced to 1 kHz) Residual øM: 0.01 rad-rms (demodulation bandwidth: 0.3 to 3 kHz) Distortion: 0.5% (modulation frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz, deviation: 5 rad) FM demodulation output Deviation: 0 to 40 kHz (4/40 kHz range selectable) Demodulation frequency range: 50 Hz to 10 kHz Output level: 4 Vpeak (EMF, at full-scale range) Output impedance: 600 Ω Frequency response: ±1 dB Distortion: 1% (FM frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz, frequency deviation: 4 kHz) Filters (3 dB cut-off frequency): HPF (300 Hz), LPF (3 kHz) De-emphasis: 750 µs
Audio analyzer		Input impedance: 600 Ω/100 kΩ selectable (unbalanced, BNC connector) Bandpass filter HPF: 400 Hz (for tone rejection) De-emphasis: 750 µs Weighting filter: ITU-T P.53, C-MESSAGE AF Level meter Frequency range: 30 Hz to 20 kHz Level range: 1 mVrms to 30 Vrms Accuracy: ±0.5 dB AF frequency counter Frequency range: 30 Hz to 20 kHz Level range: 30 mVrms to 30 Vrms Accuracy: ±0.1 Hz Distortion meter Frequency range: 100 Hz to 5 kHz Level range: 30 mVrms to 30 Vrms Accuracy: ±1 dB (frequency: 1 kHz, distortion factor: 1%)
Mass		≤500 g

• Option 04: AF low impedance output

AF oscillator	Output impedance[*1]: ≤1 Ω (MAIN connector, unbalanced, BNC connector) Maximum output current: ≥100 mApeak (MAIN connector) Waveform distortion: –50 dBc (band: <30 kHz, 1 kHz, output level: 0.3 V), –45 dBc (band: <30 kHz, 20 Hz to 20 kHz, output level: 0.3 V)

*1: <1 Ω fixed (can not exchange to 50/600 Ω)

- **Option 07: Spectrum analyzer**

Frequency	Band Band 0: 0 Hz to 3 GHz, Band 1: 10 MHz to 3 GHz; HPF: On/off switchable (Band 1, 1.6 to 3 GHz) Setting range 0 to 3 GHz (Band: 0), 10 MHz to 3 GHz (Band: 1); Resolution: 1 Hz Display accuracy: ± (display frequency x reference frequency accuracy + span x span accuracy) Marker frequency accuracy Normal marker: Same as display frequency accuracy; Delta marker: Same as span accuracy Span setting range: 0 Hz or 10 kHz to 3 GHz (Band: 0), 0 Hz or 10 kHz to 2.99 GHz (Band: 1) Span accuracy: ±2.5% Resolution bandwidth Setting range: 300 Hz to 1 MHz (3 dB BW, 1-3 sequence) Accuracy: ±2% (300 Hz to 300 kHz), ±10% (1 MHz) Selectivity (60 dB:3 dB): ≤5:1 Video bandwidth: 3 Hz to 100 kHz (1-3 sequence) or through ∗Setting range is limited by resolution bandwidth. Sideband noise: ≤–95 dBc/Hz (1 GHz, 10 kHz offset), ≤–115 dBc/Hz (1 GHz, 100 kHz offset)
Amplitude (band 1)	Maximum input level Continuous average power: +40 dBm (MAIN connector), +20 dBm (AUX connector) DC voltage: 0 V Average noise level (resolution bandwidth: 1 kHz, video bandwidth: 10 Hz) ≤–90 dBm (10 MHz to 2.2 GHz), ≤–85 dBm (>2.2 GHz) ∗MAIN connector input, input attenuator: 20 dB ≤–110 dBm (10 MHz to 2.2 GHz), ≤–105 dBm (>2.2 GHz) ∗AUX connector input, input attenuator: 0 dB Residual response: ≤–70 dBm (MAIN connector, input attenuator: 20 dB), ≤–90 dBm (AUX connector, input attenuator: 0 dB) Level accuracy ±1.5 dB (MAIN connector, reference level: +10.1 to +40 dBm, at 0 to –50 dB of reference level) ±1.5 dB (AUX connector, reference level: –9.9 to +20 dBm, at 0 to –50 dB of reference level) Reference Level Setting range: ≤–60 to +50 dBm (MAIN connector), ≤–80 to +30 dBm (AUX connector) Setting resolution: 0.1 dB Accuracy: ±0.5 dB (MAIN connector, +10.1 to +40 dBm), ±1.0 dB (MAIN connector, –60 to +10 dBm), ±0.5 dB (AUX connector, –9.9 to +20 dBm), ±1.0 dB (AUX connector, –80 to –10 dBm) ∗After calibration, frequency: 100 MHz, span: 2 MHz; Input attenuator, resolution bandwidth, video bandwidth, sweep time are AUTO.) Resolution bandwidth switching deviation: ±0.1 dB (resolution bandwidth reference: 3 kHz) Frequency characteristics: ±0.5 dB [100 MHz reference, input attenuation: 30 dB (10 dB for AUX input), 18˚ to 28˚C] Log linearity: ±0.5 dB (0 to –50 dB, resolution bandwidth: ≤1 MHz), ±1.0 dB (0 to –70 dB, resolution bandwidth: ≤30 kHz), ±1.0 dB (0 to –80 dB, resolution bandwidth: ≤1 kHz) ∗10 MHz to 2.2 GHz, reference level: ≥0 dBm (MAIN connector)/≥–20 dBm (AUX connector) Spurious (2nd harmonic distortion): ≤–55 dBc (10 to 100 MHz), ≤–60 dBc (100 to 1500 MHz) ∗Mixer input: –30 dBm
Sweep	Sweep time: 100 ms to 1000 s (frequency domain sweep), 100 ms to 1000 s (time domain sweep, resolution bandwidth: ≤1 kHz) 10 ms to 1000 s (time domain sweep, resolution bandwidth: 3 to 10 kHz), 1 ms to 1000 s (time domain sweep, resolution bandwidth: ≥30 kHz) Trigger switch: FREERUN, TRIGGERED Trigger source: WIDE IF VIDEO (3 dB bandwidth: ≥20 MHz, trigger slope: RISE/FALL), EXT (trigger: TTL level, trigger slope: RISE/FALL) Trigger delay Range: 0 µs to 100 ms, Resolution: 2 µs Gate sweep Displays spectrum of input signal at specified gate on frequency domain display Gate delay: 2 µs to 100 ms from trigger start point (resolution: 2 µs) Gate width: 2 µs to 100 ms from gate delay point (resolution: 2 µs)
Functions	Marker functions Signal search: PEAK → CF, PEAK → REF Zero marker: NORMAL, DELTA Marker function: MARKER → CF, MARKER → REF, ZONE → SPAN Peak search: PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK Measurement function Noise power: dBm/Hz, dBm/ch C/N: dBc/Hz, dBc/ch Occupied bandwidth: N% of power method, X-dB down method Adjacent channel power: Reference total power method, reference level method, channel designate display (2 channels x 2), graphic display Average power within a burst: Average power of time domain waveform within specified time
Others	Number of data point: 501 points Detector mode POS PEAK: Displays max. point between sample points, NEGATIVE PEAK: Displays min. point between sample points, SAMPLE: Displays momentary value at sample points Display memory TRACE A: Displays frequency spectrum, TRACE B: Displays frequency spectrum, Trace time: Displays time domain waveform at center frequency Storage function: NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE

• Option 11: GSM audio test

Tx measurement	Decoding characteristics	Frequency range: 50 Hz to 4 kHz Level range: 0 to 3.2768 V Accuracy: ±1 Hz (500 Hz to 2 kHz)
	AF oscillator	Frequency range: 50 Hz to 20 kHz (setting resolution: 50 Hz) Accuracy: Same as reference oscillator Output level range: 50 mVrms to 3 Vrms (EMF) *Setting resolution: 0.1 mV Accuracy (bandwidth: <30 kHz) Unbalanced output: ±0.5 dB (1 kHz, ≥1 mV), ±1 dB (20 Hz to 20 kHz, ≥1 mV) Floating output: ±2 dB (1 kHz, ≥1 mV) Output impedance Main output: 600 Ω, 50 Ω (unbalanced, BNC connector) Microphone input: 600 Ω (floating, DUT interface) Waveform distortion (bandwidth: <30 kHz): <–50 dBc (1 kHz, 1 Vrms), <–45 dBc (20 Hz to 20 kHz, 1 Vrms)
Rx measurement	Coded signal	Frequency range: 50 Hz to 4 kHz (setting resolution: 50 Hz) Level range: 0 to 2.2 V (setting resolution: 0.1 mV)
	AF level measurement	Frequency range: 30 Hz to 20 kHz Level range: 1 mVrms to 30 Vrms Accuracy: ±0.5 dB
	AF frequency measurement	Frequency range: 30 Hz to 20 kHz Level range: 30 mVrms to 30 Vrms Accuracy: ±0.1 Hz

• Option 12: CDMA measurement

Signal generator	Frequency range IS-95A: 869.01 to 893.97 MHz (30 kHz step) J-STD-008: 1930.00 to 1989.95 MHz (50 kHz step) ARIB STD-T53: 832.0125 to 833.9875 MHz, 843.0125 to 845.9875 MHz, 860.0125 to 869.9875 MHz (12.5 kHz step) KORER-PCS: 1805.05 to 1870.00 MHz (50 kHz step) Level setting range: –133 to –18 dBm (Main connector, AWGN off), –133 to +2 dBm (AUX connector, AWGN off) –133 to –24 dBm (Main connector, AWGN on), –133 to –4 dBm (AUX connector, AWGN on) Relative level accuracy: ±0.2/20 dB (Relative level accuracy at level change in time response of open-loop power control 18˚ to 28˚C) Waveform quality: >0.99 (pilot channel: 0 dB) Channel level accuracy: ±0.2 dB (relative level accuracy between any 2 channels) AWGN level accuracy: ±0.2 dB (relative level for forward traffic channel)
Reception measurement	FER measurement: FER measurement value, error frame number, test frame number, reliability limit (pass/fail)
Transmission measurement	Frequency range IS-95A: 824.01 to 848.97 MHz (30 kHz step) J-STD-008: 1850.00 to 1909.95 MHz (50 kHz step) ARIB STD-T53: 887.0125 to 888.9875 MHz, 898.0125 to 900.9875 MHz, 915.0125 to 924.9875 MHz (12.5 kHz step) KORER-PCS: 1715.05 to 1780.00 MHz (50 kHz step) Modulation analysis Level range: –20 to +40 dBm (average power within a burst, main connector only) Waveform quality measurement range: 0.9 to 1.0 Measurement error: ±0.003 (after executing adjust range) Residual vector error: <5% (after executing adjust range) Power measurement (IF level meter) Measurement range: –50 to +40 dBm Measurement accuracy: ±0.4 dB (0 to +40 dBm, after executing power meter calibration) ±0.4 dB (–10 to +40 dBm, after executing power meter calibration, 18˚ to 28˚C) ±0.7 dB (–10 to +40 dBm, after executing internal oscillator calibration, 18˚ to 28˚C) Linearity: ±0.1 dB (0 to –10 dB), ±0.2 dB (–10 to –20 dB), ±0.5 dB (–20 to –40 dB) *Referred to reference level: ≥–10 dBm Input connector: Main connector only Occupied bandwidth measurement Level range: 0 to +40 dBm (average power within a burst, MAIN connector), –20 to +20 dBm (average power within a burst, AUX connector) Spurious close to the carrier measurement Level range: 0 to +40 dBm (average power within a burst, MAIN connector), –20 to +20 dBm (average power within a burst, AUX connector) Measurement range: ≥50 dB (900 kHz offset), ≥60 dB (1.98 MHz offset) Spurious measurement Level range: 0 to +40 dBm (average power within a burst, MAIN connector), –20 to +20 dBm (average power within a burst, AUX connector) Measurement range: ≥60 dB
Call processing	Functions: Registration, origination, termination, conversation, loopback, hard handoff, disconnection from network, disconnection from mobile station, CDMA → analog handoff (IS-95A), soft handoff (MX880201A-01), softer handoff (MX880201A-01) Protocol: IS-95A (CDMA, analog), J-STD-008, ARIB STD-T53

• MX880113A IS-136A Measurement Software (extracts)

Transmission measurement	Digital	Frequency/modulation measurement Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ± (2% of indicated value + 0.5%) Amplitude measurement Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration) Adjacent channel power measurement Measurement range: ≥30 dB (30 kHz offset), ≥60 dB (60 kHz offset), ≥65 dB (90 kHz offset) Batch measurement functions Measurement time: ≤1.5 s (amplitude measurement in normal mode)
	Analog	Same as Option 01
Reception measurement	Digital	Signal generator Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms Error rate measurement Measurement pattern: PN9 (measures TCH data of up communication burst at RF input) Number of measurement bits: 1 to 99999999
	Analog	Same as Option 01
Call processing		Pass/fail judgement of registration, origination, termination communication, handoff, disconnection from network, disconnection from mobile station

• MX880114A AMPS/PCS1900 Measurement Software (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Residual phase error accuracy: ≤0.5° rms, ≤2° peak
	Amplitude measurement	Input level range: –5 to +40 dBm (average power within burst, MAIN connector) Calibration input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmission power accuracy: ±0.4 dB (+10 to +40 dBm), ±0.7 dBm (–5 to +40 dBm) *MAIN connector, after calibration by using built-in power meter with same Tx reference level as calibration
	Output RF spectrum measurement	Modulation portion measurement range: ≥50 dB (200 kHz offset), ≥66 dB (250 kHz offset) Transition portion measurement range: ≥57 dB (400 kHz offset)
	All measurement items	Measurement time: ≤2.0 s (amplitude measurement: normal mode, except MS report measurement)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Phase error: ≤1° rms, ≤4° peak
	Error rate measurement	Measurement pattern: 10 test patterns selectable Number of measurement samples: 1 to 99999999 (FER, CIb, CII)
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station
Analog measurement		Same as Option 01 for AMPS

• MX880115A GSM Measurement Software (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Residual phase error accuracy: ≤0.5° rms, ≤2° peak
	Amplitude measurement	Input level range: –5 to +40 dBm (average power within burst, MAIN connector) Calibration input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmission power accuracy: ±0.4 dB (+10 to +40 dBm), ±0.7 dBm (–5 to +40 dBm) *MAIN connector, after calibration by using built-in power meter with same Tx reference level as calibration
	Output RF spectrum measurement	Modulation portion measurement range: ≥50 dB (200 kHz offset), ≥66 dB (250 kHz offset) Transition portion measurement range: ≥57 dB (400 kHz offset)
	All measurement items	Measurement time: ≤2.0 s (amplitude measurement: normal mode, except MS report measurement)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Phase error: ≤1° rms, ≤4° peak
	Error rate measurement	Measurement pattern: 10 test patterns selectable Number of measurement samples: 1 to 99999999 (FER/CRC, CIb, CII, FAST)
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station
Analog measurement		Same as Option 01 for AMPS

• MX880116A PDC Measurement Software with Call Processing (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ±(2% of indicated value + 0.5%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter)
	Adjacent channel power measurement	Measurement range: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station

• MX880117A PHS Measurement Software with Call Processing (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ±(2% of indicated value + 0.7%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter, at +10 to +40 dBm)
	Adjacent channel power measurement	Measurement range: ≥60 dB (600 kHz offset), ≥65 dB (900 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station

• MX880118A DECT Measurement Software (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz, RF carrier accuracy: ±250 Hz + reference oscillator accuracy, Frequency drift measurement accuracy: ±250 Hz, Modulation measurement accuracy: ±10 kHz
	Amplitude measurement	Input level range: –5 to +40 dBm (MAIN connector) Calibration input level range: +15 to +40 dBm (MAIN connector) Transmitter power accuracy: ±0.4 dB (+15 to +40 dBm), ±0.7 dB (–5 to +15 dBm) *MAIN connector, after calibration by using built-in power meter
	Adjacent channel power measurement	Emission due to modulation: –8 dBm/160 μW at M ±1, –30 dBm/1 μW at M ±2, –44 dBm/40 nW at M ±3, –47 dBm/20 nW at M ±4 and M ±5 Emission due to transmitter transient: –6 dBm/250 μW at M ±1, –13 dBm/40 μW at M ±2, –23 dBm/4 μW at M ±3, –30 dBm/1 μW at M ±4 and M ±5
	All measurement items	Frequency, deviation, frequency drift, Tx power, carrier-off power, template pass/fail, timing, adjacent channel emission
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation error: ≤±8% (at 288 kHz deviation, frequency 10 MHz to 2.2 GHz)
	Error rate measurement	Modes: FER, BER (Quick Mode), BER (Full Mode) Measurement pattern: 0000111100001111, 0011001100110011, 0101010101010101, 1010 64 x 1 64 x 0 1010, pseudo-random (D-M2), ETSI patterns Number of measurement bits: 1 to 99000 k
Call processing		Bearer setup, bearer release, hand-over, loopback

• MX880131A PDC Measurement Software (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ± (2% of indicated value + 0.5%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter)
	Adjacent channel power measurement	Measurement range: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞

• MX880132A PHS Measurement Software (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ± (2% of indicated value + 0.7%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter)
	Adjacent channel power measurement	Measurement range: ≥60 dB (600 kHz offset), ≥65 dB (900 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MT8801C	Radio Communication Analyzer
	Standard accessories
J0576B	Coaxial cord (N-P · 5D-2W · P), 1 m: 1 pc
J0768	Coaxial adaptor (N-J · NC-P): 2 pcs
	Power cord: 1 pc
F0014	Fuse, 6.3 A: 2 pcs
	Options*1
MT8801C-01	Analog Measurement
MT8801C-04	AF Low Impedance Output (requires Option 01)
MT8801C-07	Spectrum Analyzer
MT8801C-11	GSM Audio Test (requires MX880115A and Option 01)
MT8801C-12	CDMA Measurement (requires Option 01)
MX880113A	IS-136A Measurement Software (requires Option 01)
MX880114A	AMPS/PCS1900 Measurement Software (requires Option 01)
MX880115A	GSM Measurement Software
MX880116A	PDC Measurement Software with Call Processing
MX880117A	PHS Measurement Software with Call Processing
MX880118A	DECT Measurement Software (requires Option 07)
MX880131A	PDC Measurement Software
MX880132A	PHS Measurement Software
MX880201A-01	Soft Handoff (for CDMA, requires Option 12)
	Peripherals
MS8604A	Digital Mobile Radio Transmitter Tester
MD6420A	Data Transmission Analyzer
MS2683A	Spectrum Analyzer
MG3681A	Digital Modulation Signal Generator
	Optional accessories
J0127C	Coaxial cord (BNC-P · G-58A/U · NC-P), 0.5 m
J0769	Coaxial adapter (BNC-J · NC-P)
J0040	Coaxial adapter (N-P · NC-J)
MA1612A	Four-Point Junction Pad
J0395	Fixed attenuator for high power (30 dB, 30 W, dc to 9 GHz)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0329D	Front cover (1MW 5U)
B0331D	Front handle kit (2 pcs/set)
B0332	Joint plate (4 pcs/set)
B0333D	Rack mount kit
B0334D	Carrying case (hard type, with protective cover and casters)
J0742A	RS-232C cable (for PC-98 PC, D-sub 25-pin), 1 m
J0743A	RS-232C cable (for DOS/V PC, D-sub 9-pin), 1 m

*1: Installed in Anritsu. It can be retrofitted to an already purchased MT8801C.
For details, contact your Anritsu sales representative.

RADIO COMMUNICATION TEST SYSTEM
ME7812 Series

GPIB

Low-Cost Automatic Test System for cdmaOne/PDC/PHS Mobile Stations

The ME7812 series test system is for automatic testing of cdmaOne mobile station for both the Japanese ARIB system and the North-American IS-95 system and PDC/PHS mobile stations. It can also be used for testing dual mode stations of the North-American AMPS (analog) and cdmaOne.
The test method can be selected from the IS-95A, J-STD-008, ARIB STD-T53 KOREA-PCS (cdmaOne), RCR STD-27 (PDC) and RCR STD-28 (PHS) standards, the TELEC Technical Standard Conformity Certification, and a high-speed method.
A full range of options permits the test system to be configured for both production lines and specific applications. A personal computer running Windows 98 can be used as a system controller.

Models	Application systems
ME7812A	cdmaOne
ME7812B	cdmaOne, PDC
ME7812C	cdmaOne, PHS
ME7812D	cdmaOne, PDC, PHS
ME7812E	PDC
ME7812F	PHS
ME7812G	PDC, PHS

Features
- Standards-based measurement
- Easy-to-understand GUI operations and help guide

Functions and performance

• LAN connection, data collection and system management
A network of plural test systems can be constructed easily using the Windows 98 Network Drive Assignment function. The test conditions and data can be saved into a server*1. In addition, network construction services are supported.
*1: Requires LAN card in PC

• Automatic correction of frequency characteristics
The I/O frequency characteristics of the test system with the options must be corrected. The MX781250A Level Correction Software measures the correction data automatically. Maintenance and periodical updates are made easily using these corrected frequency characteristic values. I/O level errors can be detected by comparing the current and previous corrected values.

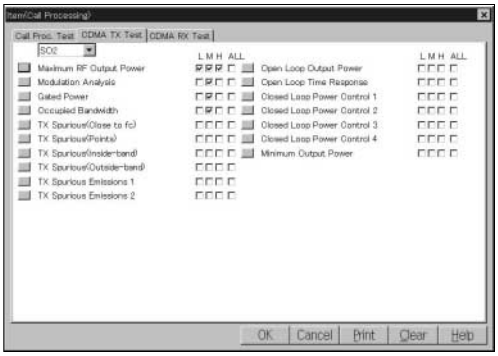
• Switching unit for continuous tests
The ME7411A Switching Unit for Transceiver Continuous Test is used for testing two mobile stations alternately. It eliminates the time required to change mobile stations, allowing continuous testing*2.
*2: The ME7410A or ME7413A switches the RF signals.

• Compact high-performance coaxial switch
The ME7413A Coaxial Switch can be connected directly to the RF I/O connector of the MT8801B/C and MT8802A. It is especially suitable for maintenance of mobile stations. The power is supplied and controlled from the controller.

• For maintenance of mobile stations
Call processing allows PDC, PHS, and cdmaOne mobile stations to be tested in the actual operation conditions (communication mode). Communication test is also possible.

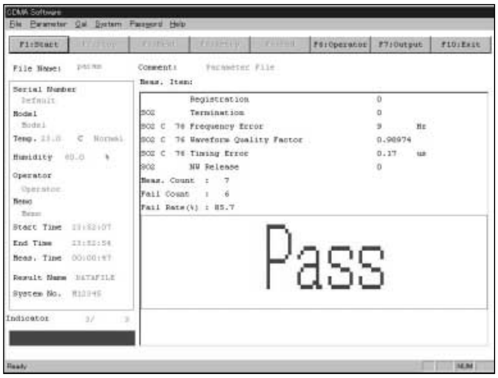
• High-speed measurement
TELEC Technical Standard Conformity Test items, such as frequency, transmission rates, antenna power, carrier-off leakage power, occupied bandwidth, adjacent channel power, spurious emissions and radiated spurious emissions can be measured for PDC/PHS in less than 30 seconds.

• Test by call processing or test mode control
Any frequency channel (L, M, H, ALL) can be selected for each test item of call processing or test mode control. The selected items can be tested continuously.



SO2

	L	M	H	ALL		L	M	H	ALL
Maximum RF Output Power	☑	☑	☑	☐	Open Loop Output Power	☐	☐	☐	☐
Modulation Analysis	☐	☑	☐	☐	Open Loop Time Response	☐	☐	☐	☐
Gated Power	☐	☑	☐	☐	Closed Loop Power Control 1	☐	☐	☐	☐
Occupied Bandwidth	☐	☑	☐	☐	Closed Loop Power Control 2	☐	☐	☐	☐
TX Spurious(Close to fc)	☐	☐	☐	☐	Closed Loop Power Control 3	☐	☐	☐	☐
TX Spurious(Points)	☐	☐	☐	☐	Closed Loop Power Control 4	☐	☐	☐	☐
TX Spurious(Inside-band)	☐	☐	☐	☐	Minimum Output Power	☐	☐	☐	☐
TX Spurious(Outside-band)	☐	☐	☐	☐					
TX Spurious Emissions 1	☐	☐	☐	☐					
TX Spurious Emissions 2	☐	☐	☐	☐					



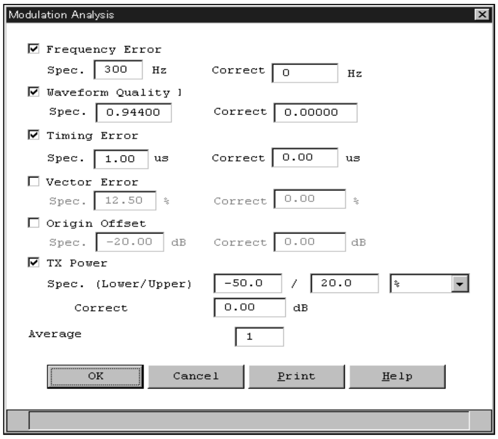
File Name: param
Comment: Parameter File
Serial Number: Default
Model: Model
Temp. 23.0 C Normal
Humidity 60.0 %
Operator: Operator
Memo: Memo
Start Time 23:52:07
End Time 23:52:54
Meas. Time 00:00:47
Result Name DATAFILE
System No. M12345
Indicator 3/ 3

Meas. Item:

```
         Registration              0
SO2      Termination               0
SO2 C  76 Frequency Error          9        Hz
SO2 C  76 Waveform Quality Factor  0.98974
SO2 C  76 Timing Error             0.17     us
SO2      NW Release                0
Meas. Count  :  7
Fail Count   :  6
Fail Rate(%) : 85.7
```

Pass

• Flexible tests with various parameters
Specifications and average, etc., parameters can be set for each test item, providing optimum test conditions suitable for the mobile station model or test purpose.



☑ Frequency Error
Spec. 300 Hz Correct 0 Hz

☑ Waveform Quality
Spec. 0.94400 Correct 0.00000

☑ Timing Error
Spec. 1.00 us Correct 0.00 us

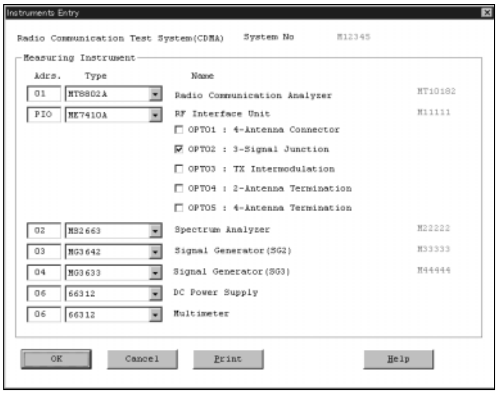
☐ Vector Error
Spec. 12.50 % Correct 0.00 %

☐ Origin Offset
Spec. -20.00 dB Correct 0.00 dB

☑ TX Power
Spec. (Lower/Upper) -50.0 / 20.0 %
Correct 0.00 dB

Average 1

• Free choice of system components
System components can be chosen to match the required functions. For example, a signal generator can be chosen for 3-signal application.



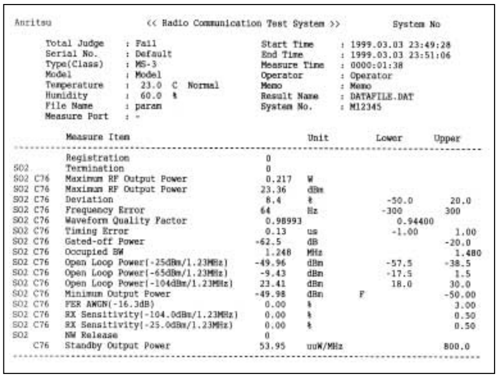
Radio Communication Test System(CDMA) System No M12345

Measuring Instrument

Adrs.	Type	Name	
01	MT8802A	Radio Communication Analyzer	MT10182
PIO	ME7410A	RF Interface Unit	M11111
		☐ OPT01 : 4-Antenna Connector	
		☑ OPT02 : 3-Signal Junction	
		☐ OPT03 : TX Intermodulation	
		☐ OPT04 : 2-Antenna Termination	
		☐ OPT05 : 4-Antenna Termination	
02	MS2663	Spectrum Analyzer	M22222
03	MG3642	Signal Generator(SG2)	M33333
04	MG3633	Signal Generator(SG3)	M44444
06	66312	DC Power Supply	
06	66312	Multimeter	

• Help guide
A help guide supports the software products. Either Japanese help guide or the English help guide (only for cdmaOne) can be selected at installation.

• Example of test data output

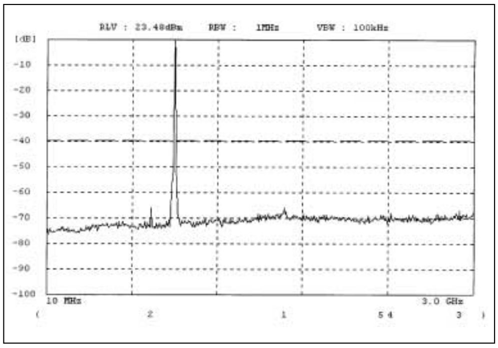


```
Anritsu               << Radio Communication Test System >>        System No

      Total Judge    : Fail                    Start Time    : 1999.03.03 23:49:28
      Serial No.     : Default                 End Time      : 1999.03.03 23:51:06
      Type(Class)    : MS-3                    Measure Time  : 0000:01:38
      Model          : Model                   Operator      : Operator
      Temperature    :  23.0  C  Normal        Memo          : Memo
      Humidity       :  60.0  %                Result Name   : DATAFILE.DAT
      File Name      : param                   System No.    : M12345
      Measure Port   : -

         Measure Item                                   Unit         Lower      Upper
-------------------------------------------------------------------------------------
         Registration                        0
SO2      Termination                         0
SO2 C76  Maximum RF Output Power             0.217   W
SO2 C76  Maximum RF Output Power            23.36    dBm
SO2 C76  Deviation                           8.4     %              -50.0       20.0
SO2 C76  Frequency Error                    64       Hz            -300         300
SO2 C76  Waveform Quality Factor             0.98993                 0.94400
SO2 C76  Timing Error                        0.13    us              -1.00       1.00
SO2 C76  Gated-off Power                   -62.5     dB                        -20.0
SO2 C76  Occupied BW                         1.248   MHz                        1.480
SO2 C76  Open Loop Power(-25dBm/1.23MHz)   -49.96    dBm            -57.5      -38.5
SO2 C76  Open Loop Power(-65dBm/1.23MHz)    -9.43    dBm            -17.5        1.5
SO2 C76  Open Loop Power(-104dBm/1.23MHz)   23.41    dBm             18.0       30.0
SO2 C76  Minimum Output Power              -49.98    dBm      F                -50.00
SO2 C76  FER AWGN(-16.3dB)                   0.00    %                          3.00
SO2 C76  RX Sensitivity(-104.0dBm/1.23MHz)   0.00    %                          0.50
SO2 C76  RX Sensitivity(-25.0dBm/1.23MHz)    0.00    %                          0.50
SO2      NW Release                          0
    C76  Standby Output Power               53.95    uuW/MHz                  800.0
-------------------------------------------------------------------------------------
```

Data printout



Graphical data printout

Only cdmaOne graphical data can be saved on disk.

Test items (For system construction, please refer to the individual data sheet.)

- **ME7812A/B/C/D**

Measurement items	System	cdmaOne		
	Options	Standard	Option 03/13	Option 04
CDMA TX tests	Maximum RF output power	●		
	Frequency error	●		
	Waveform quality factor	●		
	Transmit time error	●		
	Gated output power	◆		
	Occupied bandwidth	●		
	TX spurious (close to fc) at maximum RF output power	●		
	TX spurious (points) at maximum RF output power	●		
	TX spurious (inside-band) at maximum RF output power		●	
	TX spurious (outside-band) at maximum RF output power		●	
	TX spurious emissions		●	
	Open loop output power	■		
	Time response of open loop power control	■		
	Range of closed loop power control	■		
	Minimum controlled output power	●		
	Stand-by output power	■		
	Access probe output power	■		
CDMA RX tests	Demodulation of forward traffic channel in AWGN	■		
	Receiver sensitivity and dynamic range	■		
	Single tone desensitization			■
	Intermodulation spurious response attenuation			■
	RX spurious emissions		●	
Analog TX tests	RF frequency error	◆		
	RF output power	◆		
	Compressor	◆		
	Transmit electrical audio response	◆		
	Modulation deviation limiting	◆		
	SAT	◆		
	SA	◆		
	FM hum and noise	◆		
	Modulation distortion	◆		
Analog RX tests	RF sensitivity	◆		
	RSSI	◆		
	Electrical audio frequency response	◆		
	Audio muting	◆		
	Expander	◆		
	Hum and noise	◆		
	Audio harmonic distortion	◆		
Call processing test	CDMA origination and termination	■		
	Voice test	■		
	CDMA-to-analog hand-off	■		
	Analog origination/release	■		
DC test*1	Current consumption	●		

● : Tests with call processing and test mode control
■ : Test with call processing
◆ : Test with test mode control

*1: A DC power supply and a multimeter are required.

- **ME7812B/D/E/G**

Measurement items	System	PDC					
	Software	MX781217A (with processing)			MX781232A		
	Options	Standard	Option 03/13	Option 04	Standard	Option 03/13	Option 04
TX tests	Frequency error	●			◆		
	Modulation accuracy	●			◆		
	Transmission rate	●			◆		
	Antenna power deviation	●			◆		
	Leakage power during carrier-off	●			◆		
	Burst transmission transient response characteristics	●			◆		
	Occupied bandwidth	●	●		◆	◆	
	Adjacent channel power	●	●		◆	◆	
	Transmission timing	■			◆		
	Spurious emission strength		●			◆	
	Transmission intermodulation			◆[*2]			◆[*2]
	Transmission output control characteristics	●			◆		
	Time alignment	■					
RX tests	Receiver sensitivity	◆			◆		
	Bit error rate floor characteristics	◆			◆		
	Interference level			◆			◆
	Adjacent channel selectivity			◆			◆
	Intermodulation characteristics			◆			◆
	Spurious sensitivity			◆			◆
	Receiver level detection	●			◆		
	Network quality detection	●			◆		
	Secondary emission strength		◆			◆	
Call processing test	Origination/termination disconnection	■					
	Voice test	■					
DC test[*1]	Current consumption	●			◆		

● : Tests with call processing and test mode control
■ : Test with call processing
◆ : Test with test mode control

*1: A DC power supply and a multimeter are required.
*2: ME7410A-03 and ME7812B/C/D-03 are required.

- **ME7812C/D/F/G**

Measurement items	System	PHS					
	Software	MX781217A (with processing)			MX781232A		
	Options	Standard	Option 03/13	Option 04	Standard	Option 03/13	Option 04
TX tests	Frequency error	●			◆		
	Modulation accuracy	●			◆		
	Transmission rate	●			◆		
	Antenna power deviation	●			◆		
	Leakage power during carrier-off	●*2			◆*2	◆	
	Burst transmission transient response characteristics	●			◆		
	Occupied bandwidth	●	●		◆	◆	
	Adjacent channel power	●	●		◆	◆	
	Transmission timing	■			◆*4		
	Spurious emission strength		●			◆	
	Transmission intermodulation			◆*3			◆*3
	Transmission output control characteristics	◆			◆		
	2 signal 3rd order distortion					◆*4	
RX tests	Receiver sensitivity	◆			◆		
	Bit error rate floor characteristics	◆			◆		
	Interference level			◆			◆
	Adjacent channel selectivity			◆			◆
	Intermodulation characteristics			◆			◆
	Spurious sensitivity			◆			◆
	Receiver level detection	◆			◆		
	Network quality detection						
	Secondary emission strength		◆			◆	
Call processing test	Origination/termination disconnection	■					
	Voice test	■					
DC test*1	Current consumption	●			◆		

● : Tests with call processing and test mode control
■ : Test with call processing
◆ : Test with test mode control
*1: A DC power supply and a multimeter are required.
*2: High-speed method only
*3: ME7410A-03 and ME7812B/C/D-03 are required.
*4: PHS base station (CS) test only

W-CDMA AREA TESTER

ML8720B

2110 to 2200 MHz

For W-CDMA Base Station Area Investigation and Maintenance

The ML8720B is used for investigation and maintenance to evaluate the radio wave propagation characteristics in the area of a W-CDMA base station. When it is connected to a GPS receiver, the measured data can be correlated with positioning information (latitude and longitude).

The measurement items include functions for measuring the RSCP*1, Ec/No and SIR*2, which is used to evaluate the strength of the radio wave received from each base station; and the delay profile, which is used to evaluate the delay characteristics of the radio wave caused by multipath propagation.

There are two measurement modes: the unspecified base station measurement mode, and the specified base station measurement mode. The CPICH*3 from the base station is measured in both cases. The unspecified base station measurement mode is used when the base station scrambling code is unknown. Search methods of scrambling code include SCH search method with SCH*4 and P-CPICH*5 search method to directly search P-CPICH without depending on SCH. The specified base station measurement mode is used when the base station scrambling code is known.

∗1: RSCP (Received Signal Code Power)
∗2: SIR (Signal Interference Ratio)
∗3: CPICH (Common Pilot Channel)
∗4: SCH (Synchronization Channel)
∗5: P-CPICH (Primary CPICH)

- **High-speed and high-accuracy area analysis**

RSCP, Ec/No and SIR can be measured at 30 cm intervals (at specified base station and single-channel measurement) while travelling at 100 km/h in a monitoring vehicle to provide fast and accurate area analysis.

- **Correlation with GPS positioning data**

The measured data can be correlated with GPS positioning data (latitude and longitude) and saved to a memory card. In addition, the measured data and positioning information can be downloaded at real time to an external PC via the RS-232C interface.

- **High-accuracy measurement using diversity function**

When used in combination with the optional diversity function, even higher-accuracy measurements, such as CPICH transmit diversity format and receive antenna diversity can be performed.

- **Master/slave mode**

In addition to stand-alone measurement using a single unit, several ML8720B units can be connected as one master and several slaves, permitting parallel master/slave measurements. A separate measurement channel can be specified for each ML8720B to greatly reduce the initial code detection time.

- **Handy type**

At only 4 kg, the ML8720B is easily portable for both outside and inside work. And the large 8.4" color LCD is easy to view.

For the use under direct sunlight, 7.8-inch reflective color STN-LCD display model is also available (Option 02)* .

∗: Factory option (Display units can not be exchanged by customers)

- **3-hour battery operation**

The lithium-ion battery pack provides more than 3 hours of operation and a spare battery pack solves even long-term measurement problems.

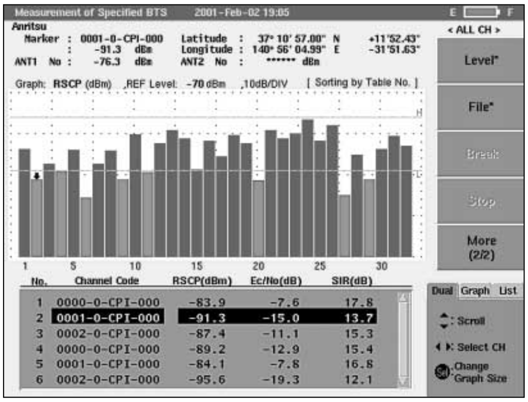
- **Large-capacity memory cards**

Large amounts of measured data can be saved to large-capacity flash-memory cards (256 MB max.).

Measurement examples

- **Channel display**

The measurement results for all the receive channels (32 max.) can be displayed simultaneously as a graph and as data. Additionally, it is possible to set measurement interval and to select the cumulative processing (max., min., median, average) for the internally accumulated data in the set measurement interval.



Measurement of Specified BTS 2001-Feb-02 19:05

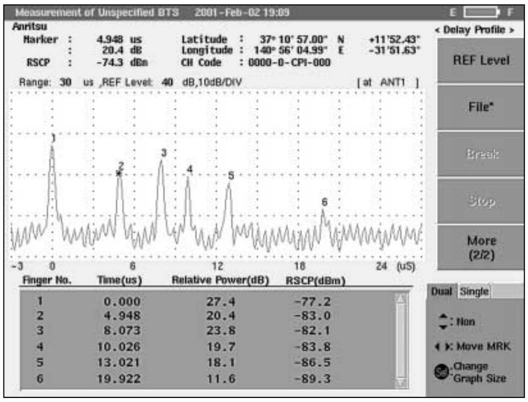
Anritsu

Marker : 0001-0-CPI-000 Latitude : 37° 10' 57.00" N +11'52.43"
: -91.3 dBm Longitude : 140° 56' 04.99" E -31'51.63"
ANT1 No : -76.3 dBm ANT2 No : ****** dBm

Graph: RSCP (dBm) ,REF Level: -70 dBm ,10dB/DIV [Sorting by Table No.]

No.	Channel Code	RSCP(dBm)	Ec/No(dB)	SIR(dB)
1	0000-0-CPI-000	-83.9	-7.6	17.8
2	0001-0-CPI-000	-91.3	-15.0	13.7
3	0002-0-CPI-000	-87.4	-11.1	15.3
4	0000-0-CPI-000	-89.2	-12.9	15.4
5	0001-0-CPI-000	-84.1	-7.8	16.8
6	0002-0-CPI-000	-95.6	-19.3	12.1

• Delay profile display
This displays the delay profile for one selected channel and the multipath can be confirmed visually. In addition, time or distance range can be selected for the horizontal axis.

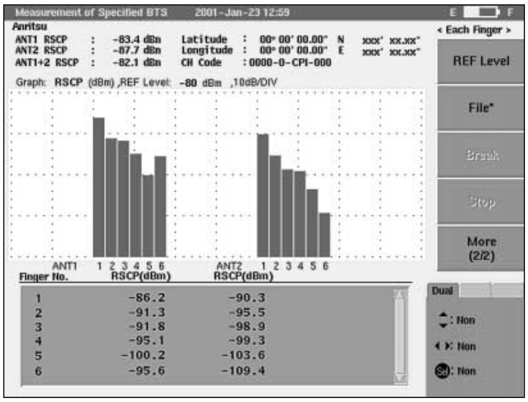

Measurement of Unspecified BTS 2001-Feb-02 19:09

Anritsu
Marker : 4.948 us Latitude : 37° 10' 57.00" N +11'52.43"
: 20.4 dB Longitude : 140° 56' 04.99" E -31'51.63"
RSCP : -74.3 dBm CH Code : 0000-0-CPI-000

Range: 30 us ,REF Level: 40 dB,10dB/DIV [at ANT1]

Finger No.	Time(us)	Relative Power(dB)	RSCP(dBm)
1	0.000	27.4	-77.2
2	4.948	20.4	-83.0
3	8.073	23.8	-82.1
4	10.026	19.7	-83.8
5	13.021	18.1	-86.5
6	19.922	11.6	-89.3

• Finger display
This displays the measured data for one selected channel path (finger). When the diversity option is installed, the RSCP for up to 12 paths can be evaluated simultaneously.
RSCP per Finger can be outputted to a file for all channels under measurement when the measurement is performed in activated Each Finger data output. It is effective for multi-path environment analysis and indoor simulation based on acquired data.

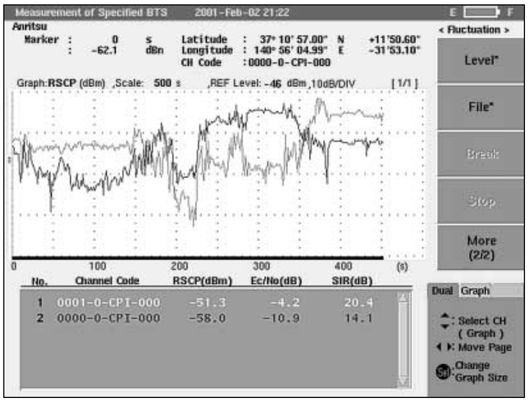

Measurement of Specified BTS 2001-Jan-23 12:59

Anritsu
ANT1 RSCP : -83.4 dBm Latitude : 00° 00' 00.00" N xxx' xx.xx"
ANT2 RSCP : -87.7 dBm Longitude : 00° 00' 00.00" E xxx' xx.xx"
ANT1+2 RSCP : -82.1 dBm CH Code : 0000-0-CPI-000

Graph: RSCP (dBm) ,REF Level: -80 dBm ,10dB/DIV

Finger No.	ANT1 RSCP(dBm)	ANT2 RSCP(dBm)
1	-86.2	-90.3
2	-91.3	-95.5
3	-91.8	-98.9
4	-95.1	-99.3
5	-100.2	-103.6
6	-95.6	-109.4

• Time/Distance variation display
A time/distance variation of the RSCP, Ec/No and SIR are displayed. The time variation can be measured in 10 ms intervals for 10 ms to 500 s and the max., min., median or average value of the cumulative totals can be displayed. The distance variation can be measured using the vehicle wheel pulse (external trigger) for 1 to 500 pulses and the max., min., median or average value of cumulative totals can be displayed.


Measurement of Specified BTS 2001-Feb-02 21:22

Anritsu
Marker : 0 s Latitude : 37° 10' 57.00" N +11'50.60"
: -62.1 dBm Longitude : 140° 56' 04.99" E -31'53.10"
CH Code : 0000-0-CPI-000

Graph:RSCP (dBm) ,Scale: 500 s ,REF Level: -46 dBm,10dB/DIV [1/1]

No.	Channel Code	RSCP(dBm)	Ec/No(dB)	SIR(dB)
1	0001-0-CPI-000	-51.3	-4.2	20.4
2	0000-0-CPI-000	-58.0	-10.9	14.1

Specifications

Frequency range	2110 to 2200 MHz
Input impedance	50 Ω (SMA-type connector)
Frequency setting resolution	200 kHz (W-CDMA measurement mode), 1 kHz (spectrum monitor mode)
Reference oscillator	Aging rate: ±1 x 10^{-6}/year
Receive signals	P-CPICH, S-CPICH
Power measurement	Measurement range W-CDMA measurement mode: –117 to –33 dBm Spectrum monitor mode: –123 to –33 dBm Resolution: 0.1 dB Display units: dBm, dBµV, dBµV/m (spectrum monitor mode) Accuracy: ±2 dB (RSCP) Average noise level (spectrum monitor mode): ≤–127 dBm (RBW: 4 kHz) SIR Accuracy: ±3 dB (at dynamic range: –100 to –40 dBm, SIR: 5 to 20 dB) Dynamic characteristics: RSCP, SIR measurement at 0 to 100 km/h (averaged distance: 50 m)
Measurement items	Specified base station, unspecified base station, spectrum monitor
Base station measurement	Measurement items: Received signal code power (RSCP), ratio of desired receive power per chip to receive power density (Ec/No), signal interference ratio (SIR) Measurement modes: Time variation (internal trigger) distance variation (external trigger) Sampling interval: 10 ms min. (at 1 channel measurement) Measurement channels: 32 max. Sync acquisition time: 600 ms x the number of search channel Data processing method: Average, median, max., min., 10%, 20%, 30%, 40%, 60%, 70%, 80%, 90% Measurement displays: All channel, delay profile, each finger, fluctuation (fluctuation is only for specification base station measurement), SCH delay profile (unspecified base station measurement)

Continued on next page

Spectrum monitor function	Frequency span: 4 MHz, 90 MHz Resolution bandwidth: 4 kHz
Other functions	Master/slave function: Daisy chain of multiple ML8720B, parallel measurement GPS connection: Supports NMEA-0183 format Remote control: Via RS-232C File I/O: Read measurement conditions, output measured results file Diversity function: Transmit diversity, receive antenna diversity (Option 01) RAKE diversity: Six fingers
Interface	IF output: ≥10 dBμV (190 MHz), BNC connector External reference input: 2 to 5 Vp-p (10 MHz), BNC connector External trigger input: 1.5 Vdc ±(2 to 13 Vp-p), BNC connector Sync output: TTL level, BNC connector RS-232C-1: For external computer (max. 115.2 kbps), D-sub 9-pin connector RS-232C-2: For GPS (supports NMEA-0183 format), mini-DIN 8-pin connector Printer: 8-bit parallel I/F (conform to Centronics), D-sub 25-pin connector Keyboard: IBM US ENGLISH (101 keys) 106 supported, Mini-DIN 6-pin connector External monitor: VGA, mini-DIN 10-pin connector
Storage media	FDD (3.5", 2HD), ATA flash card
Display	640 x 480 dots, 8.4" color LCD, 7.8" color LCD (Option 02)
Environment conditions	Temperature and humidity: 0˚ to +40˚C/≤85% (operating), —25˚ to +60˚C/≤85% (storage) Vibration: MIL-T-28800E Class 3 Drop test: 76 cm drop (Bellcore standard) EMC EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class D), EN61326: 1997/A1: 1998 (Annex A) LVD EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)
Power	10 to 26.4 Vdc 100 to 240 Vac, 50/60 Hz (with AC adapter) Battery: Z0404A Lithium Ion Battery Pack Power consumption: 35 W max., 20 W (typical), 30 W (typical with Option 01) Battery continuous operation time: 3 h (typical), 2 h (typical with Option 01)
Dimensions and mass	290 (W) x 194 (H) x 78 (D) mm, ≤4 kg (with battery pack) 290 (W) x 194 (H) x 123 (D) mm, ≤5 kg (with Option 01 and battery pack)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
ML8720B*	W-CDMA Area Tester	
	Standard accessories	
W1893AE	ML8720B operation manual:	1 copy
Z0404A	Lithium Ion Battery Pack:	1 pc
J1069	AC adapter:	1 pc
	Power cord:	1 pc
Z0402A	Protective cover:	1 pc
Z0403A	Belt with hook:	1 pc
Z0516	Antenna:	1 pc
Z0517	Antenna mount (with 5 m cable):	1 pc
J0977	Serial interface cable (for connecting GPS):	1 pc
	Option	
ML8720B-01	Diversity function	
ML8720B-02*	Display unit (STN-LCD, 7.8 inch)	
	Application software	
MX872022B	Data Conversion Software (date conversion output for MapInfo)	
	Maintenance service	
ML8720B-90	Extended three year warranty service	
ML8720B-91	Extended five year warranty service	
	Application parts	
JT128MA3-NT1	PC-ATA card (128 MB)	
JT256MA3-NT1	PC-ATA card (256 MB)	
Z0436	Hard carrying case	
Z0435	Soft carrying case [430 (W) x 300 (H) x 170 (D) mm]	
B0442	Soft carrying case [440 (W) x 310 (H) x 110 (D) mm]	
Z0526	Case for installation (for main frame)	
J0127D	BNC cable (for external trigger connection)	
J0654A	Serial interface cable (for connecting IBM-PC/AT)	
J0978	VGA conversion cable (for connecting external monitor)	

*: There are two type displays, transparent color TFT-LCD type for indoor use and reflective color STN-LCD type for outdoor use. Specify display type when ordering. Display units can not be exchanged by customers.

MEASURING RECEIVER
ML524B
25 to 1000 MHz

GPIB
OPTION

For Measuring Service Area

Custom-made product

The ML524B have a full range of features and functions plus demodulation functions for various signals. Their compact, lightweight construction makes them suitable for a variety of measurement applications. Use of the GPIB interface option allows easy configuration of an automatic test system controlled by a personal computer.

Features

- Very compact and lightweight
- High frequency stability (A synthesizer local is used. Its reference oscillator has a high frequency stability of ±1 x 10^{-6}.)
- Wide dynamic range (80 dB without switching)
- Automatic gain calibration
- Direct readout of field strength
- High precision level display (indication in 0.1 dB steps)

Applications

For field strength measurement

- Investigation to determine service areas
- Radio wave propagation test
- Measurement of spurious radiation from transmitter

For other than field strength measurement

- Radio monitoring
- Measuring receiver
- High-sensitivity signal demodulation

Specifications

RF input		Nominal impedance 50 Ω, N-type connector
Frequency	Range	25.0000 to 999.9999 MHz
	Display	Liquid crystal display, 6 digits Minimum digit: 1 kHz (0.5 kHz is displayed using a symbol of ■.)
	Resolution	12.5 kHz (120 kHz bandwidth), 1 kHz (15 kHz bandwidth)
	Setting	Keyboard and FINE dial
	Memory	Up to 100 frequencies can be stored and recalled.
	Reference frequency stability	±1 x 10^{-6}
Voltage measurement (E.M.F.)	Minimum value	5 dBμV (25 to 300 MHz), 5 dBμV (300 to 999.999 MHz)
	Maximum value	100 dBμV (25 to 999.999 MHz)
	Setting	C/N: ≥6 dB (at minimum value), Bandwidth: 15 kHz
	Accuracy (digital display)	±2 dB (≥minimum value +6 dB)
	Comparison oscillator	Pulse generator
Field strength measurement	Minimum value	–5 to 19 dBμV/m (25 to 300 MHz), 19 to 32 dBμV/m (300 to 999.999 MHz)
	Maximum value	0 to 114 dBμV/m (25 to 300 MHz), 114 to 120 dBμV/m (300 to 999.999 MHz)
	Setting	C/N: ≥6 dB (at minimum value), Bandwidth: 15 kHz
	Type of antenna	Half-wave dipole
Selectivity	6 dB bandwidth	15 ±2 kHz (15 kHz bandwidth), 120 ±20 kHz (120 kHz bandwidth)
	Detuning characteristics	15 kHz bandwidth ≥50 dB (±20 kHz off center)
Image ratio		≥60 dB (at 25.000 to 299.999 MHz), ≥45 dB (at 300 to 999.999 MHz)
Residual spurious		≤10 dBμV (typical near 50, 130, 600, 1000 MHz)
Detection system		Average value

Continued on next page

Measured level indication	Display: Liquid crystal display, 4 digits, Minimum digit 0.1 dB (on digital display), Up to 80 dB (on analog display) Unit: dBµV, dBµV/m (on digital display)
Monitor output	AM and FM can be heard from a loudspeaker, and earphone output terminal is also provided.
IF output	Level: ≥85 dBµV at 80 dBµV input, Impedance: 50 Ω (nominal), Connector: BNC-type
Discriminator output	Level: 1 V ±20% (modulation frequency: 2 kHz, frequency deviation: 3.5 kHz, into 100 kHz load) Impedance: ≤150 Ω Connector: BNC-type
Output for recorder	Level: 1 V ±10% (at 80 dB on digital display, into 100 kΩ load), Impedance: ≤150 Ω, Connector: 3.5ø jack
Ambient temperature	0˚ to 50˚C (operate), –20˚ to 60˚C (storage)
Power	12 Vdc: <1 A 100 Vac, 50/60 Hz, ≤35 VA (using MZ114A AC Power Pack supplied) Ni-Cd battery (optional MZ110B Battery Pack)
Dimensions and mass	210 (W) x 60 (H) x 175 (D) mm, ≤4 kg

Power supply selection guide

Type of power supply	Model	When used with ML524B	Remarks
Dry cell	MZ137A Battery Pack 	• Operates continuously for about 2.5 to 5 hours[*1] • Sold separately	• Twelve alkaline dry cells (LR20) • Does not permit GPIB operation
Ni-Cd battery	MZ110B Battery Pack 	• Operates continuously for about 30 to 60 minutes[*1] • Sold separately	• Six Ni-Cd batteries with the same dimensions as R14 battery, chargeable 200 to 300 times • Fits inside the receiver • Does not permit GPIB operation
AC supply	MZ114A AC Power Pack 	• Permits operation at 100/220 Vac • One of accessories supplied	• DC power is fed to the EXT +12 V terminal of the receiver. • Permits GPIB operation • EMC, safety
External DC supply	–	• The receiver can be operated directly from an external 12 Vdc supply.	• One DC power cord is supplied. • Permits GPIB operation
Battery charger	MZ115B Battery Charger	• Sold separately	• Two MZ110B can be charged simultaneously. • EMC, safety

*1: For continuous reception after power on, with calibration performed once only (more calibrations reduce the operating time). Operating is also affected by how the battery has been stored, and operating temperature.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
ML524B	Measuring Receiver
	Standard accessories
J0231	Connecting cord for recorder (3.5ø plug · – · alligator clips), 1.5 m: 1 pc
J0144	DC power cord (RM12BPG-5S · 2CC7 · arrow tips), 1.5 m: 1 pc
A0002	Earphone: 1 pc
MZ114A	AC Power Pack: 1 pc
B0259	Carrying case: 1 pc
W0285AE	ML524A/B/C operation manual: 1 copy
	Options
ML524B-01	GPIB
ML524B-05	Terminated voltage indication

Model/Order No.	Name
	Optional accessories
MP612A	RF Fuse Holder
MP613A	RF Fuse Element (5 pcs/set)
A0004	Headphone
MZ110B	Battery Pack (with six Ni-Cd batteries)
MZ115B	Battery Charger
MZ114A	AC Power Pack
MP635A	Log-periodic Antenna
MZ137A	Battery Pack
MB19A	Tripod (for MP635A)
J0006	GPIB cable, 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0009	GPIB cable, 4 m
MP663A	Dipole Antenna (with pole and tripod)
MP651B	Dipole Antenna
MP18A	Pole (for MP651B)
MB9A	Tripod (for MP651B)
MP520B	CM Directional Coupler (25 to 1000 MHz, 75 Ω, NC-type connector)
MP520D	CM Directional Coupler (100 to 1700 MHz, 50 Ω, N-type connector)

RADIO COMMUNICATION ANALYZER
MS555B
25 to 1000 MHz

For 400/800/900-MHz Narrow Band FM

GPIB

The MS555B is a versatile, compact, and portable test instrument with a frequency range of 25 to 1000 MHz. It includes all the necessary instruments for both transmitter and receiver testing, and can measure such fundamental characteristics as output power, frequency, FM deviation, sensitivity, signal-to-noise ratio, distortion, etc. The MS555B has a host of features that make many discrete instruments obsolete. For example, with its excellent frequency stability and low residual noise, the built-in signal generator is ideally suited to the production and maintenance of narrow-band 400 MHz transceivers and 800/900 MHz band radiotelephone systems. Moreover, thanks to an internal microprocessor, the MS555B can make automatic measurements via the GPIB when connected to an external computer controller. The built-in printer also provides convenient hard copies.

Features
- This instrument includes a power meter, frequency counter, FM deviation meter, AF level meter, SINAD meter, AF oscillator, synthesized signal generator, and DC voltmeter, all in a single cabinet. Additional options include a tone generator, signalling unit for personal radio, and weighting filter*.
  *: ITU-T, C-MESSAGE

MEASURING RECEIVER
ML5655C
1.4 to 1.55 GHz

For Measuring Field Strength of Digital Cellular Phones and MCA Systems

GPIB
OPTION

Recent radio communication systems such as the Personal Digital Cellular and MCA require high-speed and multichannel field strength measurements. The ML5655C Measuring Receivers meet these requirements and can be used as part of a mobile system for measuring radio wave propagation characteristics.

Applications
- Automatic radio wave propagation measurement system
- Radio wave propagation characteristics measurement system

Features
- 1 ms sampling rate
- 10%, 50%, 90% values calculation
- Measuring transmitter spurious, and measuring low-level signals in R&D and production
- Portable design

FREQUENCY CONVERTER
MH669B
1 to 3 GHz

Expandable to 3 GHz using ML524B

The measurable frequency range can be expanded to 3 GHz by using the MH669B in conjunction with the ML524B Measuring Receiver.

Applications
- Quasi-microwave propagation test
- Investigation to determine service areas

SHIELD BOX
MA8120A

Suitable Shield Box for the Test of Mobile Phones

NEW

- The internal wide-band antenna (800 to 2500 MHz) enable to the test of W-CDMA, cdma2000®, GSM, PDC, PHS mobile terminals and Wireless LAN terminal etc. under the air connection.
- Both air and coaxial connection between mobile phones and MA8120A are available.

Specifications

Frequency	800 to 2500 MHz
Shield characteristic	≤–60 dB
Interface	RF connector: N type Control connector: DX50
Dimensions and mass	320 (W) x 132.5 (H) x 370 (D) mm, ≤3.5 kg
Environment conditions	Temperature: +10° to +50 °C (operating), –20° to +60 °C (storage)
LVD	EN61010-1: 2001 (Installation Category II, Pollution Degree 2)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MA8120A	Shield Box	
	Standard accessories	
B0509	UE holder:	1 pc
W2115AE	MA8120A operation manual:	1 copy
	Application parts	
J1150D	Coaxial cable (N-P · N-P, 170 mm)	
J1150G	Coaxial cable (N-P · N-P, 3 m)	
J1152E	Control I/F cable [DX50 · DX50, 3 m, for external measurement equipment connection cable (control signal line)]	
J1151A	Control I/F cable for PC (DX50 · USB, for PC connection)	
J1152B	Control I/F cable [DX50 · DX50, 170 mm, for external measurement equipment connection cable (control signal line)]	
J1153A	UE I/F cable (for W-CDMA mobile phone connection inside MA8120A, control signal)	
J1155A	UE I/F cable with RF (for W-CDMA mobile phone connection inside MA8120A, control signal and RF)	
J1157A	Control cable for PC (DX50 · D-sub 9 pin, for PC connection)	

W-CDMA PROTOCOL TEST SYSTEM (PTS) MX785201A

W-CDMA VIRTUAL SIGNALING TESTER (VST) MX785101A

Development and Proving 3G Terminals

The MX785201A PTS (Protocol Test System) and MX785101A VST (Virtual Signaling Tester) are a family of test and verification tools from Anritsu for next generation wireless products. They have been developed to provide the test support today's research and development engineers need to successfully meet demanding performance and time to market targets.

They provide a common user interface thus reducing operator learning time as development progresses and migrates over the range of Anritsu's 3G development tools. In addition, test procedures generated for the PTS can be run on the VST and vice versa. This enables test procedures to be developed very early in the development cycle and to evolve as the user equipment evolves. A substantial saving in the investment in development of test procedures can be realized.

Features

- W-CDMA protocol test capability
- 3GPP Standard compliant development tool
- Common user interface across Anritsu development tools
- Comprehensive on-line help
- Environment supporting TTCN test case execution
- TTCN test procedure library available
- Re-use of test cases on VST (Virtual Signaling Tester) and PTS (Protocol Test System)

PTS

The MX785201A PTS software is combined with the MD8480B W-CDMA Signaling Tester to make a system providing an environment to exercise Layer 3 and Layer 2 signaling protocols defined within the Third Generation Partnership Project (3GPP).

The PTS and VST software component runs on a Windows 2000/NT™ PC. They execute TestStand™ test sequences made up of calls into a library of TTCN test cases through which can be defined:

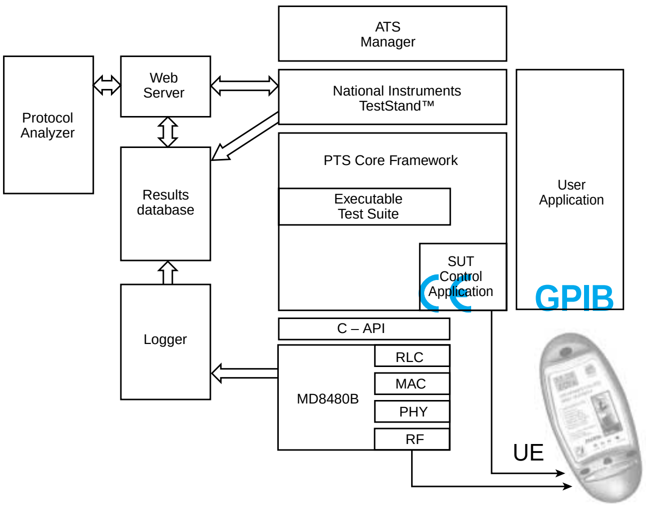
- Sequences of layer 3 messages and expected responses
- Layer 3 to layer 2 service primitives to trigger specific layer 2 procedures, or to configure layer 2 operation
- Layer 3 to layer 1 service primitives to configure and initiate layer 1 operation
- Service primitives to and from user provided code modules for UE control

The layer 2 protocol stack and layer 3 test tools are functionally equivalent to those used in the Anritsu VST (Virtual Signaling Tester).

An application-programming interface (API) to enable user generated C-language test scenarios to be executed is available for the PTS.

Supports multiple 3G cell enabling Soft and Hard handover. In addition supports inter-system handover between GSM to WCDMA, GPRS to WCDMA, and vice versa.

System overview



PTS Core Software

VST

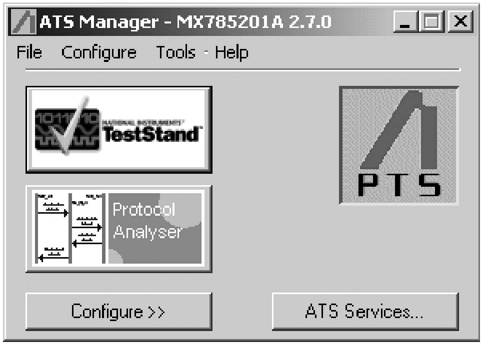
The MX785101A VST software provides an environment to exercise Layer 3 and Layer 2 signaling protocols defined within the Third Generation Partnership Project (3GPP). When linked to the customer's signaling protocol development environment, Layer 3 and Layer 2 Test Procedures running on the VST platform enable verification and subsequent validation of the signaling protocol Software Under Test.

The VST executes on a standard Windows PC. The SUT (Software Under Test) may reside on any machine that can be connected via a TCP/IP port to the Windows PC running the VST. In order to interface to the VST, the User Equipment (UE) abstract layer 1 and UE adapter software components are required for the Software Under Test. The VST Network (NW) abstract layer 1 and adapter components can be used as a starting point to develop these components. The Abstract Layer 1 has also been developed in such a way that users can easily customize it in order to simulate specific features of the air interface.

Evolution with 3GPP

The capability of the VST & PTS will evolve and additional capability added in-line with the 3GPP specifications. When available, the PTS will run the 3GPP Conformance Test Suite as defined in TS34.123. In addition, the Protocol Test System will support the layer 1 and layer 2 parameter sets defined in the 3GPP specifications TS34.108.

ATS manager



The ATS Manager provides a user interface which allows configuration of the MX785201A PTS, launch of the test sequencer tool to select and execute pre-prepared Layer 3 and Layer 2 Test Procedures and browse the results of the Test Procedures using the Protocol Analyzer.

Protocol analyzer

All Layer 3, Layer 2 and Layer 1 message exchanges between the MX785201A PTS and the System Under Test are logged. These messages are decoded to show the name and content of each field and displayed using the Protocol Analyzer. Raw captured data is displayed in hexadecimal format.

National Instruments TestStand™

The MX785201A PTS uses the National Instruments TestStand™ run-time engine as a high level sequencing tool. The TestStand™ development system is used to create test sequences.

C-API

As an alternative language to develop Layer 3 and Layer 2 Test Procedures, a 'C' based Application Programmer's Interface (C-API) is included in the form of a DLL.

Executable test suite

Layer 3 and Layer 2 test cases are implemented using TTCN (Tree and Tabular Combined Notation). Created TTCN tests are compiled to an Executable Test Suite (ETS) which interfaces to the MX785201A PTS via the GCI Management Interface and the GCI Operational Interface. These provide an open, standardized interface to TTCN based executable test suites. The MX785201A PTS has been developed to work with the Telelogic Test Suite TTCN Browser tool. The GCI framework provided by the MX785201A PTS provides support for a number of Test Suite Operations (TSOs) and also Protocol Implementation Conformance Statement (PICS/PIXIT).

Codec

The ETS is supported by a codec capable of encoding and decoding Radio Resource Control (RRC), Non Access Stratum (NAS) and lower layer configuration data.

Thin RRC

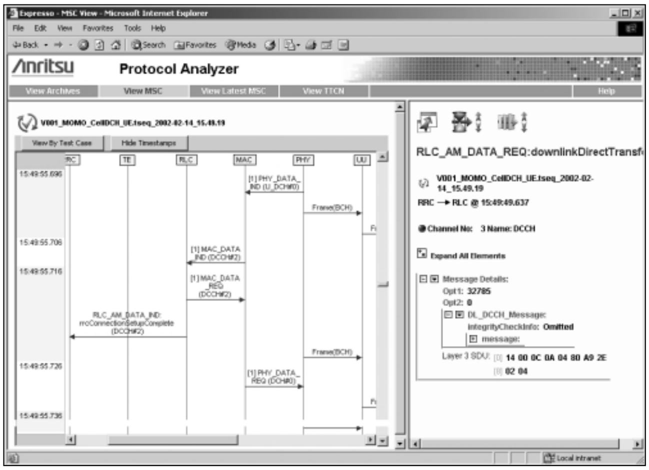
A thin RRC is provided to load NAS messages into RRC direct transfer messages and unload NAS messages from RRC direct transfer messages transparently.

SUT control application

The MX785201A PTS frame-work provides an API to support automatically communicating with the UE to replace keyboard or internal (to UE) signals.

Logger and results database

The logger captures data from the majority of components in the system and stores it in the results database. This data is used by the protocol analyzer to create message sequence charts and display decoded messages.



RLC and MAC

RLC and MAC layers conforming to the 3GPP specifications TS25.322 Radio Link Control Protocol Specification and TS25.321 Medium Access Control Specification are supplied as part of MD8480B.

TE (Terminal Equipment)

The TE is an optional software component available as part of the MD8480B in the MX785201A PTS. It supports a number of features including voice AMR 12.2K Codec, ISDN, IP and PPP.

Layer 1

The MX785201A PTS provides a physical layer 1 through the MD8480B that can communicate with a terminal.

Libraries available

Integration library

The Integration library provides a proven set of test scripts that have been tested on real terminals. These test cases take the user through specific milestones (e.g., RRC Connection, location update, voice call, etc.) and provide a straightforward method for testing of terminals during the integration process. They provide a step by step test approach to prove functionality in a UE.

The Test Procedures are 3GPP compliant and are designed to be customized to the particular needs of an Integration environment. The PTS Integration Library provides TestStand™ Sequences in an executable form of the TTCN test cases. National Instruments TestStand is required to implement these cases.

The Integration Library is available in source code form allowing the more experienced user to make changes to the parameters in order to test more specific details of the terminal design.

Developer Library

The Developer library provides a proven set of TTCN test scripts that have been tested on real terminals and complement the Integration Library. These test cases provide a more flexible test capability and allow experienced designers to exercise their terminals beyond the requirements of 3GPP. This library is supplied in source code form.

Conformance testing

Anritsu offers a range of solutions designed to meet specific customers requirements for UE protocol testing based on the 3GPP standards. These can be summarized as follows:

Standard PTS/VST product

PTS/VST with the 3GPP adapter option enables users to run the 3GPP conformance tests. PTS/VST includes 3GPP T1 approved test cases in ETS form as standard. Quarterly updates to support new test cases. Appropriate for conformance and verification testing in an R&D Lab.

Subscription service

PTS users gain earliest access to 3GPP conformance test cases through a monthly update subscription service

- Receive monthly conformance test case updates
- Includes all working conformance test cases in ETS form
  - 3GPP T1 approved
  - 3GPP T1 submitted

For applications where conformance testing is on a critical development path.

Validated GCF Packages

Seven conformance test case packages conforming to the GCF (Global Certification Forum) defined packages containing GCF validated test cases in ETS form.

- Specific PTS & MD8480 software required for validation
- Certificate of validation
- Product release notes
- Audit utility
- Operating manuals
- Example log files
- GCF current exceptions/issues
- Test time estimates

For formal UE validation and pre-conformance testing.

Options available

MX785X01A-42 IP Driver

The IP Driver software option allows data and application testing to be performed in virtually any signalling environment or scenario using automated tests controlled via TTCN running on the MX785201A Protocol Test System (PTS) or MX785101A Virtual Signalling Test system (VST). The IP Driver provides access to User-Plane packet data and to route that data through a PC onto a conventional data network.

Key features include multiple primary and secondary PDP contexts with single UE supported. TFT routing for secondary context support. All protocols over IPv4 and fully flexible IP address allocation supported.

MX785201A-43 Rapid Test Designer

The Rapid Test Designer (RTD) option provides a quick and easy method of developing test cases to run on the PTS. It provides a graphical, point and click interface to a broad library of procedural building blocks that can be placed on the screen to assemble more complex tests. The library contains composite functions that move the UE into a desired state to start the test, and elemental functions that allow the testing of detailed behaviour. This allows the test creator to focus on specific problem areas using his knowledge of 3GPP networks rather than test concepts.

The RTD's procedural building blocks are integrated with an expert system that guides the user through the complexity of the 3GPP protocols when setting the parameters for a particular test. Anritsu provides comprehensive catalogues of common network settings that can be used to quickly produce working test scenarios. The tool also provides interactive error checking on the procedures and parameters and will pick up any potential problems and mistakes made during test design. Finally, the RTD provides one click, instant execution with no test case build or compilation phase necessary to enable very effective and efficient development of test case libraries for a wide variety of purposes.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MX785201A	PTS Core Software Single Cell ETS Framework
	Options
MX785201A-10	Multi-Cell Capability (SHO)
MX785201A-11	Multi-Cell (Inter-frequency) Capability (HHO)
MX785201A-12	Multi-RAT (FDD/GSM) Capability
MX785201A-15	3GPP Compliant TTCN Adapter
MX785201A-40	Security Mode
MX785201A-41	OCNS
MX785201A-42	IP Driver
MX785201A-43	Rapid Test Designer
	Libraries
MX785201A-31	TTCN Integration Library Source Code
MX785201A-33	TTCN Developer Library Source code
MX785211A	GCF validation Package 1
MX785212A	GCF validation Package 2
MX785213A	GCF validation Package 3
MX785214A	GCF validation Package 4
MX785215A	GCF validation Package 5
MX785216A	GCF validation Package 6
MX785217A	GCF validation Package 7
	Support
MX785201A-01	National Instruments TestStand™
MX785201A-20	Software Update and Maintenance Contract
MX785201A-21	Training Course (2 days)
MX785201A-23	Installation & Commissioning (1 day)
	Main frame
MX785101A	VST Core Software Single Cell ETS Framework
	Options
MX785101A-10	Multi-Cell Capability (SHO)
MX785101A-11	Multi-Cell (Inter-frequency) Capability (HHO)
MX785101A-15	3GPP Compliant TTCN Adapter
MX785101A-40	Security Mode
MX785101A-42	IP Driver
	Libraries
MX785101A-31	TTCN Integration Library Source Code
MX785101A-33	TTCN R&D Library Source code
	Support
MX785101A-01	National Instruments TestStand™
MX785101A-20	Software Update and Maintenance Contract
MX785101A-21	Training Course (2 days)
MX785101A-23	Installation & Commissioning (1 day)

Note that libraries and options require the underlying core functionality to be present to function fully.

PERL™

This product includes a standard version of PERL (http://www.perl.org). This standard version of PERL™ is provided "as is" and without any express or implied warranties, including, without limitation, the implied warranties of merchantability and fitness for a particular purpose.

Apache™

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TestStand™

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FLEXlm™

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(http://www.macrovision.com/).

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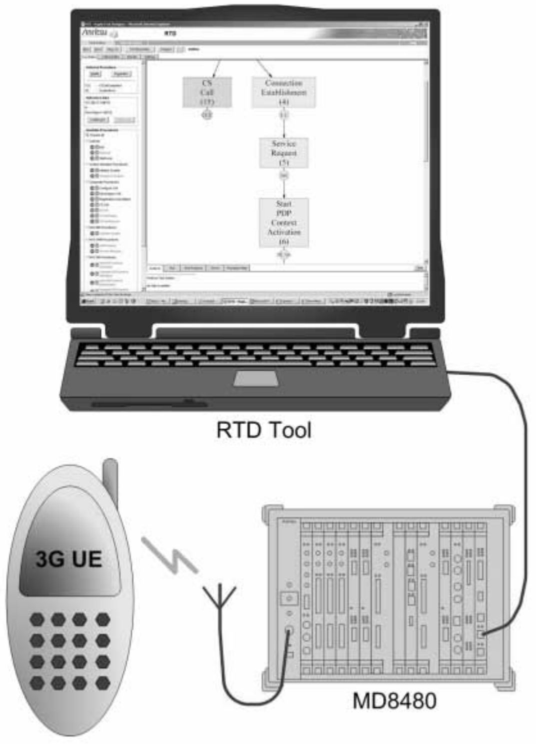
TestStand™ is a Trade Mark of National Instruments™ Corporation.
FLEXlm™ is a Trade Mark of Macrovision™ Corporation.

W-CDMA RAPID TEST DESIGNER (RTD)
MX786201A

NEW

Development and Testing of 3G Terminals



The Rapid Test Designer (RTD) is a revolutionary new tool which aims to speed up the testing of WCDMA devices significantly by-greatly simplifying the way in which tests are created, executed and analyzed.

The RTD presents an intuitive and interactive graphical environment for designing test cases, coupled with an expert system that guides the user through the complexity of the 3GPP protocols. It provides a graphical interface to a broad library of procedural building blocks that can be placed on the screen to assemble the tests. The building blocks can be configured through the setting of parameters.

The procedure library contains many standard procedures that can be used as they are or with minor changes to parameters to guide the UE into the desired test state. This allows the test creator to focus on specific problem areas using knowledge of 3GPP networks rather than test concepts.

Anritsu provides catalogues of common network settings that can be used to produce test scenarios that work "out of the box," or as a starting point for customer specific configurations.

The tool also provides interactive error checking on procedures and parameters that will pick up many potential problems and mistakes as early as possible during test design.

Finally, the RTD provides one click, instant execution with no test case build or compilation phase necessary to enable very effective and efficient development of test case libraries for a wide variety of purposes:

- Acceptance Testing
- Integration Testing
- Interoperability Testing
- Generating variants
- Application Testing
- Regression Testing

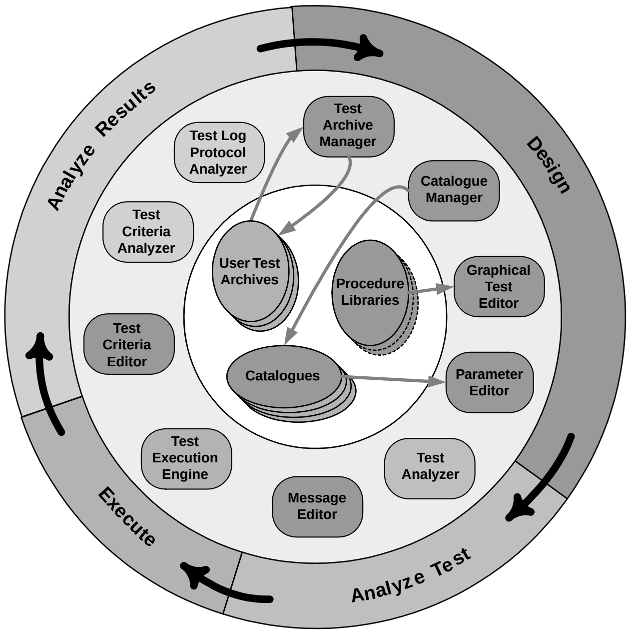
The RTD has an integrated protocol analyzer to show the decoded results of the message exchanges between the RTD and the System Under Test during execution of a test.

This revolutionary test tool hides much of the complexity of testing 3GPP protocols and allows the user to concentrate on testing specific functions and protocols within the UE without having to be an expert on all the protocol layers. The intuitive graphical interface also avoids the need for the users having to learn a special test language, or needing a detailed knowledge of how to drive the system simulator. It is built upon Anritsu's many years of experience in testing 3GPP protocols with the leading UE vendors.

The RTD system consists of a Personal Computer running a Windows operating system, connected to the Anritsu MD8480B W-CDMA Signalling Tester (system simulator). The RTD is also available as an upgrade for existing users of Anritsu's MD8480B and MX785201 (PTS) products.

Tool Overview

The RTD has been designed to support the iterative test process, which cycles between Design, Test Analysis, Test Execution and Results Analysis. The RTD consists of a set of core tools designed to support this process, together with a number of optional components that allow the RTD to easily support specialized testing activities.



Test Archive Manager

RTD stores tests in test archives. In order to manage these archives RTD provides the following functionality:

- Browsing an archives contents
- Opening a test within an archive
- Editing/viewing the properties of a test
- Creation of a new test
- Copying a test between archives
- Deletion of a test from an archive
- Creation/Deletion of a test archive
- Renaming a test archive

Catalogue Manager

The catalogues used to parameterize a RTD test are managed within this tool, which provides the following functions:

- Multiple catalogue support in a test
- Creation/Deletion of user defined catalogues
- Copying of catalogues
- Cut and paste copying between catalogues
- Editing of catalogue entries
- Validation of catalogue entries (structure, type and ranges)

Graphical Test Case Editor
The RTD test is constructed and edited using a graphical environment, which supports the following features:
- Procedures
- Loops
- Delays
- Interactive dialogs

To construct a test the RTD provides:
- Point and click selection of procedures
- Automatic guidance on available procedures suitable at any point in the test
- Addition/deletion of graphical test constructs
- Procedure clipboard
- Online help for the procedures

RTD procedures are configured using parameters, which can be changed at three levels within the RTD:
- The user can make selections from configurations held in a catalogue. Procedures select the appropriate parameters from the catalogue entries.
- The user can edit the parameters after they have been selected from catalogue components, overriding values if they wish to. These parameters are used to populate the actual protocol messages sent by the procedure.
- The user can edit the messages sent by the procedure, overriding any parameters previously selected or changed.

Parameter Editor
Allows the user to parameterize procedures and provides the following features:
- Guidance on suitable catalogue entries for a procedure
- Modify which catalogue entries to use
- Override values selected from catalogue entries
- Ability to revert parameter values back to original catalogue based configuration
- Type and range validation of parameters

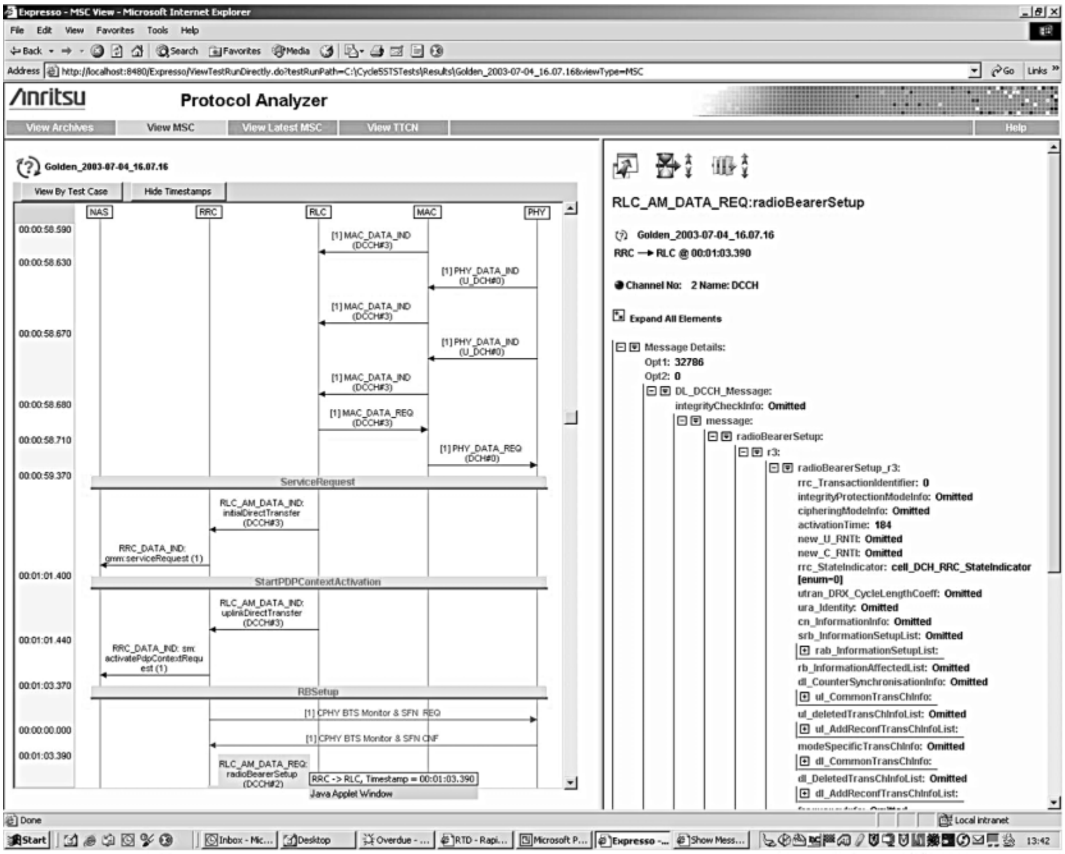
Test Analysis
Checks the test for simple errors and provides the following features:
- Correct procedure connectivity checking
- Parameterization completeness checking
- Parameter validation
- Warnings and error reports linked to the test

Message Editor
Allows editing of messages that are to be sent by a procedure and provides the following features:
- Editing of message values
- Reverting messages back to their default values
- Collapsible tree presentation of the test
- Element name and type display
- Node highlighting
- Structure, type and range validation of a message

Test Criteria Editor & Analyzer
RTD defines the success or failure of a test execution by the means of test criteria, which is currently defined in terms of the route taken through the procedures making up an RTD test. In the future, incoming message content and time between significant events will be available as other criteria. This tools provides the following functions:
- Graphical criteria creation and deletion
- Criteria group creation and deletion
- Criteria group property editing
- Copying criteria between groups

After running a test, the RTD matches the criteria against the actual test performance and reports on the success or failure of each criterion. This allows new criteria to be checked against old test results.

Test Execution Engine
RTD tests are run immediately after they have been checked for simple errors, without a compile or build cycle, using the following features:
- Test and system simulator control
- Dynamic message log from the system simulator
- Graphical test progress feedback
- Cancel execution



RLC_AM_DATA_REQ:radioBearerSetup

Golden_2003-07-04_16.07.16
RRC → RLC @ 00:01:03.390

● Channel No: 2 Name: DCCH

Message Details:
Opt1: 32786
Opt2: 0
DL_DCCH_Message:
integrityCheckInfo: Omitted
message:
radioBearerSetup:
r3:
radioBearerSetup_r3:
rrc_TransactionIdentifier: 0
integrityProtectionModeInfo: Omitted
cipheringModeInfo: Omitted
activationTime: 184
new_U_RNTI: Omitted
new_C_RNTI: Omitted
rrc_StateIndicator: cell_DCH_RRC_StateIndicator [enum=0]
utran_DRX_CycleLengthCoeff: Omitted
ura_Identity: Omitted
cn_InformationInfo: Omitted
srb_InformationSetupList: Omitted
rab_InformationSetupList:
rb_InformationAffectedList: Omitted
dl_CounterSynchronisationInfo: Omitted
ul_CommonTransChInfo:
ul_deletedTransChInfoList: Omitted
ul_AddReconfTransChInfoList:
modeSpecificTransChInfo: Omitted
dl_CommonTransChInfo:
dl_DeletedTransChInfoList: Omitted
dl_AddReconfTransChInfoList:

Test Log (Protocol) Analyzer

For any test execution, the RTD has an integrated protocol analyzer, which logs all Layer 3, Layer 2 and Layer 1 message exchanges between the RTD and the System Under Test. These messages are decoded to show the name and content of each field, and displayed using the RTD Protocol Analyzer.

The RTD Protocol Analyzer also provides:
- Direct launch to test results from within RTD
- Message Sequence charts of test runs
- Full and collapsible sequence views at procedure level, with pre and post filtering of log files
- Display of test message contents sent or received by the RTD
- Naming and display of protocol layer information elements at layer 1, 2, and 3
- Textual display of enumerated field values
- Decoding and display of MIB/SIB embedded bit strings
- Collapsible tree presentation of message contents
- Open Protocol Data Units in separate windows for ease of comparison
- Timestamps against individual messages
- Management of test log archives

Procedures

In addition to test and system simulator control procedures, the RTD provides support for a set of procedures similar to those defined in 3GPP standards.

RRC Procedures

Each procedure includes associated system simulator configuration, timers, and appropriate parameters.

General Functionality
- Broadcast of system information
- Create and release a signalling connection to the NAS layer, with support for both Network and UE originated types
- Enable/Disable application of security mode (Integrity protection only) to a connection
- Perform a UE capability enquiry

RRC State Transitions

All standard RRC State Transitions are supported.

RRC Connection Mobility

Procedures support a number of cell/URA updating scenarios, including:
- Periodic Cell and URA Updating
- Change of Cell or URA
- Re-entry of service area
- Radio Link failure

Procedures support the following handover scenarios:
- Soft Handover: Radio Link addition and removal
- Hard Handover (CELL_FACH -> CELL_ FACH in FDD mode)

Measurement

Procedures support the following measurement controls:
- Measurement Control with periodic Measurement Reporting
- Measurement Control with selected event driven Measurement Reporting

The list of events is constantly expanding, with the current list available from your Anritsu Sales contact.

NAS Procedures

The RTD includes support for the following types of NAS procedures. Each procedure includes associated system simulator configuration, timers and parameters.

Mobility Management (Packet and Circuit)

The RTD is able to create a MM or GMM connection suitable for the transport of CC/SM signalling to/from the UE. In addition, support is provided for the following types of procedures:

Authentication
Identification
IMSI detach
Abort
IMSI attach
MM Status
Identification
Paging
Status
GPRS detach

TMSI reallocation
Location updating - normal
Location updating - periodic
GPRS attach procedure (PS only)
Combined GPRS attach (PS & CS)
Routing area update
P-TMSI reallocation
Authentication and ciphering
CM service request
MM Information

Call Control

Call Establishment and Clearing

The RTD can establish the following types of call:
- Speech Call
  - Mobile originated establishment, mobile and network originated clearing
  - Network originated establishment, mobile and network originated clearing
- Circuit Switched Data Call
  - Mobile originated establishment, mobile originated clearing
  - Network originated establishment, network originated clearing
- Packet Data Connection (covered under Session Management functionality below)

Other Call Control Procedures
- Call re-establishment, UE and Network side
- Progress
- DTMF protocol control

Session Management

The RTD supports PDP contexts and the handling of IP traffic as follows:
- Activation/Deactivation of multiple primary PDP contexts (Network or UE initiated)
- Activation/Deactivation of multiple secondary PDP contexts (Network or UE initiated)
- PDP Context Modification (Network initiated)

Other NAS signalling entities

The RTD supports the sending and receiving of SMS and supplementary services signalling messages.

GSM/GPRS Inter-working

Support for inter-working with GSM and GPRS is available as an option, which provides the following capabilities:
- GSM & GPRS Neighbor Cell (for InterRAT measurements)
- Reselection from UMTS to GSM and GSM to UMTS
- Handover of speech call from UMTS AMR to GSM FR & from GSM FR to UMTS AMR
- Reselection during packet data connection from UMTS to GPRS & from GPRS to UMTS

Lower Layer Capability

RTD conforms to Release 99 of the 3GPP specifications and follows industry agreement on which version of the specifications to support. The functionality mappings include:
- RTD Physical Layer functionality maps to TS25.211, TS25.212 & TS25.213.
- RTD MAC Layer functionality maps to TS25.321
- RTD RLC Layer functionality maps to TS25.322

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MX786201A	RTD Core Software (Multi Cell Multi Frequency)
	Options
MX786201A-12	Multi-RAT (FDD/GSM) Capability
MX786201A-40	Security Mode
	Support
MX786201A-20	Software Update and Maintenance Contract
MX786201A-21	Training Course
MX786201A-22	Premium Support
MX786201A-23	Installation & Commissioning

Please note that the RTD is also available as Option 43 on the Protocol Test System (MX785201A-43).

As the RTD is continuously tracking the 3GPP standards, the details given above are subject to change. For full details of the functionality currently available and planned for, please contact your local Anritsu Sales office to request the RTD (MX786201A) data sheet, specification and roadmap documents.

For the latest information about the RTD, please go to the Anritsu website (www.anritsu.com).

HANDHELD MEASURING INSTRUMENTS

CELL MASTER

MT8212A

25 MHz to 4.0 GHz

A Multi-Function Base Station Test Tool for Greater Flexibility and Technician Productivity

NEW

Cell Master MT8212A is a comprehensive, one-box base station test tool for deploying, maintaining and troubleshooting wireless base stations. Combining the functionality of a cable and antenna analyzer (25 MHz to 4.0 GHz), spectrum analyzer (10 MHz to 3.0 GHz), power meter, and T1/E1 analyzer into one lightweight, handheld test set - eliminates the need for field engineer and field technician to carry, manage and learn multiple test sets. MT8212A measurement capability includes precision return loss, VSWR, cable loss, distance-to-fault, signal identification, interference analysis, channel power, adjacent channel power ratio, field strength, occupied bandwidth, transmitter power and T1/E1 measurements. Patented RF interference rejection enables accurate, repeatable measurements in the presence of high RF activity. PC data analysis software enables assessment of system trends, problems, and performance in addition to professional report generation.
The MT8212A includes PC data analysis software, soft carrying case, rechargeable battery, AC/DC power supply, 12V automotive cigarette lighter adapter, RS232 null modem serial cable and user's guide.

Features

- Handheld, battery-operated, under 5 lbs (2.28 kg), including battery
- Rechargeable, snap-in field replaceable battery
- Withstands repeated drops and rough handling
- Weather resistant seals and rubber membrane keypad protect unit from dirt and moisture
- Built-in worldwide signal standards and frequency channels
- Multilingual user interface: English, French, Chinese, Japanese, Spanish, German
- Intuitive and easy to use with on-screen test set-ups and single key functions
- No external power sensor required for power meter measurements
- Store/Recall 25 setup configurations and up to 200 traces
- Alphanumeric labeling and automatic time/date stamp of saved measurements
- 6 markers, limit line, and segmented limit lines
- Trace overlay, trace math
- Superior immunity to RF interference
- 130, 259 and 517 data points for optimal resolution and long range fault locations
- FlexCal™ allows troubleshooting cable and antenna systems without multiple calibrations and calibration setups
- < 500 msec per sweep to identify real time intermittent cable problems
- ± 0.5 dB typical amplitude accuracy power measurements
- –135 dBm typical DANL
- Interference analysis
- T1 and E1 histograms

Handheld PC Software Analysis Tools Features

- Transfer traces with a single menu selection
- Stores an unlimited number of data traces for comparison to historical performances
- Trace overlay for on-screen comparison of current measurements to previously saved measurements
- On screen "click and drag," zoom and change measurement units capabilities
- Graphical or tabular clipboard format and export format
- Cable editor supports downloading and uploading cable list and saving as a file
- Antenna editor supports downloading and uploading cable list and saving as a file
- Distance-to-fault and Smith Chart analysis

Specifications[*1]

Cable and Antenna Analyzer

Frequency	Range	25 MHz to 4.0 GHz
	Accuracy	≤± 75 ppm @ +25°C
	Resolution	100 kHz
Output Power	< 0 dBm (–10 dBm nominal)	
Immunity to Interfering Signals	on-channel[*2]	+17 dBm
	on-frequency[*3]	–5 dBm
Measurement speed	≤3.5 msec / data point (CW ON)	
Number of data points	130, 259, 517	
Return Loss	Range	0.00 to 60.00 dB
	Resolution	0.01 dB
VSWR	Range	1.00 to 65.00
	Resolution	0.01
Cable Loss	Range	0.00 to 30.00 dB
	Resolution	0.01 dB
Measurement Accuracy	> 42 dB corrected directivity after calibration	
Distance-To-Fault	Vertical Range	Return Loss: 0.00 to 60.00 dB VSWR: 1.00 to 65.00
	Horizontal Range	Range: 0 to (# of data pts –1) x Resolution to a maximum of 1197m (3929 ft), # of data pts = 130, 259, 517
	Horizontal Resolution (Rectangular windowing)	Resolution (meter) = (1.5 x 10^8) x (Vp)/DF Where Vp is the cable's relative propagation velocity and where DF is the stop frequency minus the start frequency (in Hz)

Spectrum Analyzer

Frequency	Range	10 MHz to 3.0 GHz
	Reference (Internal Timebase)	Aging: ± 1 ppm/yr Accuracy: ± 2 ppm
	Span	10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span
	Sweep Time	≤1.1 sec full span; ≤50 µsec to 20 sec zero span
	Resolution Bandwidth (–3 dB)	100 Hz to 1 MHz in 1-3 sequence ± 5% Accuracy
	Video Bandwidth (–3 dB)	3 Hz to 1 MHz in 1-3 sequence ± 5% Accuracy
	SSB Phase Noise (1 GHz) @ 30 kHz Offset	≤–75 dBc/Hz
	Spurious Responses	≤–45 dBc
	Spurious Residual Responses	≤–90dBm, (10 kHz RBW, pre-amp on)
Amplitude	Total Level Accuracy	±1 dB max (± 0.5 dB typical) for input signal levels ≥–60 dBm (10 MHz to 2 GHz, excludes input VSWR mismatch)
	Measurement Range	+20 dBm to –135 dBm
	Input Attenuator Range	0 to 51 dB, selected manually or automatically coupled to the reference level. Resolution in 1 dB steps.
	Displayed Average Noise Level	≤–135 dBm typical (Input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW, preamp on)
	Dynamic Range	>65 dB
	Display Range	1 to 15 dB/division, in 1 dB steps, 10 divisions displayed
	Scale Units	dBm, dBV, dBmV, dBµV
	RF Input VSWR	(≥20 dB atten.) 1.5:1 typical, (10 MHz to 2.4 GHz)

Power Meter

Frequency Range	10 MHz to 3.0 GHz
Display Range	–80 dBm to +80 dBm
Offset Range	0 to +60 dB
Accuracy	±1 dB max (± 0.5 dB typical) for input signal levels ≥–60 dBm, 10 MHz to 2 GHz excludes input VSWR
VSWR	1.5:1 typical (P_{in} > –30 dBm, 10 MHz to 2.4 GHz)
Maximum Power	20 dBm (0.1W) without external attenuator

T1 Analyzer

Line Coding	AMI, B8ZS
Framing Modes	D4 (Superframe), ESF (Extended Superframe)
Connection Configurations	Terminate (100 Ω) Bridge (≥1000 Ω) Monitor (Connect via 20 dB pad in DSX)
Receiver Sensitivity	0 to –36 dBdsx
Transmit Level	0 dB, –7.5 dB, and –15 dB
Clock Sources	External Internal: 1.544 MHz ± 30 ppm
Pulse Shapes	Conform to ANSI T1.403
Pattern Generation and Detection	PRBS: 2-9, 2-11, 2-15, 2-20, 2-23 Inverted and non-inverted, QRSS, 1-in-8 (1-in-7), 2-in-8, 3-in-24, All ones, All zeros, T1-Daly, User defined (≤32 bits)
Circuit Status Reports	Carrier present, Frame ID and Sync., Pattern ID and Sync.
Alarm Detection	AIS (Blue Alarm), RAI (Yellow Alarm)
Error Detection	Frame Bits, Bit, BER, BPV, CRC, Error Sec
Error Insertion	Bit, BPV, Framing Bits, RAI, AIS
Loopback Modes	Self loop, CSU, NIU, User defined, In-band or Data Link
Level Measurements	Vp-p (± 5%)
Data Log	Continuous, up to 48 hrs

E1 Analyzer

Line Coding	AMI, HDB3
Framing Modes	PCM30, PCM30CRC, PCM31, PCM31CRC
Connection Configurations	Terminate (75, 120 Ω) Bridge (≥1000 Ω) Monitor (Connect via 20 dB pad in DSX)
Receiver Sensitivity	0 to –43 dB
Clock Sources	External Internal 2.048 MHz ± 30 ppm
Pulse Shapes	Conform to ITU G.703
Pattern Generation and Detection	PRBS: 2-9, 2-11, 2-15, 2-20, 2-23 Inverted and non-inverted, QRSS, 1-in-8 (1-in-7), 2-in-8, 3-in-24, All ones, All zeros, T1-Daly, User defined (32 bits)
Circuit Status Reports	Carrier present, Frame ID and Sync., Pattern ID and Sync.
Alarm Detection	AIS, RAI, MMF
Error Detection	Frame Bits, Bit, BER, BPV, CRC, E-Bits, Error Sec
Error Insertion	Bit, BPV, Framing Bits, RAI, AIS
Loopback Modes	Self loopback
Level Measurements	Vp-p (± 5%)
Data Log	Continuous, up to 48 hrs

General

Language Support	English, Spanish, French, German, Chinese, Japanese	
Internal Trace Memory	Up to 200 traces	
Setup Configuration[4]	25	
Display	VGA, monochrome LCD with adjustable backlight	
Input and Output Ports	RF Out Maximum Input without Damage	Type N, female, 50 Ω +20 dBm, ± 50 VDC
	RF In Maximum Input without Damage	Type N, female, 50 Ω +43 dBm (Peak), ± 50 VDC
	Ext. Trig In	BNC, female (5V TTL)
	Ext. Freq Ref In (2 to 20 MHz)	Shared BNC, female, 50 Ω, (–15 dBm to +10 dBm)
	T1/E1 (Receive & Transmit)	Bantam Jack
	Serial Interface	RS-232 9 pin D-sub, three wire serial
Electromagnetic Compatibility	Meets European Community requirements for CE marking	
Safety	Conforms to EN 61010-1 for Class 1 portable equipment	
Temperature	Operating	–10°C to 50°C, humidity 85% or less
	Non-operating	–20°C to +75°C (recommend battery be stored separately between 0°C to +40°C for any prolonged non-operating storage period)
Power Supply	External DC Input	+12 to +15 VDC, 1350 mA max
	Internal	NiMH battery: 10.8 volts, 1800 mA maximum
Dimensions	Size	25.4 cm x 17.8 cm x 6.1 cm (10.0 in x 7.0 in x 2.4 in)
	Weight	<2.28 kg (<5 lbs) includes battery

∗1: All specifications apply when calibrated at ambient temperature after a five minute warm up.
∗2: On-Channel interference immunity is specified to within 1 MHz of the carrier frequency.
∗3: On-Frequency interference immunity is specified to within +10 kHz of the carrier frequency.
∗4: Calibration stored with instrument configuration.

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MT8212A	Cable & Antenna Analyzer (25 MHz to 4.0 GHz), with built-in DTF, Spectrum Analyzer (10 MHz to 3.0 GHz), Power Meter, T1/E1 Analyzer
	Standard Accessories Include
	User's Guide
	Soft Carrying Case
	AC-DC Adapter with Power Cord
	Automotive Cigarette Lighter/12 Volt DC Adapter
	One Year Warranty
	CDROM containing Fault Location (DTF), Smith Chart and Software Management Tools
	Serial Interface Cable
	Rechargeable Battery, NiMH
	Optional Accessories
1N50C	Limiter, N(m) to N(f), 50 Ω, 10 MHz to 18 GHz
42N50-20	Attenuator, 20 dB, 5 watt, DC to 18 GHz, N(m)-N(f)
42N50A-30	Attenuator, 30 dB, 50 watt, DC to 18 GHz, N(m)-N(f)
ICN50	InstaCal™ Calibration Module, 2 MHz to 4.0 GHz, N(m), 50 Ω
22N50	Open/Short, DC to 18 GHz, N(m), 50 Ω
22NF50	Open/Short, DC to 18 GHz, N(f), 50 Ω
SM/PL	Precision Load, DC to 4 GHz, 42 dB, N(m), 50 Ω
SM/PLNF	Precision Load, DC to 4 GHz, 42 dB, N(f), 50 Ω
OSLN50LF	Precision Open/Short/Load, DC to 4 GHz, 42 dB, 50 Ω, N(m)
OSLNF50LF	Precision Open/Short/Load, DC to 4 GHz, 42 dB, 50 Ω, N(f)
2000-767	Precision Open/Short/Load, DC to 4 GHz, 7/16 DIN(m), 50 Ω
2000-768	Precision Open/Short/Load, DC to 4 GHz, 7/16 DIN(f), 50 Ω
15NN50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-N(m),6 GHz, 50 Ω
15NN50-3.0C	Test Port Cable Armored, 3.0 meters, N(m)-N(m),6 GHz, 50 Ω
15NN50-5.0C	Test Port Cable Armored, 5.0 meters, N(m)-N(m),6 GHz, 50 Ω
15NNF50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-N(f), 6 GHz, 50 Ω
15NNF50-3.0C	Test Port Cable Armored, 3.0 meters, N(m)-N(f), 6 GHz, 50 Ω
15NNF50-5.0C	Test Port Cable Armored, 5.0 meters, N(m)-N(f), 6 GHz, 50 Ω
15ND50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-7/16 DIN(m), 6 GHz, 50 Ω
15NDF50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-7/16 DIN(f), 6 GHz, 50 Ω

Model/Order No.	Name
34NN50A	Precision Adapter, N(m)-N(m), DC to 18 GHz, 50 Ω
34NFNF50	Precision Adapter, N(f)-N(f), DC to 18 GHz, 50 Ω
1091-26	Adapter, N(m)-SMA(m), DC to 18 GHz, 50 Ω
1091-27	Adapter, N(m)-SMA(f), DC to 18 GHz, 50 Ω
1091-80	Adapter, N(f)-SMA(m), DC to 18 GHz, 50 Ω
1091-81	Adapter, N(f)-SMA(f), DC to 18 GHz, 50 Ω
1091-172	Adapter, N(m)-BNC(f), DC to 1.3 GHz, 50 Ω
510-90	Adapter, 7/16 DIN(f)-N(m), DC to 7.5 GHz, 50 Ω
510-91	Adapter, 7/16 DIN(f)-N(f), DC to 7.5 GHz, 50 Ω
510-92	Adapter, 7/16 DIN(m)-N(m), DC to 7.5 GHz, 50 Ω
510-93	Adapter, 7/16 DIN(m)-N(f), DC to 7.5 GHz, 50 Ω
510-96	Adapter, 7/16 DIN(m)-7/16 DIN(m), DC to 7.5 GHz, 50 Ω
510-97	Adapter, 7/16 DIN(f)-7/16 DIN(f), DC to 7.5 GHz, 50 Ω
2000-1030	Portable Antenna, SMA (m), 1.71 to 1.88 GHz, 50 Ω
2000-1031	Portable Antenna, SMA (m), 1.85 to 1.99 GHz, 50 Ω
2000-1032	Portable Antenna, SMA (m), 2.4 to 2.5 GHz, 50 Ω
2000-1200	Portable Antenna, SMA (m), 806-869 MHz, 50 Ω
2000-1035	Portable Antenna, SMA (m), 902-960 MHz, 50 Ω
806-16	Bantam Plug to Bantam Plug
806-116	Bantam Plug to BNC
806-117	Bantam "Y" Plug to RJ48
551-1691	USB to RS232 adapter cable
48258	Soft Carrying Case
760-215A	Transit Case
633-27	Rechargeable Battery, NiMH
2000-1029	Battery Charger, NiMH, w/ Universal Power Supply
40-115	AC/DC Adapter
806-62	Automotive Cigarette Lighter/12 Volts DC Adapter
800-441	Serial Interface Cable
2300-347	Software Tools
10580-00083	Cell Master User's Guide (for Model MT8212A)
10580-00094	Cell Master Programming Manual (for Model MT8212A)
10580-00095	Cell Master Maintenance Manual (for Model MT8212A)
	Printers
2000-1214	HP DeskJet Printer, Model 450: Includes printer cable, 2000-1216 black print cartridge and U.S. power cord. Also includes 2000-753 serial-to-parallel Centronics converter cable and 1091-310 Centronics-to DB25 adapter. Rechargeable battery is optional and is not included.
2000-753	Null Modem Serial-to–Parallel Centronics Converter Cable
1091-310	Adapter 36-pin Centronics female-to-DB25 female
2000-1216	Black Print Cartridge
2000-663	Power Cable (Europe) for DeskJet Printer
2000-664	Power Cable (Australia) for DeskJet Printer
2000-666	Power Cable (Japan) for DeskJet Printer
2000-667	Power Cable (S. Africa) for DeskJet Printer
2000-1217	Rechargeable Battery for DeskJet Printer, Model 450
2000-1218	Power Cable (U.K.) for DeskJet Printer

SITE MASTER
S100C/S200C/S300D/S800C Series
2 MHz to 20 GHz

GPIB

For Analyzing Cable and Antenna Problems

S331D

S332D

S251C

S113C

S114C

S820C

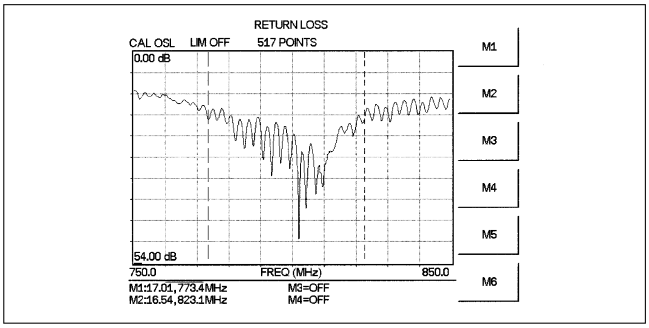
Site Master is the instrument of choice for transmission line/antenna installation and maintenance. It is the best way to reduce maintenance expenses and improve quality. It replaces stacks of heavy, expensive, and complex test equipment. Site Master's frequency domain reflectometry technique allows it to locate faults before they become catastrophic faults, thereby creating huge cost savings.

The Site Master is a precision, hand-held return loss/SWR and fault location measurement instrument. The Site Master series offers wide frequency coverage, from 2 MHz to 20 GHz. Built-in fault location, RF power monitor, bias tee, and spectrum analysis capabilities are available. Light weight, rugged design, and wide temperature range make them ideal for field applications. Site Master's proprietary design provides superior immunity to on-channel RF interference, which is important for live site testing.

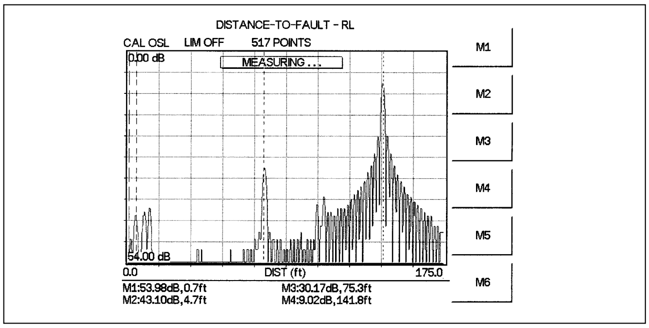
Handheld Software Tools is a Windows® compatible software program provided with every Site Master unit. This software program provides many useful features, including a database for Site Master measurements, Smith Chart display of S11, zoom capability, a "drag-n-drop" overlay for measurement comparison, the capability to download data to a PC, the capability to upload data such as custom cable list or traces to selected Site Master models, and distance-to-fault calculation from return loss or SWR plots. Advanced printing capabilities are provided by Handheld Software Tools including user definable plot scaling and a multiple plots per page option.

Site Master is the first test tool to provide the required accuracy, interference immunity, and repeatability for transmission line/antenna commissioning, and maintenance of today's wireless systems infrastructures.

Features
- Accurate return loss/SWR and fault location measurements
- Accurately tests RF transmission lines and antennas
- Superior immunity to on-channel interference for testing at co-located antenna sites
- Multilingual user interface: English, German, Spanish, French, Chinese, Japanese
- Optional color display (S331D and S332D only)
- Insertion Loss/Gain (S251C only)
- Optional built-in bias tee (S251C only)
- Spectrum analysis (S114C and S332D only)
- Optional RF power monitor and optional RF power meter
- Synthesizer accurate to 75 ppm
- Internal memory saves up to 200 traces
- Instrument configuration up to 20 configurations
- Alphanumeric trace naming
- Time, Date stamp
- Field replaceable battery
- Segmented limit lines
- Six markers
- Graticule lines
- Trace overlay
- Direct printing via RS-232 serial port
- Remote operation via RS-232 serial port



Return loss



Distance-to-fault

Applications
Cellular, ISM, PCS/PCN, paging service, safety service, avionics, two-way radio, military, and microwave point-to-point radio.

Site Master allows implementation of preventative maintenance procedures. Unlike TDRs and spectrum analyzers/tracking generators, Site Master can spot RF degradation before failures occur. Problems can be fixed before expensive cables or waveguides are ruined. Site Master is designed for field requirements. Its rugged construction survives rough field treatment. Battery power, light weight, small size, wide temperature range, and simple user interface are exactly what field technicians want today. Technicians can test antennas from ground level because Site Master's distance-to-fault measurement compensates for cable insertion loss. Furthermore, spectrum analysis, available in certain Site Master models, allows technicians and field engineers to quickly identify and solve common RF system problems, such as coverage, interference, and other path related signal problems. Site Master offers a new and better method to install and maintain transmission lines and antennas.

Specifications[*1]

<table>
<tr><td>Model</td><td>S251C</td><td colspan="2">S113C/S331D</td><td colspan="2">S114C/S332D</td></tr>
<tr><td>Frequency range</td><td>625 to 2500 MHz</td><td colspan="2">2 to 1600 MHz (S113C)
25 to 4000 MHz (S331D)</td><td colspan="2">2 to 1600 MHz (114C)
25 to 4000 MHz (S332D)</td></tr>
<tr><td>Frequency resolution</td><td>10 kHz</td><td colspan="2">10 kHz (S113C)
100 KHz (S331D)</td><td colspan="2">10 kHz (S114C)
100 KHz (S332D)</td></tr>
<tr><td>Frequency accuracy (CW mode)</td><td colspan="5">± 75 ppm</td></tr>
<tr><td>Display data points</td><td colspan="5">Selectable: 130, 259, 517</td></tr>
<tr><td>Immunity to interfering RF signals[*2]</td><td>S251C</td><td>S113C</td><td>S331D</td><td>S114C</td><td>S332D</td></tr>
<tr><td>On-frequency[*3]</td><td>+10 dBm (RF out), +30 dBc transmission</td><td>+10 dBm</td><td>–5 dBm</td><td>+10 dBm</td><td>–5 dBm</td></tr>
<tr><td>On-channel[*4]</td><td>+17 dBm</td><td>+17 dBm</td><td>+17 dBm</td><td>+17 dBm</td><td>+17 dBm</td></tr>
<tr><td>Return loss</td><td colspan="5">Range: 0 to 54 dB; Resolution: 0.01 dB (S331D and S332D have return loss range of 0 to 60 dB)</td></tr>
<tr><td>SWR</td><td colspan="5">Range: 1 to 65; Resolution:0.01</td></tr>
<tr><td>Cable loss</td><td colspan="5">Range: 0 to 30 dB; Resolution: 0.01 dB (S331D and S332D)
Range: 0 to 54 dB; Resolution: 0.01 dB (S251C, S113C and S114C)</td></tr>
<tr><td>Distance-to-fault</td><td colspan="5">Vertical range
Return loss: 0 to 54 dB; 0 to 60 dB (S331D and S332D)
SWR: 1 to 65
Horizontal range (meter): 0 to (# of data points –1) x resolution, where data points = 130, 259 or 517
Horizontal resolution, rectangular windowing resolution (meter): (1.5 x 10^{8}) (υp)/ Δ frequency[*5]</td></tr>
<tr><td>RF power monitor (Option 5 - S113C, S114C & S251C only)</td><td colspan="5">Display range: –80 to +80 dBm, 10 pW to 100 kW
Detector range: –45 to +20 dBm, 30 µW to 100 mW
Offset range: 0 to +60 dB
Resolution: 0.1 dB or 0.1 W</td></tr>
<tr><td>RF power meter
(S331D & S332D only)</td><td>N/A</td><td colspan="4">Frequency range: 10 MHz to 3 GHz
Display range: –80 to +80 dBm, 10 pW to 100 kW
Offset range: 0 to +60 dB
Accuracy: ±1 dB max (± 0.5 dB typical) for input signal levels ≥–60 dBm, 10 MHz to 2 GHz excludes input VSWR</td></tr>
<tr><td>Bias Tee (Option 10B)
S251C only</td><td>Voltage: Switchable 15V (high voltage) OR 12V (low voltage)
Current: Switchable 1A surge/650 mA steady state (high current) OR 460 mA surge/244 mA steady state (low current)</td><td colspan="2">N/A</td><td colspan="2">N/A</td></tr>
<tr><td>Insertion Loss/Gain
S251C only</td><td>Display range: –120 to +100 dB
Resolution: 0.1 dB
Measurement Range: –90 to +50 dB</td><td colspan="2">N/A</td><td colspan="2">N/A</td></tr>
<tr><td colspan="6">Spectrum analysis</td></tr>
<tr><td>Frequency range</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">100 kHz to 1600 MHz (S114C)
100 kHz to 3000 MHz (S332D)</td></tr>
<tr><td>Accuracy</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">± 2 ppm</td></tr>
<tr><td>Aging</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">± 1 ppm/yr</td></tr>
<tr><td>Frequency span</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">1 kHz to 1.6 GHz in 1, 2, 5 step selections in auto mode, plus zero span (S114C)
10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span (S332D)</td></tr>
<tr><td>Resolution bandwidth</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">10 kHz, 30 kHz, 100 kHz, 1 MHz (S114C)
100 Hz to 1 MHz in 1-3 sequence ±5% Accuracy (S332D)</td></tr>
<tr><td>Video Bandwidth</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">100 Hz to 300 kHz in 1-3 sequence (S114C)
3 Hz to 1 MHz in 1-3 sequence ± 5% Accuracy (S332D)</td></tr>
<tr><td>SSB Phase Noise @ (1 GHz)
30 kHz offset</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">≤ –75 dBc/Hz</td></tr>
<tr><td>Spurious responses (Input related)</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">≤ –45 dBc</td></tr>
<tr><td>Spurious responses (residual)</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">≤ –95 dBm</td></tr>
</table>

Continued on next page

Model	S251C	S113C/S331D	S114C/S332D
Dynamic range	N/A	N/A	≥ 65 dB
Average noise level	N/A	N/A	100KHz to 300KHz ≤ –80 dBm 300KHz to 500KHz ≤ –92 dBm 500KHz to 3GHz ≤ –95 dBm (S114C) ≤–135 dBm typical, ≥1 MHz (preamp on) ≤–115 dBm typical, ≥500 kHz to <1 MHz ≤–110 dBm typical, <500 kHz for input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW
Measurement range	N/A	N/A	+20 dBm to –95 dBm (S114C) +20 dBm to –135 dBm (S332D)
Display range	N/A	N/A	2 to 15 dB/div (S114C) 1 to 15 dB/div (S332D) in 1 dB steps - 10 divisions display
Total level accuracy	N/A	N/A	± 2 dB ≥ 500 kHz, typical ± 3 dB < 500 kHz, typical (S114C) ± 1 dB ≥ 10 MHz to 2 GHz ± 3dB <10 MHz (excludes input VSWR mismatch) (S332D)
RF input VSWR	N/A	N/A	2.0:1 (S114C) RF Input VSWR: (20 dB atten.) 1.5:1 typical, (10 MHz to 2.4 GHz) (S332D)
Trace memory	Up to 200		
Instrument configuration[*6]	10	10 (S113C); up to 20 (S331D)	10 (S114C); up to 20 (S331D)
Markers	6 for all models		
Test port connector	Precision N female		
Maximum input level without damage			
RF OUT test port	+23 dBm, 50 Ω, +50 Vdc	+23 dBm, 50 Ω, +50 Vdc	+23 dBm, 50 Ω, +50 Vdc
RF IN test port (S251 only)	+27 dBm, 50 Ω, +50 Vdc	N/A	N/A
RF power detector (S113C, S114C & S251C only)	+20 dBm, 50 Ω, +50 Vdc	+20 dBm, 50 Ω, +50 Vdc	+20 dBm, 50 Ω, +50 Vdc
RF power meter (S331D & S332D only)	N/A	+43 dBm, 50 Ω, +50 Vd	+43 dBm , 50 Ω, +50 Vdc
RF IN Spectrum analyzer port (S114C only)	N/A	N/A	+27 dBm, 50 Ω,± 50 Vdc
RF IN Spectrum analyzer port (S332D only)	N/A	N/A	+43 dBm, 50 Ω, +50 Vdc
Temperature	Operating: –10°C to +50°C humidity 85% or less Non-operating: –20°C to +75°C (recommend battery stored separately between 0°C and +40°C for any prolonged non-operating storage period)		
Weight	2.14 kg (4.76 lbs.) nominal; <2.28 kg (< 5 lbs.) including battery (S332D)		
Size	25.4 cm x 17.8 cm x 6.1 cm (10 in x 7 in x 2.4 in)		
General	Electromagnetic compatibility: Meets European community requirements for CE marking. RS232: 9 pin D-sub, three wire serial Safety: Conforms to EN 61010-1 for Class 1 portable equipment.		

*1: All specifications apply when calibrated at ambient temperature after a five minute warm up.
*2: In most applications, immunity is typically better because interfering signals are modulated and varying in frequency rather than being CW. Measurements were made in CW mode by injecting a signal into the Site Master through a coupler.
*3: On-Frequency interference immunity is specified to within +10 kHz of the carrier frequency.
*4: On-Channel interference immunity is specified to within 1 MHz of the carrier frequency.
*5: Where υ_p is the cable’s relative propagation velocity. Δ frequency is the stop frequency minus the start frequency (in Hz). Wide frequency sweeps improve resolution but reduce maximum display range.
*6: Calibration stored with instrument configuration.

InstaCal® Calibration Module*

The InstaCal calibration module is available for all one-port Site Master models (S113C, S114C, S331D and S332D). With InstaCal, users can cut the time required to calibrate the Site Master by as much as 50%. Moreover, InstaCal reduces the potential for calibration error. With discrete calibration components users are required to connect, disconnect, and reconnect the various calibration components during the calibration process, which greatly increases the potential for calibration/measurement error. With InstaCal, users are only required to connect the InstaCal calibration module once – the calibration process sequences automatically, ensuring an accurate calibration of the Site Master. The benefit is calibrated measurements in much less time.

*The InstaCal® Calibration Module exhibits slightly degraded directivity performance compared to precision loads. Users having applications that require DTF-RL measurements > | 38 dB | may want to consider using precision load calibration components in place of the InstaCal calibration module for greater measurement accuracy.

InstaCal® Module ICN50

Specifications*1

Model	S810C/S820C
Frequency range	3.3 to 10.5 GHz (S810C) 3.3 to 20 GHz (S820C)
Frequency accuracy (CW mode)	≤ ± 50 ppm
Frequency resolution	100 kHz
Display data points	Selectable: 130, 259, 517
RF immunity*2	–10 dBm
Return loss	Range: 0 to 54 dB, Resolution: 0.01 dB
SWR	Range: 1 to 65, Resolution: 0.01
Cable/Waveguide Loss	Range: 0 to 54 dB, Resolution: 0.01 dB
Distance-to-fault	Vertical range Return loss: 0 to 54 dB SWR: 1 to 65 Horizontal range: (# of data points –1) x resolution, where data points = 130, 259 or 517 Horizontal resolution, rectangular windowing resolution (meter): Coax: $(1.5 \times 10^8)(\upsilon p)/\Delta$ frequency*3 Waveguide: $(1.5 \times 10^8)(\sqrt{}(1–(F_c/F_1)^2)/\Delta$ frequency)*4
RF power monitor (Option 5)	Display range: –80 to +80 dBm, 10 pW to 100 kW Detector range: –45 to +20 dBm, 30 µW to 100 mW Offset range: 0 to +60 dB Resolution: 0.1 dB, 0.1 x W
Trace memory	Up to 200 traces
Instrument configuration with calibration	10 memory locations
Markers	6 for all models
Test port connector*5	K female or N female (option 11NF)
Maximum input without damage	N(f) test port: +22 dBm RF power detector: +20 dBm, 50 Ω
Temperature	–10°C to 50°C humidity 85% or less Non-operating –20°C to 75°C (recommended battery stored separately between 0°C and +40°C for any prolonged non-operating storage period)
Weight	2.14 kg (4.76 lbs.) nominal
Size	25.4 cm x 17.8 cm x 6.1 cm (10 in x 7 in x 2.4 in)
General	Electromagnetic compatibility: Meets European community requirements for CE marking. RS232: 9-pin D-sub, three wire serial Safety: Conforms to EN 61010-1 for Class 1 portable equipment.

*1: All specifications apply when calibrated at ambient temperature after a five minute warm up.

*2: In most applications, immunity is typically better because interfering signals are modulated and varying in frequency rather than being CW. Measurements were made in CW mode by injecting a signal into the Site Master through a coupler.

*3: Where υp is the cable's relative propagation velocity. Δ frequency is the stop frequency minus the start frequency (in Hz). Wide frequency sweeps improve resolution but reduce maximum display range.

*4: Where F_c is the waveguide's cutoff frequency (in Hz) and F_1 is the start frequency (in Hz). Δ frequency is the stop frequency minus the start frequency (in Hz). Wide frequency sweeps improve resolution but reduce maximum display range.

*5: Must specify option 11NF at the time of purchase to have N female test port connector.

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
Model S113C	Site Master (2 to 1600 MHz), Built in DTF
Model S114C	Site Master (2 to 1600 MHz), Built in DTF, Spectrum Analysis (100 kHz to 1.6 GHz)
Model S251C	Site Master (625 to 2500 MHz), Built in DTF, 2-port
Model S331D	Site Master (25 to 4000 MHz), Built in DTF
Model S332D	Site Master (25 to 4000 MHz), Built in DTF, Spectrum Analysis and Power Meter (100 kHz to 3.0 GHz)
Model S810C	Site Master (3.3 to 10.5 GHz), Built in DTF
Model S820C	Site Master (3.3 to 20 GHz), Built in DTF
	Standard accessories
	User's Guide
	Soft Carrying Case
	AC-DC Adapter
	Automotive Cigarette Lighter/12 Volt DC Adapter
	One Year Warranty
	CD ROM containing Fault Location (DTF), Smith Chart, and Software Management Tools
	Serial Interface Cable
	Rechargeable battery, NiMH
	Precision ruggedized K(m) to N(f) adapter when ordered with out 11NF option (S810C and S820C only)
	Option
Option 3	Color Display – S331D & S332D
Option 5	RF Power Monitor (RF detector not included)
Option 10B	Built-in Bias Tee – S251C
Option 11NF	N(f) test port connector - S810C & S820C
Option 29	RF Power Meter (requires no detector) – S331D
Option 50	T1/E1 Analyzer – S331D
	Optional accessories
42N50A-30	Attenuator, 30 dB, DC to 18 GHz, 50 W
42N50-20	Attenuator, 20 dB, DC to 18 GHz, 5 W
ICN50	InstaCAL (S113C, S114C, S331D, S332D)
5400-71N50	RF Detector, N(m), 50 Ω, 1 to 3000 MHz
560-7N50B	RF Detector, N(m), 50 Ω, 10 MHz to 20 GHz
560-7K50	RF Detector, K(m), 50 Ω, 10 MHz to 40 GHz
560-7VA50	RF Detector, V(m), 50 Ω, 10 MHz to 50 GHz
IN50C	5W Limiter, N(m)-N(f), 18 GHz
22K50	Precision K(m) Short/Open, 40 GHz
22KF50	Precision K(f) Short/Open, 40 GHz
22N50	Precision N(m) Short/Open, 18 GHz
22NF50	Precision N(f) Short/Open, 18 GHz
SM/PL	Precision N(m) Load, 42 dB, 4.0 GHz
SM/PLNF	Precision N(f) Load, 42 dB, 4.0 GHz
OSLN50LF	Precision N(m) Open/short/Load, 42 dB, 4.0 GHz
OSLNF50LF	Precision N(f) Open/short/Load, 42 dB, 4.0 GHz
28K50	Precision N(m) Load, 40 GHz
28KF50	Precision N(f) Load, 40 GHz
28N50-2	Precision N(m) Load, 40 dB, 18 GHz
28NF50-2	Precision N(f) Load, 40 dB, 18 GHz
2000-767	Precision Open/Short/Load, 7-16 (m), 4 GHz
2000-768	Precision Open/Short/Load, 7-16 (f), 4 GHz
15ND50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(m), 6 GHz
15NDF50-1.5C	Test Port Ext. Cable, 1.5 meters, N(m) to 7/16 DIN(f), 6 GHz
15NN50-1.5C	Test Port Ext. Cable, 1.5 meters, N(m) to N(m), 6.0 GHz
15NN50-3.0C	Test Port Ext. Cable, 3.0 meters, N(m) to N(m), 6.0 GHz
15NN50-5.0C	Test Port Ext. Cable, 5.0 meters, N(m) to N(m), 6.0 GHz
15NNF50-1.5B	Test port cable armored, 1.5 meter, N(m) to N(f), 18 GHz
15NNF50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(f), 6.0 GHz
15NNF50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(f), 6.0 GHz
15NNF50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(f), 6.0 GHz
15KKF50-1.5A	Test port cable armored, 1.5 meter, K(m) to K(f), 26.5 GHz
15NDF50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(f), 6 GHz

Model/Order No.	Name
800-109	Detector extender cable, 7.6 m (25 ft.)
800-110	Detector extender cable, 15.2 m (50 ft.)
800-111	Detector extender cable, 30.5 m (100 ft.)
800-112	Detector extender cable, 61 m (200 ft.)
34NN50A	Precision N(m) to N(m) Adapter, 18 GHz
34NFNF50	Precision N(f) to N(f) Adapter, 18 GHz
34RKNF50	Precision Ruggedized K(m) to N(f) Adapter, 20 GHz
K220B	Precision K(m)-K(m) Adapter, 40 GHz
K222B	Precision K(f)-K(f) Adapter, 40 GHz
1091-26	Adapter N(m) to SMA(m), 18 GHz
1091-27	Adapter N(m) to SMA(f), 18 GHz
1091-80	Adapter, N(f) to SMA(m), 18 GHz
1091-81	Adapter, N(f) to SMA(f), 18 GHz
1091-172	Adapter, DC to 1.3 GHz, 50 Ω, N(m) to BNC(f)
510-90	Adapter 7-16(f) to N(m), 7.5 GHz
510-91	Adapter 7-16(f) to N(f), 7.5 GHz
510-92	Adapter 7-16(m) to N(m), 7.5 GHz
510-93	Adapter 7-16(m) to N(f), 7.5 GHz
510-96	Adapter 7/16 (m) to 7/16 (m), 7.5 GHz
510-97	Adapter 7/16 (f) to 7/16 (f), 7.5 GHz
48258	Spare Soft Carrying Case for
40-115	Spare AC/DC Adapter
806-62	Spare Automotive Cigarette Lighter/12 Volts DC adapter
800-441	Spare Serial Interface Cable
760-215A	Transit Case for Site Master
633-27	Rechargeable battery, NiMH for "C" version Site Master
2300-347	Spare Handheld Software Tools
10580-00076	Spare Site Master S810C, S820C User's Guide
10580-00060	Spare Site Master User's Guide (S113C, S114C, S331C & S332C)
10580-00065	Spare Site Master User's Guide (S251C)
10580-00077	Site Master Programming Manual (for S810C, S820C)
10580-00061	Site Master Programming Manual (for S113C, S114C, S331C, S332C)
10580-00066	Site Master Programming Manual (for S251C)
10580-00078	Site Master Maintenance Manual (for S810C & S820C)
10580-00079	Spare S331D and S332D user guide
10580-00062	Site Master Maintenance Manual (for S113C, & S331C)
10580-00067	Site Master Maintenance Manual (for S251C)
10580-00068	Site Master Maintenance Manual (for S114C & S332C)
10580-00100	S331D & S332D Programming Manual
10580-00101	S331D Maintenance Manual
10580-00102	S332D Maintenance Manual
2000-1214	HP DeskJet printer includes: serial-to-parallel interface cable, black print cartridge, and US power cable
2000-753	Spare serial-to-parallel converter cable
2000-663	Power cable (Europe) for DeskJet printer
2000-664	Power cable (Australia) for DeskJet printer
2000-665	Power cable (UK) for DeskJet printer
2000-666	Power cable (Japan) for DeskJet printer
2000-667	Power cable (So. Africa) for DeskJet printer
2000-1030	Portable antenna, SMA (m) 1.71 to 1.88 GHz
2000-1031	Portable antenna, SMA (m) 1.85 to 1.99 GHz
2000-1032	Portable antenna, SMA (m) 2.4 to 2.5 GHz
2000-1200	Portable antenna, SMA (m) 806 to 869 MHz
2000-1035	Portable antenna, SMA (m) 902 to 960 MHz
2000-1216	Black printer cartridge for DeskJet printer
2000-1217	Rechargeable battery for DeskJet printer
551-1691	Earthmate USB to serial adapter cable

Universal Waveguide Component Accessories

	Part number*2	Freq. range	Waveguide type	Compatible flanges
Precision waveguide calibration components*1	XXUM70	5.85 to 8.20 GHz	WR137, WG14	CAR70, PAR70, UAR 70, PDR70
	XXUM84	7.05 to 10.00 GHz	WR112, WG15	CBR84, UBR84, PBR84, PDR84
	XXUM100	8.20 to 12.40 GHz	WR90, WG16	CBR100, UBR100, PBR100, PDR100
	XXUM120	10.00 to 15.00 GHz	WR75, WG17	CBR120, UBR120, PBR120, PDR120
	XXUA187	3.95 to 5.85 GHz	WR187, WG12	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U
	XXUA137	5.85 to 8.20 GHz	WR137, WG14	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U
	XXUA112	7.05 to 10.00 GHz	WR112, WG15	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U
	XXUA90	8.20 to 12.40 GHz	WR90, WG16	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135/U, UG-136B/U
	XXUA62	12.40 to 18.00 GHz	WR62, WG18	UG-541A/U, UG-419/U, UG-1665/U, UG1666/U
	XXUA42	17.00 to 26.50 GHz	WR42, WG20	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U
Precision waveguide-to-coaxial adapters*1	35UM70N	5.85 to 8.20 GHz	WR137, WG14	CAR70, PAR70, UAR 70, PDR70
	35UM84N	7.05 to 10.00 GHz	WR112, WG15	CBR84, UBR84, PBR84, PDR84
	35UM100N	8.20 to 12.40 GHz	WR90, WG16	CBR100, UBR100, PBR100, PDR100
	35UM120N	10.00 to 15.00 GHz	WR75, WG17	CBR120, UBR120, PBR120, PDR120
	35UA187N	3.95 to 5.85 GHz	WR187, WG12	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U
	35UA137N	5.85 to 8.20 GHz	WR137, WG14	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U
	35UA112N	7.05 to 10.00 GHz	WR112, WG15	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U
	35UA90N	8.20 to 12.40 GHz	WR90, WG16	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135/U, UG-136B/U
	35UA62N	12.40 to 18.00 GHz	WR62, WG18	UG-541A/U, UG-419/U, UG-1665/U, UG1666/U
	35UA42K	17.00 to 26.50 GHz	WR42, WG20	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U

*1: Call or contact Anritsu sales rep for other frequencies waveguide calibration components and waveguide-to-coaxial adapters.

*2: Part number Ordering information

Prefix (XX)	23 for 1/8 λ offset short
	24 for 3/8 λ offset short
	26 for Precision waveguide load
	35 waveguide to coaxial adapter

SPECTRUM MASTER
MS2711B/D
100 kHz to 3.0 GHz

CE

Fast, Accurate, Repeatable, Portable Spectrum Analysis

NEW

The MS2711B/D Handheld Spectrum Analyzer provides the "ultimate" in measurement flexibility for field environments and applications requiring mobility. Unlike traditional spectrum analyzers, the MS2711B/D features a rugged, ultra-lightweight, battery-operated design that enables users to conduct spectrum analysis measurements – anywhere, anytime.

Providing complete freedom from AC/DC power requirements, the MS2711B/D enables you to locate, identify, record and solve communication systems problems quickly and easily, without sacrificing measurement accuracy.

Whether you are installing, maintaining, or troubleshooting a modern wireless communication system, the MS2711B/D provides exceptional performance combined with ease-of-use and broad functionality – making it an ideal solution for engineers and technicians who conduct field measurements in the 100 kHz to 3.0 GHz frequency range. In fact, it is ideal for finding the source of interfering signals in modern wireless systems.

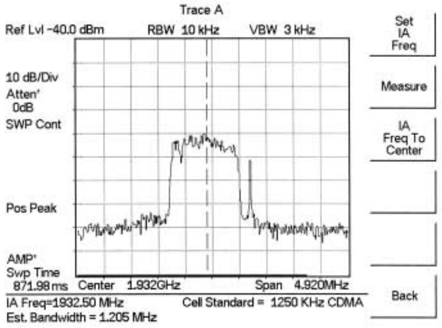
Rugged and Reliable
Because the MS2711B/D was designed specifically for field environments, it can easily withstand the day-to-day punishment of field use. Rugged packaging also keeps the MS2711B/D performing in harsh environments.

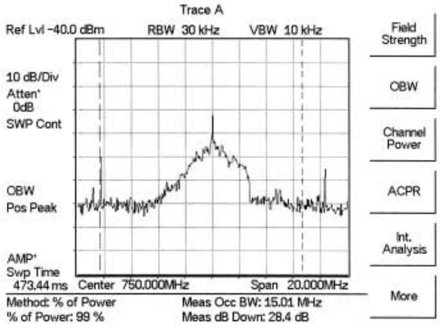
Easy-to-Use
Not only is the MS2711B/D the lightest fully-functional spectrum analyzer available at 4.5 pounds (base model including battery), operation is straight-forward and driven by firmware that simplifies the process of making measurements and interpreting the results shown on the large, high-resolution LCD display. The menu-driven user interface is easy to use and requires little training.

A full range of marker capabilities such as peak, center and delta functions are also provided, giving users a faster and more comprehensive measurement of displayed signals. Limit lines simplify amplitude measurements, giving users the capability to create quick, simple, pass/fail measurements. Frequency, span and amplitude functions are easily configured for optimum performance. Used together with the Save Setup feature, these functions can help to make testing easier and faster for less experienced users.

Powerful Trace Management
Users are able to store ten test setups along with 200 measurement traces internally in the unit's memory. The stored data can be easily downloaded to a personal computer (PC) or a printer via an RS-232 serial cable for further analysis. A notebook computer can be used with the RS-232 interface for automated control and data collection in the field.

A standard preamplifier (option 8) plus a number of available options including an internal tracking generator (option 20, MS2711B) or transmission measurement (option 21, MS2711D) expand the MS2711B/D's capabilities.


Trace A
Ref Lvl –40.0 dBm RBW 10 kHz VBW 3 kHz
10 dB/Div
Atten' 0dB
SWP Cont
Pos Peak
AMP'
Swp Time 871.98 ms Center 1.932GHz Span 4.920MHz
IA Freq=1932.50 MHz Cell Standard = 1250 KHz CDMA
Est. Bandwidth = 1.205 MHz


Trace A
Ref Lvl –40.0 dBm RBW 30 kHz VBW 10 kHz
10 dB/Div
Atten' 0dB
SWP Cont
OBW
Pos Peak
AMP'
Swp Time 473.44 ms Center 750.000MHz Span 20.000MHz
Method: % of Power Meas Occ BW: 15.01 MHz
% of Power: 99 % Meas dB Down: 28.4 dB

To meet the challenges of today's wireless market, Anritsu Company has incorporated a pre-amp (standard) for its revolutionary MS2711B/D Handheld Spectrum Analyzer which increases the analyzer's sensitivity and dynamic range while improving measurement time. With the built-in pre-amp feature, the MS2711B/D is particularly effective in measuring low-level signals. The handheld spectrum analyzer's sensitivity is improved to –115 dBm for MS2711B and –135 dBm for MS2711D (100 Hz RBW) (full span). With this option, the MS2711B/D can identify and make measurements on low-level signals much faster than previously possible.

The improved sensitivity, dynamic range, and measurement speed complement the existing benefits of the MS2711B/D. Weighing only 4.9 pounds (including a NiMH battery, fully loaded, base model only 4.5 pounds), the MS2711B/D is the world's lightest fully functional handheld spectrum analyzer with the built-in tracking generator option (option 20).

MS2711B/D has been enhanced so that it can make highly accurate channel power measurements, occupied bandwidth and Adjacent Channel Power Ratio (ACPR) measurements. These are increasingly critical measurements, particularly for power amplifiers used in wireless communication systems. With the enhancements, the MS2711B/D has dedicated one button channel power, occupied bandwidth, and ACPR measurement capability to significantly reduce test time and expense. The MS2711B/D also features local language graphical user interface support (in Chinese, Japanese, French, German, and Spanish).

Features

- Lightweight (4.5 lbs - base model, 4.9 lbs with tracking generator - option 20, or transmission measurement, option 21)
- Synthesizer-based performance
- Wide dynamic range
- One button, ACPR, OBW, channel power, C/I measurement
- Quick zoom-in, zoom-out display
- 5 minute warm up
- Manual and automatic attenuator control
- Improved user interface, with local language support in five different languages
- Automatic overload and ESD protection
- Built-in AM/FM demodulation
- Built-in field strength measurement
- Built-in interference analysis
- Ability to store and recall up to six antenna factors
- Full range of marker capabilities including peak, center, and delta functions
- Limit lines for quick, simple pass/fail measurements
- Rugged, reliable packaging
- Battery operated design
  - 2.5 hours of continuous operation
  - Built-in energy conservation that extends battery life beyond an eight-hour workday
  - Operation using a 12.5 Vdc source AC-DC adapter or automotive cigarette lighter adapter, which simultaneously charges the battery
  - Field replaceable battery
- Built in clock and calender
- Low cost ownership, global warranty
- Data storage and memory
  - Store up to ten test setups and 200 measurement traces in non-volatile memory
  - Stored data is easily and quickly downloaded to a personal computer (PC) or printer
- Powerful trace management
  - Automatically date/time stamped
  - Alphanumeric labeling
- PC reporting software
  - Windows® 95/98/2000/ME, XP, NT Workstation compatible
  - Supports long file names for descriptive labeling
  - Can display an unlimited number of traces for comparison to historical performance
- Optional Monochrome or Color LCD with backlight capability display
- Direct printer control via RS232 serial port

Applications

Convenient operating procedures, high sensitivity, and excellent repeatability enable the MS2711B/D to pinpoint the smallest system performance degradation and allow for easy verification of system compliance. Typical applications include:

- Transmitter Spectrum Analysis – occupied bandwidth, power, modulation measurements, location and identification of in-band, out-of-channel spurious and out-of-band spurious signals
- Receive Signal Analysis – measure receiver sensitivity, locate and identify sources of interfering signals
- Modulation identification, modulation depth, deviation, and spectral mask
- Signal Strength Mapping – to determine the most suitable location for antennas, base stations, and repeaters; or pinpoint Electromagnetic (EM) leakage in broadcast systems

Specifications

	Model	MS2711B	MS2711D
Frequency	Frequency range	100 kHz to 3.0 GHz	
	Frequency reference	Aging: ±1 ppm/yr Accuracy: ±2 ppm	
	Frequency span	1 kHz to 3 GHz in 1, 2, 5 step selections in auto mode, plus zero span	10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span
	Sweep time	≥6500 msec full span; 500 msec zero span	≤ 1.1 second full span; ≤ 50 msec to 20 second zero span
	Resolution bandwidth (–3dB width)	10 kHz, 30 kHz, 100 kHz, 1 MHz, ±20%	100 Hz to 1 MHz in 1-3 sequence, ±5%
	Video bandwidth (–3dB)	100 Hz to 300 kHz in 1-3 sequence	3 Hz to 1 MHz in 1-3 sequence, ±5%
	SSB Phase Noise (1 GHz) @30 kHz Offset	≤–75 dBc/Hz	
	Spurious responses Input related	≤–45 dBc	
	Spurious residual responses	≤–90 dBm (≥500 kHz)	
Amplitude	Measurement range	+20 dBm to –115 dBm (with preamp on)	+20 dBm to –135 dBm (with preamp on)
	Displayed average noise level	–115 dBm (≥1 MHz typical with preamp on) ≤–95 dBm (≥500 kHz, typical) ≤–80 dBm (< 500 kHz, typical)	≤-135 dBm typical, ≥1 MHz (preamp on) ≤–115 dBm typical, ≥500 kHz to <1 MHz ≤–110 dBm typical, < 500 kHz for input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW
	Dynamic range	>65 dB, typical	
	Total level accuracy	±2 dB, ≥500 kHz, typical; ±3 dB, <500 kHz, typical (For input signal level ≥–60 dBm)	±0.5 dB typical (±1 dB max), ≥10 MHz to 2 GHz ±1 dB typical (±1.5 dB max), >2 GHz to 3 GHz ±2 dB, ≥500 kHz to <10 MHz ±3 dB typical, <500 kHz for input signal levels ≥–60 dBm, excludes input VSWR mismatch
	Display range	1 to 15 dB/div in 1 dB steps, Ten divisions displayed	
	Max input level without damage	+23 dBm, ±50 Vdc	+43 dBm (Peak), ±50 Vdc
	Attenuator Range	0 to 50 dB, selected manually or automatically coupled to the reference level. Resolution in 10 dB steps	0 to 51 dB, selected manually or automatically coupled to the reference level. Resolution in 1 dB steps.
	RF input	VSWR 2.0:1	1.5:1 typical, (≥20 dB atten., 10 MHz to 2.4 GHz)

Continued on next page

General	Model	MS2711B	MS2711D
	Internal trace memory	200 maximum	
	Setup storage	10 test setups	15 test setups
	Display	VGA Monochrome LCD	VGA Color or VGA Monochrome LCD
	Inputs and Outputs Ports RF In RF Out Ext trig In Ext Freq Ref In (2 MHz to 20 MHz) Serial Interface	 Type N, female, 50 Ω Type N, female, 50 Ω N/A N/A RS-232 9 pin D-sub, three wire serial	 Type N, female, 50 Ω Type N, female, 50 Ω BNC, female (5V TTL) Shared BNC, female, 50 Ω (–15 dBm to +10 dBm) RS-232 9 pin D-sub, three wire serial
	Electromagnetic compatibility	Meets European community requirements for CE marking	
	Safety	Conforms to EN 61010-1 for Class 1 portable equipment	
	Temperature Operating Non-operating	 0°C to 50°C, humidity 85% or less –20°C to +75°C (recommend battery stored separately between 0°C to 40°C for any prolonged storage period)	 –10°C to 55°C, humidity 85% or less –51°C to +71°C (recommend battery stored separately between 0°C to 40°C for any prolonged storage period)
	Power supply External DC Input Internal	 +12.5 to +15 volts dc, 1350 mA max NiMH battery: 10.8 volts, 1800 mA mAH	
	Dimensions Size (W x H x D) Weight	 25.4 cm x 17.8 cm x 6.10 cm (10.0 in x 7.0 in x 2.4 in) 2.04 kg (4.5 lbs.) includes battery, 2.2 kg (4.9 lbs) includes tracking generator	 25.4 cm x 17.8 cm x 6.10 cm (10.0 in x 7.0 in x 2.4 in) <2.14 kg (4.7 lbs.) includes battery, <2.28 kg (5 lbs) includes transmission measurement

MS2711B/D (Option 10) Bias Tee specifications

Bias Tee	Voltage	+18 Vdc
	Current	1 A peak 200 ms, 300 mA max steady state

MS2711D (Option 21) Transmission Measurement specifications

Frequency	Frequency range Frequency resolution	25 MHz to 3 GHz 10 Hz
Output	Output power level Output impedance	–10 dBm typical 50 Ω

FCN4760 Frequency Converter specifications

Frequency	Frequency range	4.7 GHz to 6 GHz
	Frequency resolution[*1]	10 Hz
	Frequency reference	Aging: ±1 ppm/yr Accuracy: ±2 ppm
	SSB Phase Noise (6 GHz) @30 kHz Offset	≤–65 dBc/Hz
	Spurious responses Input related	≤–45 dBc
	Spurious residual responses[1]	≤–90 dBm
Amplitude	Measurement range	–40 dBm to –100 dBm
	Sensitivity[*1] (displayed avg. noise level)	–100 dBm
	Maximum input level without damage	–5 dBm
	RF input	VSWR 2.0:1 max
General	Inputs and Outputs Ports RF In RF Out Communication Interface	 Type N, female, 50 Ω Type N, male, 50 Ω 10 pin D sub
	Electromagnetic compatibility	Meets European community requirements for CE marking
	Safety	Conforms to EN 61010-1 for Class 1 portable equipment
	Temperature Operating Non-operating	 –10°C to 50°C, humidity 85% or less –50°C to +80°C
	Power dissipation	850 mW max
	Dimensions Size (W x H x D) Weight	 6.6 cm x 10.9 cm x 3.3 cm (2.6 in x 4.3 in x 1.3 in) <0.45 kg (< 1 lb.)

∗1: Specifications apply when connected to the MS2711D spectrum analyzer

MS2711B (Option 20) Tracking generator specifications

Frequency	Frequency range	10 MHz to 3 GHz
	Frequency resolution	5 KHz
	Tracking offset range	±5 MHz
Output	Output power level	0 to –60 dBm
	Output power level resolution	0.1 dB
	Absolute level accuracy	±1.5 dB, 0 to –40 dBm ±4 dB, –40 dBm to –60 dBm
	Output flatness	≤±1.5 dB (10 MHz – 3 GHz)
	Output tracking VSWR	<2.0:1, <0 dBm
	Spurious harmonics	≤–20 dBc
	Non-Spurious	≤–20 dBc

MS2711B (Option 29) Power meter specifications

Frequency Range	3 MHz to 3.0 GHz
Total Level Accuracy	± 1 dB max (± 0.5 dB typical) for input signal levels >-60 dBm (10 MHz to 2 GHz, excludes input VSWR) ± 1.5 dB max (± 1 dB typical), >2 GHz to 3 GHz ± 2 dB max, 3 MHz to 10 MHz
Measurement Range	+20 dBm to -80 dBm
Frequency Span	3 MHz to 2.99 GHz
Display Range	+80 dBm to -80 dBm
Offset Range	0 to 60 dB
Maximum Input Power	+20 dBm without input attenuator

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MS2711B/8	Handheld Spectrum Analyzer: 100 kHz to 3.0 GHz
MS2711D	Handheld Spectrum Analyzer: 100 kHz to 3.0 GHz
	Standard Accessories
	User's Guide, MS2711B
	Soft Carrying Case
	AC – DC Adapter
	Automotive Cigarette Lighter/12 Volt DC Adapter
	One Year Warranty
	CD ROM containing Software Management Tools
	Serial Interface Cable
	Rechargeable battery, NiMH
	Pre-amplifier (built-in)
	Option Accessories
Option 3	Color display - MS2711D only
Option 6	Frequency converter controller module for use with FCN4760 (MS2711D only)
Option 10	Bias Tee (built-in)
Option 20	Tracking generator (built-in) - MS2711B only
Option 21	Transmission measurement (built-in) - MS2711D only
Option 29	Power Meter (MS2711D only)
	Optional Accessories
5400-71N50	RF Detector, N(m), 50 Ω, 1 to 3000 MHz
42N50A-30	30 dB, 50 Watt, Bi-directional, DC to 18 GHz, N(m) to N(f) Attenuator
34NN50A	Precision Adapter, DC to 18 GHz, 50 Ω, N(m) to N(m)
34NFNF50C	Precision Adapter, DC to 18 GHz, 50 Ω, N(f) to N(f)
15NN50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(m), 6.0 GHz
15NN50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(m), 6.0 GHz
15NN50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(m), 6.0 GHz
15NNF50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(f), 6.0 GHz
15NNF50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(f), 6.0 GHz
15NNF50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(f), 6.0 GHz
15ND50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(m), 3.5 GHz
15NDF50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(f), 3.5 GHz
510-90	Adapter 7/16 (f) to N(m), 3.5 GHz
510-91	Adapter, 7/16 DIN(f) to N(f), 7.5 GHz
510-92	Adapter, 7/16 DIN(m) to N(m) 7.5 GHz
510-96	Adapter 7/16 DIN (m) to 7/16 DIN (m), 7.5 GHz
510-97	Adapter 7/16 DIN(f) to 7/16 DIN(f), 7.5 GHz
61N50	RF SWR Bridge, 10-2500 MHz, 50 Ω, N(m)
61NF50	RF SWR Bridge, 10-2500 MHz, 50 Ω, N(f)

Model/Order No.	Name
1030-86	Band Pass Filter, 800 MHz band, 806-869 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-87	Band Pass Filter, 900 MHz band, 902-960 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-88	Band Pass Filter, 1900 MHz band, 1.85-1.99 GHz, Loss = 1.8 dB, N(m)-SMA(f)
1030-89	Band Pass Filter, 2400 MHz band, 2.4-2.5 GHz, Loss = 1.9 dB, N(m)-SMA(f)
48258	Spare soft carrying case
40-115	Spare AC/DC adapter
806-62	Spare automotive cigarette lighter/12 Volt DC adapter
800-441	Spare serial interface cable
760-229	Transit case for Anritsu Handheld Spectrum Analyzer
2300-347	Anritsu Handheld Software Tools
10580-00074	Anritsu HHSA User's Guide, Model MS2711B (spare)
10580-00071	Anritsu HHSA Programming Manual, Model MS2711B
10580-00072	Anritsu HHSA Maintenance Manual, Model MS2711B
10580-00097	Anritsu HHSA User's Guide, Model MS2711D
10580-00098	Anritsu HHSA Programming Manual, Model MS2711D
10580-00099	Anritsu HHSA Maintenance Manual, Model MS2711D
633-27	Rechargeable battery, NiMH
551-1691	USB to Serial adapter
70-28	Headset
2000-1029	Battery charger, NiMH with universal power supply
2000-1030	Portable antenna, 50 Ω, SMA (m) 1.71-1.88 GHz
2000-1031	Portable antenna, 50 Ω, SMA (m) 1.85-1.99 GHz
2000-1032	Portable antenna, 50 Ω, SMA (m) 12.4-2.5 GHz
2000-1035	Portable antenna, 50 Ω, SMA (m) 896-941 MHz
2000-1200	Portable antenna, 50 Ω, SMA (m) 806-869 MHz
	Printers
2000-1214	HP DeskJet printer Includes: interface cable, black print cartridge, and US power cable
2000-753	Spare serial-to-parallel converter cable
2000-663	Power cable (Europe) for DeskJet printer
2000-664	Power cable (Australia) for DeskJet printer
2000-1218	Power cable (UK) for DeskJet printer
2000-667	Power cable (So. Africa) for DeskJet printer
2000-1217	Rechargeable battery for DeskJet printer
2000-1216	Black print cartridge for DeskJet printer

SPECTRUM ANALYZERS

Spectrum analyzer selection guide

Model	Measurement frequency range	Measurement level range (dBm)	Resolution bandwidth	High-level accuracy	C/N (dBc/Hz)*1	RF-band harmonic distortion (dBc)*2	Third order intermodulation distortion (dBc)*2	Counter	Measure	Zone marker	AM/FM demodulation mode	QP detection	High-speed time domain	Gate	Tracking generator	GPIB	PTA	Features
MS2687B	9 kHz to 30 GHz	–124 to +30	300 Hz to 3 MHz, 5, 10, 20 MHz (1 Hz to 1 MHz, with Opt.*3)	√	–108*1	–90	–85	√	√	√	–	–	√	√	–	RS-232	–	Portable
MS2683A	9 kHz to 7.8 GHz	–124 to +30	300 Hz to 3 MHz, 5, 10, 20 MHz, 1 Hz to 1 MHz (with Opt.)	√	–108*1	–90	–85	√	√	√	–	–	√	√	–	√	–	
MS2681A	9 kHz to 3 GHz	–124 to +30	300 Hz to 3 MHz, 5, 10, 20 MHz, 1 Hz to 1 MHz (with Opt.)	√	–108*1	–70	–85	√	√	√	–	–	√	√	–	√	–	
MS2668C	9 kHz to 40 GHz	–115 to +30	1 kHz to 3 MHz, 10 Hz to 3 MHz (with Opt.)	√	–90*3	–90	–75	√	√	√	Opt.	–	Opt.	Opt.	–	√	√	
MS2667C	9 kHz to 30 GHz	–115 to +30	1 kHz to 3 MHz, 10 Hz to 3 MHz (with Opt.)	√	–95*3	–60	–80	√	√	√	Opt.	–	Opt.	Opt.	–	√	√	
MS2665C	9 kHz to 21.2 GHz	–115 to +30	1 kHz to 3 MHz, 30 Hz to 3 MHz (with Opt.)	√	–95*3	–60	–80	√	√	√	Opt.	–	Opt.	Opt.	–	√	√	
MS2663C	9 kHz to 8.1 GHz	–115 to +30	1 kHz to 3 MHz, 30 Hz to 3 MHz (with Opt.)	√	–100	–75	–80	√	√	√	Opt.	Opt.	Opt.	Opt.	Opt.	√	√	
MS2661C	9 kHz to 3 GHz	–115 to +30, –130 to +30 (with Opt.)	1 kHz to 3 MHz, 30 Hz to 3 MHz (with Opt.)	√	–100	–75	–80	√	√	√	Opt.	Opt.	Opt.	Opt.	Opt.	√	√	
MS2661B	9 kHz to 3 GHz	–115 to +30, –130 to +30 (with Opt.)	1 kHz to 5 MHz, 30 Hz to 5 MHz (with Opt.)	√	–100	–75	–80	√	√	√	Opt.	Opt.	Opt.	Opt.	Opt.	√	√	
MS2651B	9 kHz to 3 GHz	–110 to +30	1 kHz to 5 MHz	√	–90	–60	–70	√	√	√	√	Opt.	Opt.	Opt.	Opt.	√	√	
MS2711D	100 kHz to 3 GHz	–135 to +20	100 Hz to 1 MHz	√	–75*4	–45	–45	–	√	–	√	–	–	–	Opt.	RS-232	–	Hand held (2.28 kg)

∗1: 10 kHz offset
∗2: At –30 dBm
∗3: –95 + 20 log n (n: local harmonic order)
∗4: At 30 kHz offset

SPECTRUM ANALYZER

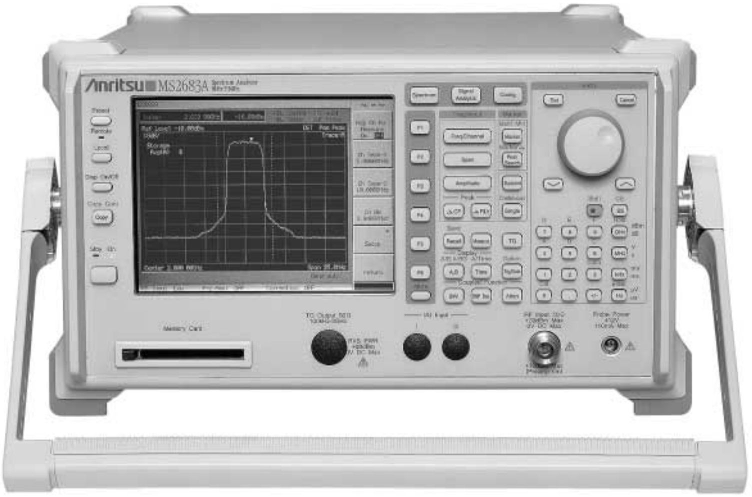
MS2681A/2683A/2687B

9 kHz to 3/7.8/30 GHz

CE GPIB

For Evaluation of IMT-2000, Bluetooth™, MMAC and Advanced Radio Communication Devices

NEW



The IMT-2000 (2 GHz band) service for third-generation mobile radio communication has started. Bluetooth, or Wireless LAN, has been adopted for close-range radio communication between portable remote terminals and peripheral equipment, and R&D of MMAC, IEEE802.11a, and HyperLAN2 for higher speed access have been conducted in various countries.
The MS2681A/2683A/2687B spectrum analyzer delivers optimum performance over a wide dynamic range (156 dB, typical value), wide resolution bandwidth (20 MHz), to high-speed sweep (refresh rate of 20 times/s), required for evaluating next-generation radio communication systems and devices.
It can be used not only as a spectrum analyzer but also to perform various measurements easily and quickly by installing measurement software.

- **Application software**

Support system	Name
W-CDMA	W-CDMA measurement software
GSM	GSM measurement software
cdmaOne,CDMA 1X	cdma measurement software
CDMA 1xEV-DO	CDMA 1xEV-DO measurement software
PDC/PHS/NADC (IS-136), STD-39/T79, STD-T61	π/4DQPSK measurement software
IEEE802.11a/11b, HiSWANa, HiperLAN2	Wireless LAN measurement software

Features

- **Wide resolution band width up to 20 MHz.**
- **Data transmission speed approximately 10 times faster. (GPIB transmission speed: 120 kbytes/s)**
- **Optional measurement software (sold separately) for high-speed modulation analysis.(1.5 sec. with W-CDMA, 0.5 sec with IEEE802.11a)**
- **Optional narrow resolution bandwidth from 1 Hz.**
- **Optional rubidium reference oscillator for warm-up time of just 7 minutes.**
- **Optional power meter that measures up to 32 GHz.**

Specifications

Specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference, and are not guaranteed.

Name	MS2681A	MS2683A	MS2687B
Frequency range	9 kHz to 3 GHz	9 kHz to 7.8 GHz	9 kHz to 30 GHz
Frequency band	—	Band 0: 9 kHz to 3.2 GHz, Band 1–L: 1.6 to 3.2 GHz (option 03), Band 1: 3.15 to 6.3 GHz, Band 1+: 6.2 to 7.8 GHz	Band 0: 9 kHz to 3.2 GHz Mixer harmonics order 1 Band 1–: 3.15 to 6.3 GHz Mixer harmonics order 1 Band 1+: 6.2 to 7.9 GHz Mixer harmonics order 1 Band 2+: 7.8 to 15.3 GHz Mixer harmonics order 2 Band 4+: 15.2 to 30 GHz Mixer harmonics order 4
Pre-selector range	—	3.15 to 7.8 GHz, 1.6 to 7.8 GHz (option 03)	3.15 to 30 GHz (band 1–, 1+, 2+, 4+)

Continued on next page

Name	MS2681A	MS2683A	MS2687B
Display frequency accuracy	± (Display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 Hz)		± (Display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 Hz x N Hz) Normal marker: same as frequency display accuracy, Delta marker: same as span accuracy ∗N: Mixer harmonics order
Frequency counter resolution	1 Hz, 10 Hz, 100 Hz, 1 kHz (counts the received frequency at the peak point inside the zone)		
Frequency counter accuracy	± (Display frequency x reference frequency accuracy + 2 Hz + 1 LSD) (at S/N 20 dB or more and RBW 3 MHz or less)		± (Display frequency x reference frequency accuracy +2 Hz + 1LSD) (at S/N 20 dB or more and RBW 3 MHz or less)
Frequency span	Setting range: 0 Hz, and 5 kHz to 3.0 GHz, Accuracy: ±1.0% (at data point of 1001)	Setting range: 0 Hz, and 5 kHz to 7.8 GHz, Accuracy: ±1.0% (at data point of 1001)	Setting range: 0 Hz, and 5 kHz to 30 GHz, Accuracy: ±1.0% (band 0,1), ±2.5% (band 2, 4) At single band sweep, data point 1001
Resolution bandwidth (RBW) [3 dB bandwidth]	Setting range: 300 Hz to 3 MHz (1, 3 sequence), 5 MHz, 10 MHz, 20 MHz ∗Manually settable, or automatically settable according to frequency span Accuracy: ±20% (300 Hz to 10 MHz), ±40% (20 MHz) Selectivity (60 dB: 3 dB): ≤15 : 1		
Video bandwidth (VBW)	1 Hz to 3 MHz (1, 3 sequence), Off ∗Manually settable, or automatically settable according to RBW		
Signal purity	Noise sideband: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 100 kHz offset)		Noise sideband: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 10 kHz offset) Spurious resulting from local cause: ≤–65 dBc (at harmonic mixing order 1)
Reference oscillator	Frequency: 10 MHz Start-up characteristics: ≤5 x 10^{-8} (after 10 minutes warm-up, with frequency after 24 hours warm-up referenced) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (with frequency after 24 hours of warm-up referenced) Temperature characteristics: ±5 x 10^{-8} (0 to 50°C, with frequency at 25°C referenced)		
Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: Continuous average power: +30 dBm (RF ATT: ≥10 dB) Peak pulse input: +47 dBm (pulse width ≤1 µs, duty ratio ≤1%, RF ATT: ≥30 dB) DC voltage: 0 Vdc		
	Average noise level display RBW: 300 Hz, VBW: 1 Hz, RF ATT 0 dB, in Sample detection mode [Without option 08] ≤–124 dBm + f [GHz] dB (1 MHz to 2.5 GHz) ≤–120 dBm + f [GHz] dB (2.5 to 3.0 GHz) [With option 08] ≤–122 dBm + 1.5f [GHz] dB (1 MHz to 2.5 GHz) ≤–120 dBm + 1.5f [GHz] dB (2.5 to 3.0 GHz) Residual response: ≤–100 dBm (1 MHz to 3.0 GHz)	Average noise level display RBW: 300 Hz, VBW: 1 Hz, RF ATT 0 dB, in Sample detection mode [Without option 08] ≤–124 dBm + f [GHz] dB (1 MHz to 2.5 GHz, band 0) ≤–120 dBm + f [GHz] dB (2.5 to 3.2 GHz, band 0) ≤–122 dBm + 0.5f [GHz] dB (3.15 to 7.8 GHz, band 1) [With option 08] ≤–122 dBm + 1.5f [GHz] dB (1 MHz to 2.5 GHz, band 0) ≤–120 dBm + 1.5f [GHz] dB (2.5 to 3.2 GHz, band 0) ≤–122 dBm + 0.5f [GHz] dB (3.15 to 7.8 GHz, band 1) Residual response: ≤–100 dBm (1 MHz to 3.2 GHz, band 0), ≤–90 dBm (3.15 to 7.8 GHz, band 1)	Average noise level display RBW: 300 Hz, VBW: 1 Hz, RF ATT 0 dB, in SAMPLE detection mode ≤–124 dBm + f [GHz] dB (1 MHz to 2.5 GHz, band 0) ≤–120 dBm + f [GHz] dB (2.5 to 3.2 GHz, band 0) ≤–115 dBm (3.15 to 7.9 GHz, band 1) ≤–113 dBm (7.8 to 15.3 GHz, band 2) ≤–103 dBm (15.2 to 30.0 GHz, band 4) Residual response: RF ATT 0 dB, input terminated at 50 Ω ≤–100 dBm (1 MHz to 3.2 GHz, band 0), ≤–90 dBm (3.15 to 7.8 GHz, band 1)
Reference level	Setting range Log scale: –100 to +40 dBm, or equivalent level, Linear scale: 2.24 µV to 22.4 V Unit Log scale: dBm, dBµV, dBmV, dBµV (emf), W, V, dBµV/m Linear scale: V Reference level accuracy: ±0.5 dB (–49.9 to 0 dBm), ±0.75 dB (+0.1 to +30 dBm, –69.9 to –50 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, at 50 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (300 Hz to 5 MHz), ±0.5 dB (10, 20 MHz) ∗After calibration, with RBW 3 kHz referenced		
	Input attenuator (RF ATT) Setting range: 0 dB to 62 dB (2 dB step), manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (10 to 50 dB), ±0.5 dB (52 to 62 dB) ∗After calibration, with 50 MHz, RF ATT 10 dB referenced Input attenuator switching mode: 2, 10 dB step mode		Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB step), manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (10 to 50 dB), ±0.5 dB (50 to 70 dB) ∗With 50 MHz, RF ATT 10 dB referenced

Continued on next page

Name	MS2681A	MS2683A	MS2687B
Frequency response	±0.6 dB (9 kHz to 3.0 GHz) 50 MHz referenced (when RF ATT 10 dB, 18 to 28°C) ±1.0 dB (9 kHz to 3.0 GHz) *With 50 MHz referenced (when RF ATT 10 to 62 dB)	±0.6 dB (9 kHz to 3.2 GHz, band 0), ±1.0 dB (3.15 to 7.8 GHz, band 1) ±1.0 dB (option 03, 1.6 to 7.8 GHz, band 1) *With 50 MHz referenced (when RF ATT 10 dB, 18 to 28°C) ±1.0 dB (9 kHz to 3.2 GHz, band 0), ±2.0 dB (3.15 to 7.8 GHz, band 1) ±2.0 dB (1.6 to 7.8 GHz, band 1) *With 50 MHz referenced (when RF ATT 10 to 62 dB), after pre-selector tuning for band 1.	Relative flatness: at RF ATT 10 dB with the center point of frequency response in the band referenced ±1.0 dB (9 kHz to 3.2 GHz, band 0), ±1.5 dB (3.15 to 7.9 GHz, band 1), ±3.0 dB (7.8 to 15.3 GHz, band 2), ±4.0 dB (15.2 to 30 GHz, band 4) *After pre-selector tuning for band 1, 2, and 4 Absolute flatness: at RF ATT 10 dB with 50 MHz referenced ±5.0 dB (9 kHz to 30 GHz), *After pre-selector tuning for band 1, 2, and 4
Waveform display	Scale: 10 div (single scale) Log scale: 10, 5, 2, 1 dB/div, Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW ≤1 kHz), ±1.0 dB (0 to –70 dB, ≤1 kHz), ±1.2 dB (0 to –90 dB, ≤1 kHz) Linear scale: 4% of reference level Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02%		
Spurious response	2nd harmonic distortion: ≤–60 dBc (input frequency 10 to 200 MHz, Mixer input: –30 dBm) ≤–75 dBc (0.2 to 0.85 GHz, Mixer input: –30 dBm) ≤–70 dBc (0.85 to 1.5 GHz, Mixer input: –30 dBm) Two-signal third-order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 3.0 GHz) *Frequency difference of two signals: ≥50 kHz, Mixer input: –30 dBm Image response: ≤–70 dBc	2nd harmonic distortion: ≤–60 dBc (input frequency 10 to 200 MHz, Mixer input: –30 dBm) ≤–75 dBc (0.2 to 0.85 GHz, band 0, Mixer input: –30 dBm) ≤–70 dBc (0.85 to 1.6 GHz, band 0, Mixer input: –30 dBm) ≤90 dBc (1.6 to 3.9 GHz, band 1, Mixer input: –10 dBm) ≤–90 dBc (option 03, 0.8 to 3.9 GHz, band 1, Mixer input: –10 dBm) Two-signal third-order intermodulation distortion: ≤–70 dBc (10 to 100 MHz) ≤–85 dBc (0.1 to 7.8 GHz) *Frequency difference of two signals: ≥50 kHz, Mixer input: –30 dBm Image response: ≤–70 dBc	2nd harmonic distortion: ≤–60 dBc (input frequency 10 to 200 MHz, Mixer input: –30 dBm) ≤–70 dBc (0.2 to 1.6 GHz, band 0, Mixer input: –30 dBm) ≤–90 dBc or lower than average noise level (1.6 to 15 GHz, band 1, 2, and 4, Mixer input: –10 dBm) Two-signal third-order intermodulation distortion (Frequency difference of two signals: ≥50 kHz, Mixer input: –30 dBm): ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 3.2 GHz, band 0) ≤–80 dBc (3.15 to 7.9 GHz, band 1) ≤–75 dBc or lower than average noise level (7.8 to 22.5 GHz, band 2, 4) ≤–75 dBc or lower than average noise level (22.5 to 30 GHz, band 4, Typical) Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz) Multiple response/spurious outside the band: ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz)
1 dB gain compression	≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz)	≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz, band 1), ≥0 dBm (≥3.15 GHz, band 1) ≥0 dBm (option 03: ≥1.6 GHz, band 1)	≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz, band 0), ≥–5 dBm (≥3150 MHz, band 1, 2, and 4)
Maximum dynamic range	1 dB gain compression to average noise level [Without Option 08] ≥124 dB – f [GHz] dB, Reference value (0.1 to 3.0 GHz) [With Option 08] ≥122 dB – 1.5f [GHz] dB, Reference value (0.1 to 3.0 GHz)	1 dB gain compression to average noise level [Without option 08] ≥124 dB –f [GHz] dB,Reference value (0.1 to 3.2 GHz, band 0) ≥122 dB –0.5f [GHz] dB, Reference value (3.15 to 7.8 GHz, band 1) [With option 08] ≥122 dB –1.5f [GHz] dB, Reference value (0.1 to 3.2 GHz, band 0) ≥122 dB –0.5f [GHz] dB, Reference value (3.15 to 7.8 GHz, band 1)	—
Sweep mode	Continuous, single		
Sweep time	Setting range: 10 ms to 1000 s *Manually settable, or automatically settable according to RBW and VBW Set resolution: 5 ms (5 ms to 1 s), Top three digits (≥1 s) Accuracy: ±3%		
Trigger switch	Free run, triggered		
Trigger source	Wide IF video, external (TTL), external (±10 V), line		
Gate sweep mode	Off, random sweep mode Setting range Gate delay range: 0 to 65.5 ms (Resolution: 1 µs) Gate length range: 2 µs to 65.5 ms (Resolution: 1 µs), Gate end: Internal/external		
Zone sweep	Sweeps the indicated range in the zone only.	—	Sweeps the indicated range in the zone only.
Tracking sweep	Sweeps following the peak point inside the zone marker (zone sweep also available).	—	Sweeps following the peak point inside the zone marker (zone sweep also available).

Continued on next page

Name		MS2681A	MS2683A	MS2687B
Time sweep	Sweep mode	Continuous, single		
	Sweep time	Setting range/resolution: 1 to 50 µs (1, 2, 5 sequence), 100 µs to 4.9 ms (100 µs resolution), Sweep time: 5.0 ms to 1 s (5 ms resolution), 1 to 1000 s (setting of top three digits) Accuracy: ±1%		
	Trigger switch	Free run, triggered		
	Trigger source	Wide IF video, video, external (TTL), external (±10 V), line		
	Trigger delay	Pre-trigger (displays waveform before trigger occurrence point) Setting range: – time span to 0 s Trigger delay: Resolution: time span/500 or 100 ns, whichever is larger Post-trigger Setting range: 0 µs to 65.5 ms Resolution: 100 ns (sweep time: ≤4.9 ms), 1 µs (sweep time: ≥5 ms)		
Functions	Number of data points	Selectable between 501 and 1001		
	Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, AVERAGE		
	Display functions	TRACE A, TRACE B, TRACE A/BG, TRACE A/TIME Trace calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A		
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE		
	Marker	Signal search: AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL Zone marker: NORMAL, DELTA Marker functions: MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE ΔMARKER → SPAN, ZONE → SPAN Peak search: PEAK, NEXT PEAK, MIN DIP, NEXT DIP Multi marker: 10 max. (highest 10, harmonics, manually		
	Measure	Noise power: dBm/Hz, dBm/CH, dBµV/ $\sqrt{\text{Hz}}$ C/N: dBc/Hz, dBc/CH Occupied bandwidth: power N% method, X-dB down method Adjacent channel leakage power REF: total power/reference level/in-band level method Display: channel designate display: 3 channels x 2, graphic display Average power within burst signal: average power in the designated range of time domain waveform Template comparison (at time sweep): upper limit x 2, lower limit x 2 MASK (at frequency sweep): upper limit x 2, lower limit x 2		
	Correction	Frequency response can be corrected arbitrarily up to 150 points		
Others	Display	Color TFT-LCD, VGA 17 cm (6.5 type)		
	Color	Number of colors: 4096, RGB, each 16-scale settable		
	Intensity	Settable in 5 steps (display off included)		
	Contents	Scale, waveform data, setting condition, menu, title		
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card		
	Hard copy	Displayed data can be hard-copied with the printer via parallel interface (PCL level 3 or lower, or ESC/P-J83, J84 compatible models only)		
	GPIB	Meets IEEE488.2. Controllable with external controller (except for power switch) Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2		
	Parallel interface	Centronics-compatible, outputs print data to printer, D-sub 25 pin connector (jack) Data line exclusive for output: 8, Control line: 4 (BUSY, $\overline{\text{DTSB}}$, $\overline{\text{ERROR}}$, PE)		
	PC card interface	Saves and recalls setting condition and waveform data, ATA flash card accessible (3.3 V/5 V), Connector: Type I or Type II of PC card		
	RS-232C	Controllable with external controller (except for power switch) Baud rate: 1200, 2400, 4800, 9600, 19.2 k, 38.4 k, 56 k, 115 kbps		
Input/output connector		Input connector: N-J, 50 Ω nominal value Impedance: VSWR ≤1.5 Typical (RF ATT ≥10 dB) Video output: outputs analog RGB, D-sub 15-pin connector (jack) IF output: BNC connector, 50 Ω nominal value, 66/10.69 MHz Level: –10 dBm Typical (frequency 50 MHz, display scale upper edge, 50 Ω terminated) Broadband IF output: BNC connector, 50 Ω nominal value, 60.69/66 MHz Gain: 0 dB Typical (50 MHz, RF ATT: 0 dB, for RF input level) Video output (Y): BNC connector Input/output connector Level: 0 to 0.5 V ± 0.1 V Typical (log scale), 0 to 0.4 V ± 0.1 V Typical (linear scale), (50 MHz, from upper edge to lower edge at 10 dB/div or 10%/div, 75 Ω terminated) Buffered Output: BNC connector, Level: 2 to 5 V (p-p) (200 Ω terminated) Sweep Output (X): BNC connector, Level: 0 to 10 V ± 0.1 V (100 kΩ termination, from the left edge to the right edge of the display scale, single band sweep) Sweep Status Output (Z): BNC connector, Level: TTL (low level at sweep) Probe source: 4-pole connector, +12 V, –12 V, ±10% each, 110 mA max. each. Trig/Gate input: BNC connector, level: ±10 V (0.1 V resolution), or TTL level External reference input: BNC connector, Frequency: 10 MHz ±10 Hz, 13 MHz ±13 Hz, level: ≥0 dBm		
Dimensions and mass		320 (W) x 177 (H) x 411 (D) mm (handle, leg, front cover, fan cover excluded), ≤16 kg (nominal value)		
Power		100 to 120/200 to 240 VAC (–15%/+10%, 250 V max., wide range input) 47.5 Hz to 63 Hz, ≤400 VA		
Ambient temperature and humidity		0° to +50°C, RH ≤85% (no condensation allowed)		
Storage temperature range		–20° to +60°C		

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Name	MS2681A	MS2683A	MS2687B
EMC	EN61326: 1997/A1: 1998 (Class A), EN61000-3-2: 1995/A2: 1998 (Class A), EN61326: 1997/A1: 1998 (Annex A)		
LVD	EN61010-1: 1993/A2: 1995 (Installation Category Ⅱ, Pollution degree 2)		

MS2687B Mainframe specifications when external mixer is used.

<table>
<tr><td rowspan="2">External Mixer</td><td>Frequency</td><td>Frequency range: 18 to 110 GHz
Frequency band:
<table>
<tr><th>Band</th><th>Frequency range</th><th>Mixer harmonics order [N]</th></tr>
<tr><td>K</td><td>18 to 26.5 GHz</td><td>4</td></tr>
<tr><td>Ka</td><td>26.5 to 40 GHz</td><td>6</td></tr>
<tr><td>Q</td><td>33 to 55 GHz</td><td>8</td></tr>
<tr><td>U</td><td>40 to 60 GHz</td><td>9 or 10</td></tr>
<tr><td>V</td><td>50 to 75 GHz</td><td>11 or 12</td></tr>
<tr><td>E</td><td>60 to 90 GHz</td><td>13 or 14</td></tr>
<tr><td>W</td><td>75 to 110 GHz</td><td>16</td></tr>
</table></td></tr>
<tr><td>Span setting range</td><td>0 Hz, (100 x N) Hz to each bandwidth</td></tr>
<tr><td rowspan="4">Amplitude</td><td>Mixer transform loss setting range</td><td>15 to 85 dB</td></tr>
<tr><td>Maximum input level</td><td>Depend of external mixer</td></tr>
<tr><td>Average noise level</td><td>Depend of external mixer</td></tr>
<tr><td>Frequency response</td><td>Depend of external mixer</td></tr>
<tr><td rowspan="4">Input/Output</td><td>Adaptive mixer</td><td>Only 2 port mixer</td></tr>
<tr><td>Local frequency</td><td>4 to 7 GHz</td></tr>
<tr><td>IF frequency</td><td>460.69 or 466 MHz</td></tr>
<tr><td>Display gain</td><td>0 ±2 dB (External mixer input level –10 dBm, Mixer transform loss 15 dB)</td></tr>
</table>

• MS2681A Options

Option 01: Precision frequency reference oscillator

Frequency	10 MHz
Start-up characteristics	≤5 x 10^{-8} (≤7 minutes, 25˚C, Typical value)
Aging rate	≤±5 x 10^{-10}/day (With the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	≤±5 x 10^{-10} (With the frequency at 0 to +50˚C and +25˚C referenced)

Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz), ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	When RBW is 1 Hz and RF ATT is 0 dB [Without Option 08] ≤–148.3 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz), ≤–146.3 dBm + f [GHz] dB Typical (2.5 to 3.0 GHz) [With Option 08] ≤–146.3 dBm + 1.5f [GHz] dB Typical (1 MHz to 2.5 GHz), ≤–144.3 dBm + 1.5f [GHz] dB Typical (2.5 to 3.0 GHz)

Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW: ≥100 Hz), ±10% NOMINAL (RBW: ≤30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW ≥100 Hz), ≤5:1 NOMINAL (RBW: ≤30 Hz) RBW switching uncertainty: 0.5 dB
Span setting	Minimum span setting: 1 kHz
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level	When RBW is 10 Hz and RF ATT is 0dB [Without Option 08] ≤–136.5 dBm + f [GHz] dB NOMINAL (1 MHz to 2.5 GHz), ≤–132.5 dBm + f [GHz] dB NOMINAL (2.5 to 3.0 GHz) [With Option 08] ≤–134.5 dBm + 1.5 x f [GHz] dB Typical (1 MHz to 2.5 GHz), ≤–130.5 dBm + 1.5 x f [GHz] dB Typical (2.5 to 3.0 GHz)

Option 08: Pre-amplifier[*1]

Frequency range	100 kHz to 3 GHz
Gain	20 dB Typical
Noise figure	6.5 dB Typical (input frequency ≤2 GHz), 12 dB Typical (input frequency >2 GHz)
Level measurement range	Average noise level display to +10 dBm
Max. input level	CW average power: +10 dBm
Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent, Linear scale: 2.24 µV to 707 mV Reference level accuracy: ±0.9 dB (–69.9 to +10 dBm), ±1.5 dB (–90 to –70 dBm) ∗After calibration, with 50 MHz referenced, 1 MHz span (RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB (300 Hz to 5 MHz), ±0.75 dB (10 MHz, 20 MHz) RF ATT switching uncertainty: ±0.5 dB (10 to 50 dB), ±0.75 dB (52 to 62 dB) ∗With 50 MHz and RF ATT 10 dB referenced
Average noise level display	–137 dBm + 2.0 x f [GHz] dB (1 MHz to 3.0 GHz) ∗When RBW is 300 Hz, VBW is 1 Hz, RF ATT is 0 dB, and detection mode is set to SAMPLE
Frequency response	±2.0 dB (100 kHz to 3.0 GHz) ∗With 50 MHz referenced, when RF ATT is 10 dB to 50 dB, and temperature is +18˚ to +28˚C
Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB, RBW ≤1 kHz), ±1.0 dB (0 to –60 dB, RBW ≤1 kHz), ±1.5 dB (0 to –75 dB, RBW ≤1 kHz) Linear scale (after calibration): ±5% (relative to reference level)
Spurious response	≤–70 dBc (10 MHz to 3 GHz) ∗Frequency difference of two signals ≥50 kHz, At pre-amplifier input level of –55 dBm[*2]
1 dB gain compression	≥–35 dBm (input frequency ≥100 MHz) ∗At pre-amplifier input level

∗1 : Overall specification with pre-amplifier ON (Noise figure and gain are single performance of pre-amplifier.)
∗2 : Pre-amplifier input level is shown by the following equation: Pre-amplifier input level = RF input level – RF ATT setting level

Option 09: Ethernet interface

Function	Control with external controller (except for power switch)
Connector	10base-T

Option 17: I/Q balanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) In-phase voltage range: ±2.5 V (at input terminal)

Option 18: I/Q unbalanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) Changeable between DC connection and AC connection

Option 46: Auto power recovery

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. ∗Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

Option 47: Rack mount (IEC)

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Option 48: Rack mount (JIS)

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

• MS2683A Options

Option 01: Precision frequency reference oscillator

Frequency	10 MHz
Start-up characteristics	≤5 x 10^{-8} (≤7 minutes, 25°C, Typical value)
Aging rate	≤±5 x 10^{-10}/day (With the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	≤±5 x 10^{-10}/day (With the frequency at 0˚ to 50˚C and 25˚C referenced)

Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz), ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	When RBW is 1 Hz and RF ATT is 0 dB [Without Option 08] ≤–146.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–142.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–144.5 dBm + 0.5f [GHz] dB Typical (3.15 to 7.8 GHz, band 1) [With Option 08] ≤–144.5 dBm + 1.5f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–140.5 dBm + 1.5f [GHz] dB Typical (2.5 to 3.2 GHz, band 1) ≤–138.5 dBm + 0.5f [GHz] dB Typical (3.15 to 7.8 GHz, band 1)

Option 03: Extension of pre-selector lower limit to 1.6 GHz

Function	Extends the lowest frequency of pre-selector from 3.15 to 1.6 GHz
Frequency band	0 band: 9 kHz to 3.2 GHz, 1–L band: 1.6 to 3.2 GHz, 1– band: 3.15 to 6.3 GHz, 1+ band: 6.2 to 7.8 GHz
Pre-selector range	1.6 to 7.8 GHz (band: 1–L, 1–, 1+)
Average noise level	≤–122 dBm + 0.5f [GHz] dB (1.6 to 7.8 GHz, band 1, RBW: 300 Hz, VBW: 1 Hz, RF ATT: 0 dB)
Residual response	≤–90 dBm (1.6 to 7.8 GHz, band 1, RF ATT: 0 dB, input terminated at 50 Ω)
Frequency response	±1.0 dB (with 1.6 to 7.8 GHz, band 1, and 50 MHz referenced, when RF ATT is 10 dB and temperature is +18˚ to +28˚C) ±2.0 dB (1.6 to 7.8 GHz, band 1, RF ATT: 10 dB to 62 dB) *After pre-selector tuning for band 1
2nd harmonic distortion	≤–90 dBc (0.8 to 3.9 GHz, band 1, mixer input: –10 dBm)
1 dB gain compression	≥0 dBm (1.6 to 7.8 GHz, band 1)
Maximum dynamic range	≥–122 dB + 0.5f [GHz] dB (1.6 to 7.8 GHz, band 1)

Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW: ≥100 Hz), ±10% NOMINAL (RBW: ≥30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW: ≥100 Hz), ≤5:1 NOMINAL (RBW: ≤30 Hz) RBW switching uncertainty: 0.5 dB
Span setting	Minimum span setting: 1 kHz
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level	When RBW is 10 Hz and RF ATT is 0 dB [Without Option 08] ≤–136.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–134.5 dBm + 0.5f [GHz] dB Typical (3.15 to 7.8 GHz, band 1) [With Option 08] ≤–134.5 dBm + 1.5 x f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–130.5 dBm + 1.5 x f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–134.5 dBm + 0.5 x f [GHz] dB Typical (3.15 to 7.8 GHz, band 1)

Option 08: Pre-amplifier[*1]

Frequency range	100 kHz to 3 GHz
Gain	20 dB Typical
Noise figure	6.5 dB Typical (input frequency ≤2 GHz), 12 dB Typical (input frequency >2 GHz)
Level measurement range	Average noise level display to +10 dBm
Max. input level	CW average power: +10 dBm
Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent, Linear scale: 2.24 µV to 707 mV Reference level accuracy: ±0.9 dB (–69.9 to +10 dBm), ±1.5 dB (–90 to –70 dBm) *After calibration, with 50 MHz referenced, 1 MHz span (RF, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB (300 Hz to 5 MHz), ±0.75 dB (10 MHz, 20 MHz) RF ATT switching uncertainty: ±0.5 dB (10 to 50 dB), ±0.75 dB (52 to 62 dB) *With 50 MHz referenced, when RF ATT is 10 dB
Average noise level display	–137 dBm + 2.0 x f [GHz] dB (1 MHz to 2.5 GHz, band 0) *When RBW is 300 Hz, VBW is 1 Hz, RF ATT is 0 dB, and detection mode set to SAMPLE
Frequency response	±2.0 dB (100 kHz to 3.0 GHz) *With 50 MHz referenced, when RF ATT is 10 dB to 50 dB, and temperature is +18˚ to +28˚C
Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB, RBW: ≤1 kHz), ±1.0 dB (0 to –60 dB, RBW: ≤1 kHz), ±1.5 dB (0 to –75 dB, RBW: ≤1 kHz) Linear scale (after calibration): ±5% (relative to reference level)
Spurious response	≤–70 dBc (10 MHz to 3 GHz) *Frequency difference of two signals ≥50 kHz, At pre-amplifier input level of –55 dBm[*2]
1 dB gain compression	≥–35 dBm (input frequency ≥100 MHz) *At pre-amplifier input level

*1 : Overall specification with pre-amplifier ON (Noise figure and gain are single performance of pre-amplifier.)
*2 : Pre-amplifier input level is shown by the following equation: Pre-amplifier input level = RF input level – RF ATT setting level

Option 09: Ethernet interface

Function	Exercises control with external controller (except for power switch)
Connector	10base-T

Option 17: I/Q balanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) In-phase voltage range: ±2.5 V (at input terminal)

Option 18: I/Q unbalanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) Changeable between DC connection and AC connection

Option 34: 4 GHz LO output

Frequency	Frequency: 4 GHz Frequency accuracy: ± (4 GHz x reference frequency accuracy) ±1 Hz
Output level	–10 dBm Typical
Spurious	≤–40 dBc Typical

Option 46: Auto power recovery

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. *Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

Option 47: Rack mount (IEC)

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Option 48: Rack mount (JIS)

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

• MS2687B Options

Option 01: Precision frequency reference oscillator

Frequency	10 MHz
Start-up characteristics	$\leq 5 \times 10^{-8}$ ($\leq$7 min. 25˚C, Typical)
Aging rate	$\leq \pm 5 \times 10^{-10}$/day (With the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	$\leq \pm 5 \times 10^{-10}$ (With the frequency at 0 to +50˚ and +25˚C referenced)

Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz) ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	When RBW is 1 Hz, RF ATT is 0 dB ≤–146.5 dBm + 1.5f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–142.5 dBm + 1.5f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–137.5 dBm Typical (3.15 to 7.9 GHz, band 1) ≤–129.5 dBm Typical (7.8 to 15.2 GHz, band 2) ≤–125.5 dBm Typical (15.1 to 22.5 GHz, band 3) ≤–118.5 dBm Typical (22.4 to 30 GHz, band 4)

Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW ≥100 Hz) ±10% Typical (RBW ≤30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW ≥100 Hz) ≤5:1 Typical (RBW ≤30 Hz) RBW switching uncertainty: ±0.5 dB
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level	When RBW is 10 Hz, RF ATT is 0 dB ≤–136.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–127.5 dBm Typical (3.15 to 7.9 GHz, band 1) ≤–119.5 dBm Typical (7.8 to 15.2 GHz, band 2) ≤–115.5 dBm Typical (15.1 to 22.5 GHz, band 3) ≤–108.5 dBm Typical (22.4 to 30 GHz, band 4)

Option 05: Rubidium reference oscillator*

Frequency	10 MHz
Start-up characteristics	$\pm 1 \times 10^{-9}$/7 min. (with frequency one hour after the power is turned on referenced)
Aging rate	$\pm 1 \times 10^{-10}$/month (with frequency one hour after the power is turned on referenced)
Temperature characteristics	$\pm 1 \times 10^{-9}$/day (with frequency at 0˚ to +45˚C and +25˚C referenced)
Accessories	J1066 coaxial code 0.15 m (BNC211-LP4)

* Can not be installed with option 22

Option 09: Ethernet interface

Function	Control with external controller (except for power switch)
Connector	10base-T

Option 18: I/Q unbalanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 to 1 Vp-p (at input terminal) Changeable between DC connection and AC connection

Option 21: Power meter function

Frequency range	100 kHz to 32 GHz
Level range	–10 to +20 dBm
Applicable power sensor	MA4601A, MA4701A, MA4703A, MA4705A
Display	Selectable from W, dBm, and dB (RELATIVE), Digital 4 digit display, 20% over range, Power range: 4 range/10 dB step (Measurement level range is listed on the power sensor specifications.)
Range switching	Auto, manual (settable to arbitrary range irrespective of range hold or input level)
Accuracy	±0.7% (W mode), ±0.03 dB [dBm mode, dB (RELATIVE) mode] ∗ Pressing ZERO ADJ key allows automatic adjustment to zero point.
Zero setting	±0.5% of full scale Typical value (100 µW range of maximum sensitivity)
Zero move between ranges	±0.2% (after zero setting at 100 µW range of maximum sensitivity)
Calibration oscillator frequency	50 MHz
Calibration oscillator level	1 mW ± 1.2% (for one year)
Averaging	Sample rate time settable in 4 steps

Option 34: 4 GHz LO output

Frequency	Frequency: 4 GHz Frequency accuracy: ± (4 GHz x reference frequency accuracy) ±1 Hz
Output level	–10 dBm Typical
Spurious	≤–40 dBc Typical

Option 46: Auto power recovery

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. ∗ Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

Option 47: Rack mount (IEC)

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Option 48: Rack mount (JIS)

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MS2681A	Spectrum Analyzer
MS2683A	Spectrum Analyzer
MS2687B	Spectrum Analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
J0996B	RS-232C cable: 1 pc
JT32MA3-NT1	PC-ATA card (32 MB): 1 pc
F0014	Fuse, 6.3 A: 1 pc
MX268001A	File Transfer Utility: 1 pc
W1754AE	MS2681A/2683A/2687B operation manual: 1 copy
	Options
MS2681A-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)
MS2681A-02	Narrow resolution bandwidths (FFT)
MS2681A-04	Digital resolution bandwidth
MS2681A-08	Pre-amplifier
MS2681A-09	Ethernet interface
MS2681A-17	I/Q balanced input
MS2681A-18	I/Q unbalanced input
MS2681A-46	Auto power recovery
MS2681A-47	Rack mount (IEC) without handles
MS2681A-48	Rack mount (JIS) without handles
MS2683A-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)
MS2683A-02	Narrow resolution bandwidths (FFT)
MS2683A-03	Extension of pre-selector lower limit to 1.6 GHz
MS2683A-04	Digital resolution bandwidth
MS2683A-08	Pre-amplifier
MS2683A-09	Ethernet interface
MS2683A-17	I/Q balanced input
MS2683A-18	I/Q unbalanced input
MS2683A-34	4 GHz LO output
MS2683A-46	Auto power recovery
MS2683A-47	Rack mount (IEC) without handles
MS2683A-48	Rack mount (JIS) without handles
MS2687B-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)
MS2687B-02	Narrow resolution bandwidths (FFT)
MS2687B-04	Digital resolution bandwidth
MS2687B-05	Rubidium reference oscillator
MS2687B-09	Ethernet interface
MS2687B-18	I/Q unbalanced input
MS2687B-21	Power meter function
MS2687B-34	4 GHz LO output
MS2687B-46	Auto power recovery
MS2687B-47	Rack mount (IEC) without handles
MS2687B-48	Rack mount (JIS) without handles
	Measurement software
MX268101B	W-CDMA Measurement Software (for MS2681A)
MX268301B	W-CDMA Measurement Software (for MS2683A)
MX268701B	W-CDMA Measurement Software (for MS2687B)
W1746AE	W-CDMA Measurement Software operation manual (MS2681A/2683A/2687B Common)
MX268102A	GSM Measurement Software (for MS2681A)
MX268302A	GSM Measurement Software (for MS2683A)
MX268702A	GSM Measurement Software (for MS2687B)
W1854AE	GSM Measurement Software operation manual (MS2681A/2683A/2687B Common)

Continued on next page

Model/Order No.	Name
MX268103A	cdma Measurement Software (for MS2681A)
MX268303A	cdma Measurement Software (for MS2683A)
MX268703A	cdma Measurement Software (for MS2687B)
W1865AE	cdma Measurement Software operation manual (MS2681A/2683A/2687B Common)
MX268104A	1xEV-DO Measurement Software (for MS2681A)
MX268304A	1xEV-DO Measurement Software (for MS2683A)
MX268704A	1xEV-DO Measurement Software (for MS2687B)
W2090AE	1xEV-DO Measurement Software operation manual (MS2681A/2683A/2687B Common)
MX268105A	π/4DQPSK Measurement Software (for MS2681A)
MX268305A	π/4DQPSK Measurement Software (for MS2683A)
MX268705A	π/4DQPSK Measurement Software (for MS2687B)
W1866AE	π/4DQPSK Measurement Software operation manual (MS2681A/2683A/2687B Common)
MX268130A	WIRELESS LAN Measurement Software (for MS2681A)
MX268330A	WIRELESS LAN Measurement Software (for MS2683A)
MX268730A	WIRELESS LAN Measurement Software (for MS2687B)
W2080AE	WIRELESS LAN Measurement Software operation manual (MS2681A/2683A/2687B Common)
	Application parts
J0576D	Coaxial cord (N-P, 5D-2W, N-P), 2 m
J0561	Coaxial cord (N-P, 5D-2W, N-P), 1 m
J0104A	Coaxial cord (BNC-P, RG-55/U, BNC-P), 1 m
J0127C	Coaxial cord (BNC-P, RG-58A/U, BNC-P), 0.5 m
J0127A	Coaxial cord (BNC-P, RG-58A/U, BNC-P), 1 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J1047	Ethernet cross cable
MA1612A	Four-port Junction Pad (5 MHz to 3000 MHz)
MA1621A	50 Ω → 75 Ω Impedance Transformer (75 Ω, 9 kHz to 3 GHz, ±100 V, NC-type)
MP614B	50↔70 Ω Impedance Converter (50 to 1200 MHz, 1.5 dB or lower)
J0395	Fixed attenuator for high-power (30 dB, 30 W, DC to 9 GHz)
B0472	Fixed attenuator for high-power (30 dB, 100 W, DC to 18 GHz)
J0078	High power attenuator (N type, 20 dB, 10 W, DC to 18 GHz)
34AKNF50	Ruggedized K-to-Type N Adapter
MA2507A	DC Block Adaptor (50 Ω, 9 kHz to 3 GHz, ±50 V)
J0805	DC block, N type (10 kHz to 18 GHz, made by Wineshell)
B0452A	Hard carrying case (with casters)
B0452B	Hard carrying case (without casters)
B0488	Rear panel protective pad
W1888AE	Assembling guide drawing for rear protective pad (supplied with B0488 as standard)
B0481B	Carrybone
B0479	Soft carrying case (rucksack type)
MA4601A	Power Sensor (100 kHz to 5.5 GHz, –30 to +20 dBm, N connector)
MA4701A	Power Sensor (10 MHz to 18 GHz, –30 to +20 dBm, N connector)
MA4703A	Power Sensor (50 MHz to 26.5 GHz, –30 to +20 dBm, APC3.5(P) connector)
MA4705A	Power Sensor (50 MHz to 32 GHz, –30 to +20 dBm, APC3.5(P) connector)
J0370A	Sensor connecting cord, 1.5 m (attached to a power meter option)
J0370C	Sensor cord, 2.5 m (attached to a power meter option)
J0370E	Sensor cord, 5 m (attached to a power meter option)
J0370G	Sensor cord, 10 m (attached to a power meter option)
MA2741A	External Mixer (26.5 to 40 GHz)
MA2742A	External Mixer (33 to 50 GHz)
MA2743A	External Mixer (40 to 60 GHz)
MA2744A	External Mixer (50 to 75 GHz)
MA2745A	External Mixer (60 to 90 GHz)
MA2746A	External Mixer (75 to 110 GHz)
J0364	APC-3.5 to N conversion connector (for MA4703A and MA4605A)
	Warranty
MS2681A-90	Extended three year warranty service
MS2681A-91	Extended five year warranty service
MS2683A-90	Extended three year warranty service
MS2683A-91	Extended five year warranty service
MS2687B-90	Extended three year warranty service
MS2687B-91	Extended five year warranty service

SPECTRUM ANALYZER

MS2668C

9 kHz to 40 GHz

GPIB

For Measuring High-Speed Communications, such as MMAC and ITS

In recent wireless communication market, the utilization of microwave/millimeter wave band frequencies is being considered in order to realize high-speed and large-capacity data communication. In the markets of ITS and ultrahigh-speed wireless LAN, aiming for the speedup of wireless LAN which began to be spread as a typical application, millimeter wave band is used for realizing collision avoidance radar.
MS2668C is a portable and high-performance spectrum analyzer that has various radio evaluation functions for microwave/millimeter wave devices and systems.

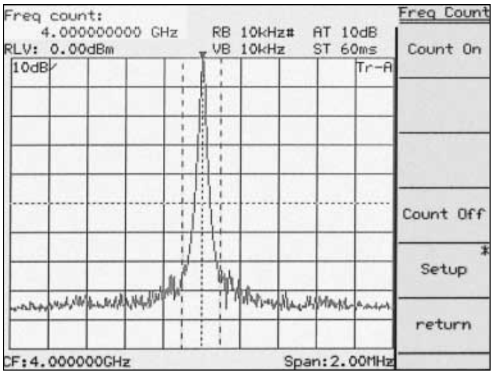
Features

- Compact and lightweight (15 kg in standard configuration)
- High C/N and superior distortion characteristics
- Easy-to-use, simple operation
- Millimeter wave applications
- Options support wide range of applications

Performance and functions

- **Counter with 1 Hz resolution**

A full complement of frequency counter functions are provided. Resolution is as high as ±1 Hz even at full span, and high-speed frequency measurements can be performed. The high sensitivity compared with ordinary counters makes it easy to select one signal from many and to determine its frequency.

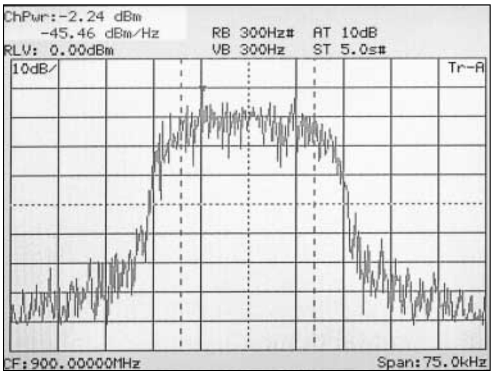


```
Freq count:
   4.000000000 GHz   RB 10kHz#  AT 10dB
RLV: 0.00dBm         VB 10kHz   ST 60ms
10dB/                                Tr-A
CF:4.000000GHz                 Span:2.00MHz
```

Frequency measurement (1 Hz resolution)

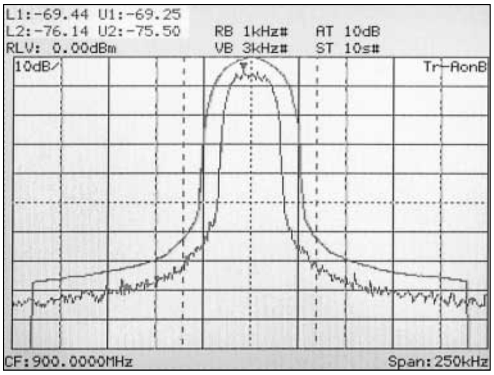
- **Radio equipment evaluation functions (“measure” functions)**

A full range of functions including measurement of power levels, frequencies, adjacent channel power, and mask and time template measurements are provided for performance evaluation of radio equipment. Key operation is simple and high-speed calculations make the measurement fast and efficient.



```
ChPwr:-2.24 dBm
  -45.46 dBm/Hz      RB 300Hz#  AT 10dB
RLV: 0.00dBm         VB 300Hz   ST 5.0s#
10dB/                                Tr-A
CF:900.00000MHz               Span:75.0kHz
```

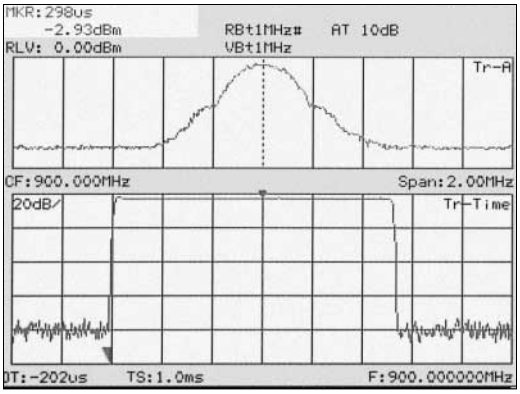
Channel power measurement



```
L1:-69.44 U1:-69.25
L2:-76.14 U2:-75.50  RB 1kHz#   AT 10dB
RLV: 0.00dBm         VB 3kHz#   ST 10s#
10dB/                              Tr-AonB
CF:900.0000MHz                 Span:250kHz
```

Adjacent channel power measurement

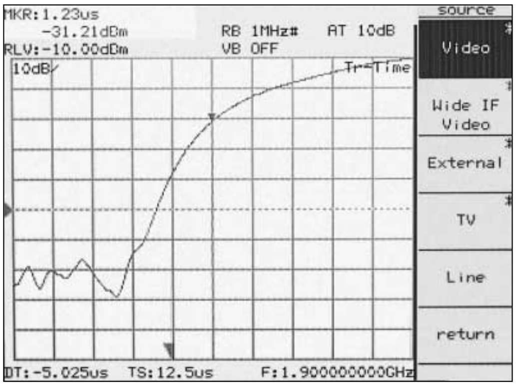
• Multi-screen display
The Trace A and Trace B waveforms are superimposed on the same screen, and two spectra with different frequencies are displayed simultaneously. In addition, it is possible to simultaneously display spectrum and time domain screens for the same signal. The multi-screen display permits efficient signal level adjustment and harmonic distortion measurement, too.
In addition to being able to display amplitude in the time domain, it is possible to display the FM demodulation waveform.



Spectrum and time domain measurement

• For testing digital mobile communication equipment

High-speed time domain sweep (Option 04)
Testing of TDMA-type radio equipment requires time domain (zero-span) measurements of antenna power, transient response characteristics of burst transmissions, transmission timing, and other characteristics. The high-speed time domain sweep option boosts sweep time to 12.5 µs and resolution to 0.025 µs. This option must be used with the trigger/gate circuit (Option 06).



High-speed time domain measurement (TS = 12.5 µs)

Specifications

Except where noted otherwise, specified values were obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 40 GHz
	Frequency band	Band 0: 0 kHz to 3.2 GHz (n = 1), Band 1–: 3.1 to 5.6 GHz (n = 1), Band 1+: 5.4 to 8.1 GHz (n = 1), Band 1+: 8.0 to 14.3 GHz (n = 2), Band 2–: 14.1 to 26.5 GHz (n = 4), Band 3–: 26.2 to 40 GHz (n = 6) ∗n: local harmonic order
	Pre-selector range	3.1 to 40 GHz
	Frequency setting resolution	(1 x n) Hz ∗n: local harmonic order
	Frequency display accuracy	± (display frequency x reference frequency accuracy + span x span accuracy)
	Marker frequency display accuracy	Normal marker: Same as display frequency accuracy Delta marker: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, (100 x n) Hz to 40.0 GHz ∗n: local harmonic order Accuracy: ±5%
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) Option 02: 30 Hz, 100 Hz, and 300 Hz are added Option 03: 10, 30, 100, 300 Hz are added Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF ∗Manually settable, or automatically settable according to RBW
	Signal purity and stability	Noise sidebands: ≤ –95 dBc/Hz + 20 log n (1 MHz to 40 GHz, 10 kHz offset) ∗n: local harmonic order Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 x n Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1-hour warm-up at constant ambient temperature; n: local harmonic order
	Reference oscillator	Frequency: 10 MHz Start-up characteristics: ≤5 x 10^{-8} /year (after 10 minutes warm-up, referenced to frequency after 24 hours warm-up) Aging rate: ≤1 x 10^{-7} /year, ≤1 x 10^{-8} /day Temperature characteristics: ±5 x 10^{-8} (0° to 50°C, referenced to frequency at 25°C)
	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz), ≤–114 dBm (3.1 to 8.1 GHz), ≤–113 dBm (8.0 to 14.3 GHz), ≤–105 dBm (14.1 to 26.5 GHz), ≤–101 dBm (26.2 to 40 GHz) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–90 dBm (RF ATT: 0 dB, input: 50 Ω terminated, 1 MHz to 8.1 GHz)

Continued on next page

Frequency	Reference level	Setting range Log scale: –100 to +30 dBm, Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) ∗After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) ∗Manual settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) ∗After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
Amplitude	Frequency response	Relative: ±1.5 dB (9.0 kHz to 3.2 GHz), ±1.0 dB (100 kHz to 3.2 GHz), ±1.5 dB (3.1 to 8.1 GHz), ±3.0 dB (8.0 to 14.3 GHz), ±4.0 dB (14.1 to 26.5 GHz), ±4.0 dB (26.2 to 40 GHz) ∗After pre-selector tuning at microwave band, referenced to midpoint between highest and lowest frequency deviation in each band. Absolute: ±5.0 dB (9 kHz to 40 GHz, RF ATT: 10 dB, referenced to 100 MHz) ∗After pre-selector tuning at microwave band
	Waveform display	Scale (10 div.) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, mixer input: –30 dBm), ≤–70 dBc (0.2 to 1.55 GHz, mixer input: –30 dBm), ≤–90 dBc or noise level (1.55 to 20 GHz, mixer input: –10 dBm) Two signal 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz), ≤–75 dBc or average noise level (8.1 to 26.5 GHz), ≤–75 dBc or average noise level (typical, 26.5 to 40 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤40 GHz) Multiple/out of band response: ≤–70 dBc(≤14 GHz), ≤–60 dBc (≤26 GHz), ≤–55 dBc (≤40 GHz)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input)
Sweep	Sweep time	Setting range: 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW, and VBW) Accuracy: ±15% (20 ms to 100 s), ±25% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zero sweep	Sweeps only in frequency range indicated by zone marker.
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible).
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points. POS PEAK: Displays max. point between sample points. NEG PEAK: Displays min. point between sample points. SAMPLE: Displays momentary value at sample points. Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 14 cm, Number of colors: 17 (RGB, each 64-scale settable), Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum. Trace B: Displays frequency spectrum. Trace Time: Displays time domain waveform at center frequency. Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies. Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously. Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously. Trace move/calculation: A → B, B → A, A ⟷ B, A + B → A, A — B → A, A — B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled, RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≤50 kHz/div, VBW: off, at 3 dB bandwidth) ∗RBW: ≥1 kHz to 3 MHz usable
	Input connector	K-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: –10 dBm (typical, 100 MHz, upper edge of scale, 50 Ω terminated), 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ± 0.1 V (typical, from lower edge to upper edge at 10 dB/div) 0 to 0.4 V± 0.1 V (typical, from lower edge to upper edge at 10%/div) BNC connector ∗75 Ω terminated at 100 MHz input COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ± 10 Hz, –10 to +2 dBm (50 Ω terminated), BNC connector REF BUFFERED OUTPUT: ≥0 dBm (50 Ω terminated), BNC connector 1ST LOCAL OUTPUT: 4 to 7 GHz, ≥+8 dBm, 50 Ω, SMA-J connector

Continued on next page

Functions	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, Δ MARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves setting conditions and waveform data to internal memory (max. 12) or memory card.
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB and Centronics (Option 10) interface. Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface.
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer. Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch).
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA. Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) ∗Typical value
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM (Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS.) Connector: Meets the PCMCIA Rel. 2.0; 2 slots
External mixer	Frequency	Frequency range: 18 to 110 GHz Frequency band configuration Band K: 18 to 26.5 GHz (n = 4), Band A: 26.5 to 40 GHz (n = 6), Band Q: 33 to 50 GHz (n = 8), Band U: 40 to 60 GHz (n = 9), Band V: 50 to 75 GHz (n = 11), Band E: 50 to 90 GHz (n = 13), Band W: 75 to 110 GHz (n = 16) Span setting range: 0 Hz, (100 x n) Hz to each bandwidth ∗n: local harmonic order
	Amplitude	Level measurement Mixer conversion loss setting range: 15 to 85 dB Maximum input level: Depends on the external mixer used Average noise level: Depends on the external mixer used Reference level setting range: –100 dBm to (–25 to M) dBm ∗Log scale, M: mixer conversion loss Frequency response: Depends on the external mixer used
	Input/output	Suitable mixer: 2-port mixer only (local frequency: 4 to 7 GHz, IF frequency: 689.31 MHz) Display gain: 0 ±2 dB (external mixer input: –10 dBm, when the mixer conversion loss is 15 dB)
Others	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, ≤400 VA
	Dimensions and mass	320 (W) x 177 (H) x 381 (D) mm, ≤15 kg (without option)
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz reference)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB : 3 dB)	≤15:1

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable), 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	Log scale: 0.1 dB Linear scale: 0.2% (relative to reference level)

• Option 03: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	10 Hz, 30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz reference)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB : 3 dB)	≤15:1
Average noise level	≤–135 dBm (1 MHz to 1 GHz), ≤–135 dBm + 1.5f [GHz] dB (1 to 3.1 GHz), ≤–132 dBm (3.1 to 8.1 GHz), ≤–131 dBm (8.0 to 14.3 GHz), ≤–123 dBm (14.1 to 26.5 GHz), ≤–119 dBm (26.2 to 40 GHz) ∗RBW: 10 Hz, VBW: 1 Hz, RF ATT: 0 dB

• Option 06: Trigger/gate circuit

Trigger switch	FREERUN, TRIGGERED
Trigger source	EXT Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/fall Connector: BNC VIDEO Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/fall WIDE IF VIDEO Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/fall LINE Frequency: 47.5 to 63 Hz (line lock)
Trigger delay	Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s, Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms, Resolution: 1 µs
Gate sweep	In frequency domain, displays spectrum of input signal in specified gate interval. Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface*1

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

∗1: GPIB interface can not be installed simultaneously.

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• External mixer

Models	Frequency range	Flange	Max. input power
MA2740A	18 to 26.5 GHz	MIL-F-3922/68-001KM	100 mW
MA2741A	26.5 to 40 GHz	MIL-F-3922/68-001AM	100 mW
MA2742A	33 to 50 GHz	MIL-F-3922/67B-006	100 mW
MA2743A	40 to 60 GHz	MIL-F-3922/67B-007	100 mW
MA2744A	50 to 75 GHz	MIL-F-3922/67B-008	100 mW
MA2745A	60 to 90 GHz	MIL-F-3922/68B-009	100 mW
MA2746A	75 to 110 GHz	MIL-F-3922/68B-010	100 mW

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MS2668C	Spectrum analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0013	Fuse, 5 A: 2 pcs
W1335AE	MS2668C operation manual: 1 copy
B0329G	Front cover (3/4MW4U): 1 pc
	Options
MS2668C-02	Narrow resolution bandwidth
MS2668C-03	Narrow resolution bandwidth
MS2668C-04	High-speed time domain sweep
MS2668C-06	Trigger/gate circuit
MS2668C-07	AM/FM demodulator (outputs to loudspeaker or earphone connector)
MS2668C-10	Centronics interface (GPIB interface can not be used simultaneously)
MS2668C-15	Sweep signal output
	Application parts
J0911	Coaxial cord (K-P · K-P), 1 m (DC to 40 GHz, SUCOFLEX 102A)
J0912	Coaxial cord (K-P · K-P), 0.5 m (DC to 40 GHz, SUCOFLEX 102A)
34AKNF50	Coaxial adaptor (DC to 20 GHz, SWR: 1.5, ruggedized K-P · N-J)
J0322B	Coaxial cord (SMA-P · SMA-P), 1 m (DC to 18 GHz, SUCOFLEX 104)
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P), 1 m
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC block (Model 7003, 10 kHz to 18 GHz, ±50 V, N-type, Weinschel product)

Model/Order No.	Name
J0910	DC block (Model 7006, 10 kHz to 18 GHz, ±50 V, SMA-type, Weinschel product)
MA2507A	DC Block Adaptor (50 Ω, 9 kHz to 3 GHz, ±50 V, N-type)
MA8601A	DC Block Adaptor (50 Ω, 30 kHz to 2 GHz, ±50 V, N-type)
MA8601J	DC Block Adaptor (75 Ω, 10 kHz to 2.2 GHz, ±50 V, NC-type)
MA1621A	50 Ω → 75 Ω Impedance Transformer (75 Ω, 9 kHz to 3 GHz, ±100 V, NC-type)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 to 1200 MHz, transformer type, NC-type)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m (for PC-98 Personal Computer and VP-600, D-sub 25-pins, straight)
J0743A	RS-232C cable, 1 m (for PC/AT compatible, D-sub 9-pins, cross)
J0064A	7 GHz band coaxial/waveguide adaptor (5.8 to 8.6 GHz, N-J · BRJ-7)
J0064C	10 GHz band coaxial/waveguide adaptor (8.2 to 12.4 GHz, N-J · BRJ-10)
J0004	Coaxial adaptor (N-P · SMA-J)
DGM010-02000EE	Coaxial cord, 2 m (N-type connector, general use)
DGM024-02000EE	Coaxial cord, 2 m (N-type connector, low-loss type)
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz, N-type)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz, N-type)
J0078	Fixed attenuator for high power (20 dB, 10 W, DC to 18 GHz, N-type)
MP526D	High Pass Filter (400 MHz band, N-type)
MA1601A	High Pass Filter (800/900 MHz band, N-type)
MA2740A	External Mixer (18 to 26.5 GHz)
MA2741A	External Mixer (26.5 to 40 GHz)
MA2742A	External Mixer (33 to 50 GHz)
MA2743A	External Mixer (40 to 60 GHz)
MA2744A	External Mixer (50 to 75 GHz)
MA2745A	External Mixer (60 to 90 GHz)
MA2746A	External Mixer (75 to 110 GHz)
B0421A	Carrying case (hard type, with casters)
B0421B	Carrying case (hard type, without casters)
B0435A	Carrying case (soft type)

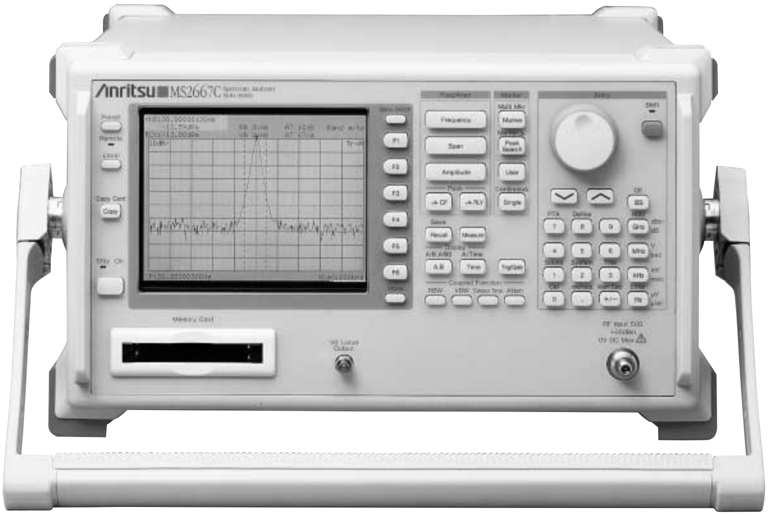
SPECTRUM ANALYZER

MS2667C

9 kHz to 30 GHz

CE GPIB

For Evaluating LMDS Subscriber Radio Systems



The MS2667C is a compact, lightweight, and low-price spectrum analyzer that covers a frequency range of 9 kHz to 30 GHz. It has superior basic performance, such as high C/N ratio, low distortion, and high frequency/level accuracies, and is easy to operate. A large selection of options is provided to handle a wide range of applications at reasonable cost.

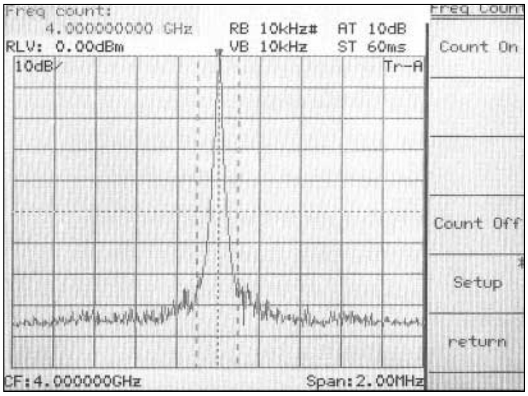
Features

- Compact and lightweight (15 kg in standard configuration)
- High C/N and superior distortion characteristics
- Easy-to-use, simple operation
- Millimeter wave applications
- Options support wide range of applications

Performance and functions

• Counter with 1 Hz resolution

A full complement of frequency counter functions are provided. Resolution is as high as ±1 Hz even at full span, and high-speed frequency measurements can be performed. The high sensitivity compared with ordinary counters makes it easy to select one signal from many and to determine its frequency.



Freq count:
4.000000000 GHz
RLV: 0.00dBm
RB 10kHz# VB 10kHz
AT 10dB ST 60ms
10dB/
Tr-A
CF:4.000000GHz
Span:2.00MHz
Freq Count
Count On
Count Off
Setup
return

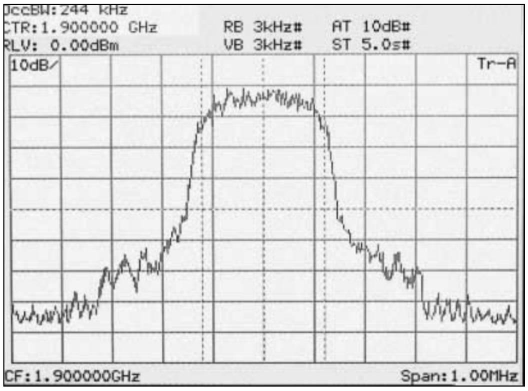
Frequency measurement (1 Hz resolution)

• 100 dB display dynamic range

For measurements requiring a wide dynamic range such as adjacent channel power measurements, the MS2667C can display nearly 90 dB on a single screen.

• Highly-accurate measurement

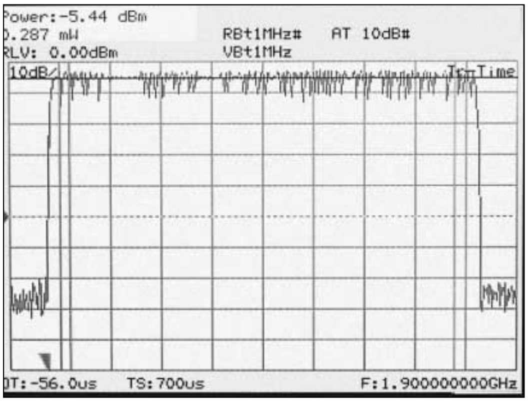
Automatic calibration ensures a high level of accuracy. A span accuracy of 5% and 501 sampling points ensure accurate occupied frequency bandwidth and adjacent channel power measurements.



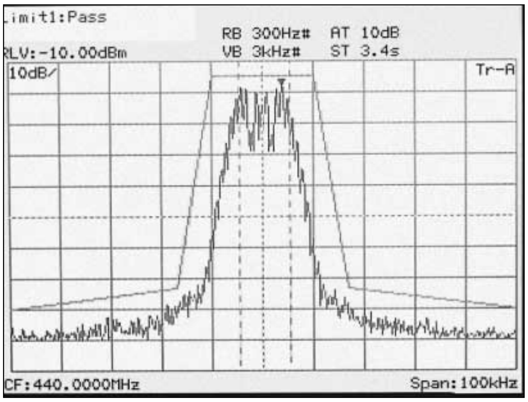
OccBW:244 kHz
CTR:1.900000 GHz
RLV: 0.00dBm
RB 3kHz# VB 3kHz#
AT 10dB# ST 5.0s#
10dB/
Tr-A
CF:1.900000GHz
Span:1.00MHz

Occupied bandwidth measurement

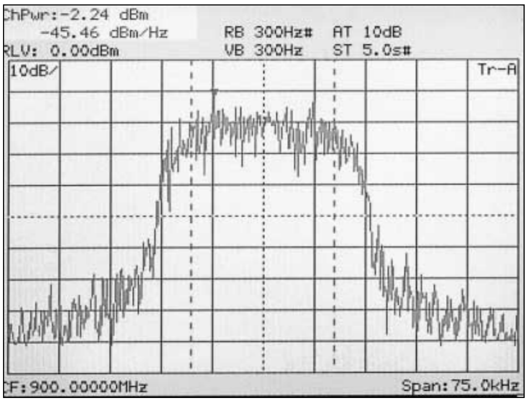
• Radio equipment evaluation functions ("measure" functions)
A full range of functions including measurement of power levels, frequencies, adjacent channel power, and mask and time template measurements are provided for performance evaluation of radio equipment. Key operation is simple and high-speed calculations make the measurement fast and efficient.



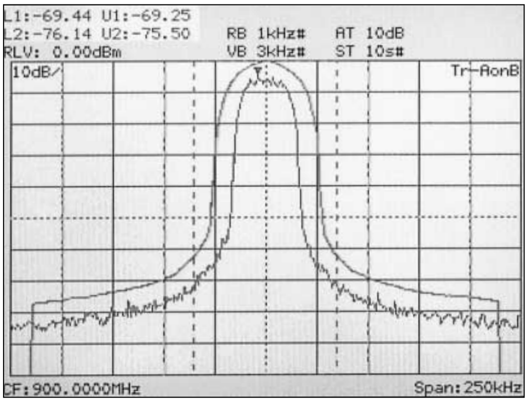
Burst average power measurement



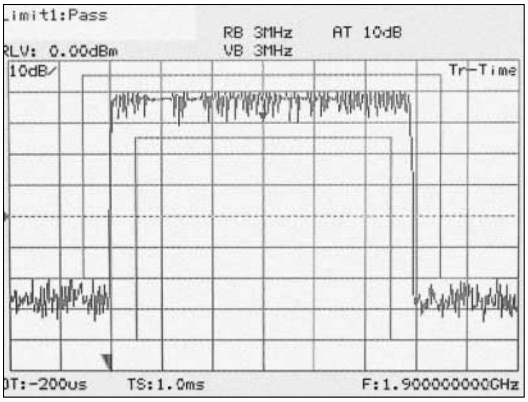
Mask measurement



Channel power measurement

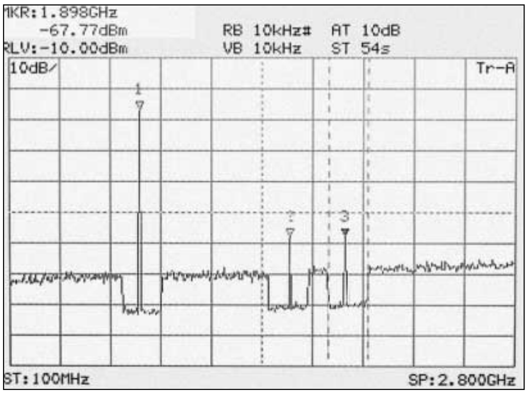


Adjacent channel power measurement



Time template measurement

• Zone sweep and multi-zone sweep functions
Sweeps can be limited to zones defined by zone markers which results in reduced sweep time. This zone sweep function can be combined with "measure" functions such as "noise measure," which can directly readout the total noise power within the zone to reduce measurement time greatly. The multi-zone sweep function enables up to 10 zones to be swept.



Multi-zone sweep

Specifications

Except where noted otherwise, specified values were obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 30 GHz
	Frequency band	Band 0: 0 to 3.2 GHz (n: 1); Band 1–: 3.1 to 6.5 GHz (n: 1); Band 1+: 6.4 to 8.1 GHz (n: 1); Band 2+: 8.0 to 15.3 GHz (n: 2); Band 3+: 15.2 to 22.4 GHz (n: 3); Band 4+: 22.3 to 30 GHz (n: 4) *n: harmonic order of the mixer
	Pre-selector range	3.1 to 30 GHz (band 1–, 1+, 2+, 3+, 4+)
	Frequency setting resolution	(1 x n) Hz *n: harmonic order of the mixer
	Frequency display accuracy	± (display frequency x reference frequency accuracy + span x span accuracy) *Span: ≥ (10 x n) kHz (n: harmonic order of the mixer, after calibration)
	Marker frequency display accuracy	Normal marker: Same as display frequency accuracy Delta marker: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 100 Hz to 30 GHz Accuracy: ±5%
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) *Option 02 (30 Hz, 100 Hz, 300 Hz), Option 03 (10 Hz, 30 Hz, 100 Hz, 300 Hz) are added. Measurements of noise, C/N, adjacent channel power and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF *Manually settable, or automatically settable according to RBW
	Signal purity and stability	Noise sidebands: ≤–95 dBc/Hz + 20 log n (1 MHz to 30 GHz, 10 kHz offset) *n: harmonic order of the mixer Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 x n Hz/min (span: ≤10 kHz x n, sweep time: ≤100 s) *After 1-hour warm-up at constant ambient temperature; n: harmonic order of the mixer
	Reference oscillator	Frequency: 10 MHz Aging rate: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: ±5 x 10^{-8} (0° to 50°C, referenced to frequency at 25°C)
Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz, band 0), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–110 dBm (3.1 to 8.1 GHz, band 1), ≤–102 dBm (8.0 to 15.3 GHz, band 2), ≤–98 dBm (15.2 to 22.4 GHz, band 3), ≤–91 dBm (22.3 to 30 GHz, band 4) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–90 dBm (RF ATT: 0 dB, input: 50 Ω terminated, 1 MHz to 8.1 GHz)
	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) *After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) *Manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	Relative: ±1.5 dB (9 to 100 kHz, band 0), ±1.0 dB (100 kHz to 3.2 GHz, band 0), ±1.5 dB (3.1 to 8.1 GHz, band 1), ±3.0 dB (8 to 15.3 GHz, band 2), ±4.0 dB (15.2 to 22.4 GHz, band 3), ±4.0 dB (22.3 to 30 GHz, band 4) *After pre-selector tuning at band 1, 2, 3 and 4, referenced to midpoint between highest and lowest frequency deviation in each band Absolute: ±5.0 dB (9 kHz to 30 GHz, RF ATT: 10 dB, referenced to 100 MHz) *After pre-selector tuning at band 1, 2, 3 and 4
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer input: –30 dBm), ≤–70 dBc (0.2 to 1.55 GHz, band 0, mixer input: –30 dBm), ≤–90 dBc or noise level (1.55 to 15 GHz, band 1/2/3/4, mixer input: –10 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz), –75 dBc or average noise level (8.1 to 26.5 GHz), ≤–75 dBc or average noise level (typical, 26.5 to 30 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz) Multiple/out of band response: ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input)

Continued on next page

Sweep	Sweep time	Setting range: 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW and VBW) Accuracy: ±15% (20 ms to 100 s), ±25% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable), Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies. Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously Trace A/Time: Displays frequency spectrum and time domain waveforms at center frequency simultaneously Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled. RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth) *RBW: ≥1 kHz to 3 MHz usable
	Input connector	K-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical, from lower edge to upper edge at 10 dB/div), 0 to 0.4 V ±0.1 V (typical, from lower edge to upper edge at 10%/div), BNC connector *75 Ω terminated at 100 MHz input COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, –10 to +2 dBm (50 Ω terminated), BNC connector REF BUFFERED OUTPUT: ≥0 dBm (50 Ω terminated), BNC connector 1ST LOCAL OUTPUT: 4 to 7 GHz, ≥+8 dBm, 50 Ω, SMA-J connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface. Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface.
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system function.
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) *Typical value
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM (Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS.) Connector: Meets the PCMCIA Rel. 2.0, 2 slots

Continued on next page

External mixer	Frequency	Frequency range: 18 to 110 GHz Frequency band configuration Band K: 18 to 26.5 GHz (n: 4), Band A: 26.5 to 40 GHz (n: 6), Band Q: 33 to 50 GHz (n: 8), Band U: 40 to 60 GHz (n: 9), Band V: 50 to 75 GHz (n: 11), Band E: 60 to 90 GHz (n: 13), Band W: 75 to 110 GHz (n: 16) Span setting range: 0 Hz, (100 x n) Hz to each bandwidth ∗n: harmonic order of the mixer
	Amplitude	Level measurement Mixer conversion loss setting range: 15 to 85 dB Maximum input level: Depends on the external mixer used Average noise level: Depends on the external mixer used Reference level setting range: –100 dBm to (–25 to M) dBm ∗Log scale, M: mixer conversion loss Frequency response: Depends on the external mixer used
	Input/output	Suitable mixer: 2-port mixer only (local frequency: 4 to 7 GHz, IF frequency: 689.31 MHz) Display gain: 0 ±2 dB (external mixer input: –10 dBm, when the mixer conversion loss is 15 dB)
Others	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, ≤400 VA
	Dimensions and mass	320 (W) x 177 (H) x 381 (D) mm, ≤15 kg (without option)
	Ambient temperature	0˚ to +50˚C (operate), –40˚ to +75˚C (storage)

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB:3 dB)	≤15:1

• Option 03: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	10 Hz, 30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB:3 dB)	≤15:1
Average noise level	≤–135 dBm (1 MHz to 1 GHz, band 0), ≤–135 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–130 dBm (3.1 to 8.1 GHz, band 1), ≤–122 dBm (8.0 to 15.3 GHz, band 2), ≤–118 dBm (15.2 to 22.4 GHz, band 3), ≤–111 dBm (22.3 to 30 GHz, band 4) ∗RBW: 10 Hz, VBW: 1 Hz, RF ATT: 0 dB

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	Log scale: 0.1 dB, Linear scale: 0.2% (relative to reference level)

• Option 06: Trigger/gate circuit

Trigger switch	FREERUN, TRIGGERED
Trigger source	EXT Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/fall Connector: BNC VIDEO Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/fall WIDE IF VIDEO Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/fall LINE Frequency: 47.5 to 63 Hz (line lock)
Trigger delay	Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s, Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms, Resolution: 1 µs
Gate sweep	In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface∗1

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

∗1: GPIB interface can not be installed simultaneously.

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 k Ω termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

External mixer

Model	Frequency range	Mate flange	Max. input power
MA2740A	18 to 26.5 GHz	MIL-F-3922/68-001KM	100 mW
MA2741A	26.5 to 40 GHz	MIL-F-3922/68-001AM	100 mW
MA2742A	33 to 50 GHz	MIL-F-3922/67B-006	100 mW
MA2743A	40 to 60 GHz	MIL-F-3922/67B-007	100 mW
MA2744A	50 to 75 GHz	MIL-F-3922/67B-008	100 mW
MA2745A	60 to 90 GHz	MIL-F-3922/68B-009	100 mW
MA2746A	75 to 110 GHz	MIL-F-3922/68B-010	100 mW

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name
	Main frame
MS2667C	Spectrum Analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0013	Fuse, 5 A: 2 pcs
W1335AE	MS2665C/MS2667C operation manual: 1 copy
B0329G	Front cover (3/4MW4U)
	Options
MS2667C-02	Narrow resolution bandwidth
MS2667C-03	Narrow resolution bandwidth
MS2667C-04	High-speed time domain sweep
MS2667C-06	Trigger/gate circuit
MS2667C-07	AM/FM demodulator (outputs to loudspeaker or earphone connector)
MS2667C-10	Centronics interface (GPIB interface cannot be installed simultaneously)
MS2667C-15	Sweep signal output
	Application parts
34AKNF50	Coaxial adapter (DC to 20 GHz, SWR: 1.5, ruggedized K-P · N-J)
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P) , 1 m
J0322B	Coaxial cord (SMA-P · SMA-P), 1 m (DC to 18 GHz, SUCOFLEX 104A)
J0911	Coaxial cord (K-P · K-P), 1 m (DC to 40 GHz, SUCOFLEX 102A)
J0912	Coaxial cord (K-P · K-P), 0.5 m (DC to 40 GHz, SUCOFLEX 102A)
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC block (Model 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product, N-type)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V, N-type)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V, N-type)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V, NC-type)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V, NC-type)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 to 1200 MHz, transformer type, NC-type)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m (for PC-98 Personal Computer and VP-600, D-sub 25-pins, straight)
J0743A	RS-232C cable, 1 m (for PC/AT compatible, D-sub 9-pins, cross)
J0064A	7 GHz band coaxial/waveguide adapter (5.8 to 8.6 GHz, N-J · BRJ-7)
J0064C	10 GHz band coaxial/waveguide adapter (8.2 to 12.4 GHz, N-J · BRJ-10)
J0004	Coaxial adapter (N-P · SMA-J)
DGM010-02000EE	Coaxial cord, 2 m (N-type connector, general use)
DGM024-02000EE	Coaxial cord, 2 m (N-type connector, low-loss type)
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz, N-type)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz, N-type)
J0078	Fixed attenuator for high power (20 dB, 10 W, DC to 18 GHz, N-type)
MP526D	High Pass Filter (400 MHz band)
MA1601A	High Pass Filter (800/900 MHz band, N-type)
MA2740A	External Mixer (18 to 26.5 GHz)
MA2741A	External Mixer (26.5 to 40 GHz)
MA2742A	External Mixer (33 to 50 GHz)
MA2743A	External Mixer (40 to 60 GHz)
MA2744A	External Mixer (50 to 75 GHz)
MA2745A	External Mixer (60 to 90 GHz)
MA2746A	External Mixer (75 to 110 GHz)
B0421A	Carrying case (hard type, with casters)
B0421B	Carrying case (hard type, without casters)
B0435A	Carrying case (soft type)

SPECTRUM ANALYZER

MS2665C

9 kHz to 21.2 GHz

CE GPIB

For Evaluating ETC Subscriber Radio Systems

The MS2665C is a compact, lightweight, and low-price spectrum analyzer that covers a frequency range of 9 kHz to 21.2 GHz. It has superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and is easy to operate. A large selection of options is provided to handle a wide range of applications at reasonable cost.

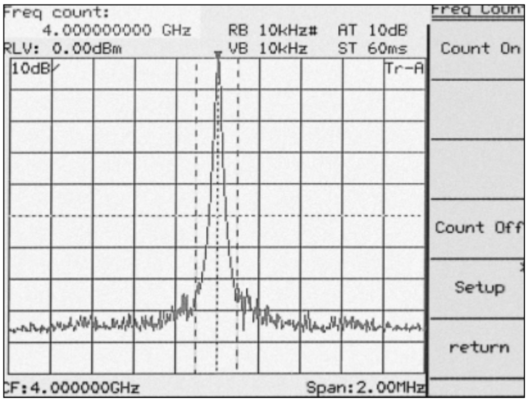
Features

- Compact and lightweight (13 kg in standard configuration)
- High C/N and superior distortion characteristics
- Easy-to-use, simple operation
- Options support wide range of applications
- Easy-to-set up automatic measurements

Performance and functions

• Counter with 1 Hz resolution

A full complement of frequency counter functions are provided. Resolution is as high as ±1 Hz even at full span, and high-speed frequency measurements can be performed. The high sensitivity compared with ordinary counters makes it easy to select one signal from many and to determine its frequency.



```
Freq count:                                   Freq Coun
   4.000000000 GHz    RB 10kHz#   AT 10dB
RLV: 0.00dBm          VB 10kHz    ST 60ms     Count On
10dB/                                  Tr-A

                                              Count Off

                                              Setup

                                              return
CF:4.000000GHz                   Span:2.00MHz
```

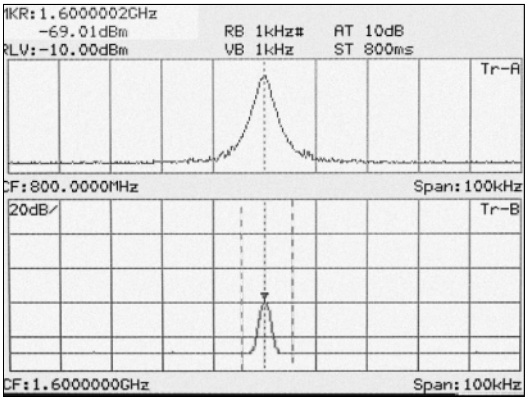
Frequency measurement (1 Hz resolution)

• 100 dB display dynamic range

For measurements requiring a wide dynamic range, such as adjacent channel power measurements, the MS2665C can display nearly 90 dB on a single screen.

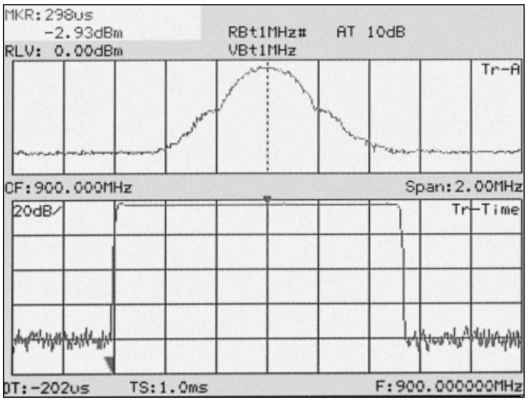
• Multi-screen display

The Trace A and Trace B waveforms are superimposed on the same screen, and two spectra with different frequencies are displayed simultaneously. In addition, it is possible to simultaneously display spectrum and time domain screens for the same signal. The multi-screen display permits efficient signal level adjustment and harmonic distortion measurement, too. Furthermore, in addition to being able to display amplitude in the time domain, it is possible to display the FM demodulation waveform.



```
KR:1.6000002GHz
   -69.01dBm          RB 1kHz#    AT 10dB
LV:-10.00dBm          VB 1kHz     ST 800ms
                                        Tr-A
F:800.0000MHz                  Span:100kHz
20dB/                                   Tr-B
F:1.6000000GHz                 Span:100kHz
```

Two traces with different frequencies



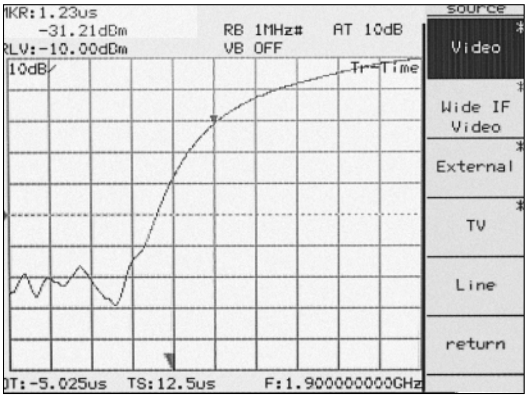
Spectrum and time domain measurement

• For testing digital mobile communication equipment

High-speed time domain sweep (Option 04)

Testing of TDMA-type radio equipment includes time domain (zero-span) measurements of antenna power, transient response characteristics of burst transmissions, transmission timing, and other quantities. The high-speed time domain sweep option boosts sweep time to 12.5 µs and resolution to 0.025 µs.

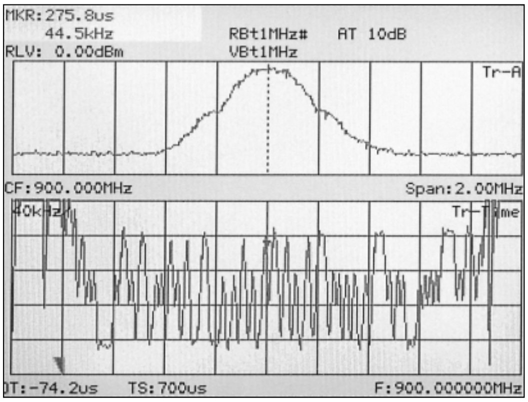
∗This option must be used with the trigger/gate circuit (Option 06).



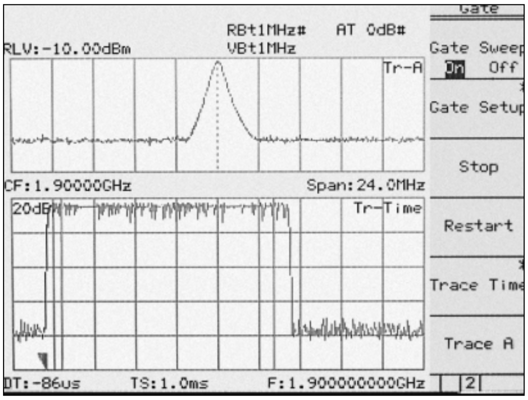
High-speed time-domain measurement (TS = 12.5 µs)

Trigger/gate circuit (Option 06)

Burst signal can be stably measured using the trigger function in time domain measurements. One of the external, video, wide IF video, or line is selectable. This makes a variety of TDMA radio equipment tests possible, including template comparison using pre-trigger and post-trigger delay functions and gate spectrum analysis using the gate sweep function. Previously, the trigger output from an external detector was required in gate spectrum analysis. However, this option for the MS2665C has a 20 MHz wide IF video trigger function, eliminating the need for trigger output from an external detector.



Wide IF video trigger function



Wide IF video trigger and gate functions

Specifications

Except where noted otherwise, specified values were obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 21.2 GHz
	Frequency band	Band 0: 0 to 3.2 GHz (n: 1); Band 1–: 2.92 to 6.5 GHz (n: 1); Band 1+: 6.4 to 8.1 GHz(n: 1); Band 2+: 8.0 to 15.3 GHz (n: 2); Band 3+: 15.2 to 21.2 GHz (n: 3) ∗n: harmonic order of the mixer
	Pre-selector range	2.92 to 21.2 GHz (band 1–, 1+, 2+, 3+)
	Frequency setting resolution	Frequency domain: (1 x n) Hz, Zero span: (100 x n) Hz ∗n: harmonic order of the mixer
	Frequency display accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz x n) ∗Span: ≥10 kHz x n (n: harmonic order of the mixer, after calibration)
	Marker frequency display accuracy	Normal marker: Same as display frequency accuracy; Delta marker: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 1 kHz to 21.3 GHz Accuracy: ±2.5% (span: ≥10 kHz x n), ±5% (span: <10 kHz x n, Option 02 installed)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting rage: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) ∗Option 02: 30 Hz, 100 Hz, and 300 Hz are added Measurements of noise, C/N, adjacent channel power, and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF ∗Manually settable, or automatically settable according to RBW

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Frequency	Signal purity, stability	Noise sidebands: ≤–95 dBc/Hz + 20 log n (1 MHz to 21.2 GHz, 10 kHz offset) ∗n: harmonic order of the mixer Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 x n Hz/min (span: ≤10 kHz x n, sweep time: ≤100 s) ∗After 1-hour warm-up at constant ambient temperature; n: harmonic order of the mixer
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01 : 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5}(typical, 0° to 50˚C); Option 01: ±5 x 10^{-8} (0° to 50˚C, referenced to frequency at 25˚C)
Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz, band 0), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–110 dBm (2.92 to 8.1 GHz, band 1), ≤–102 dBm (8.0 to 15.3 GHz, band 2), ≤–98 dBm (15.2 to 21.2 GHz, band 3) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–90 dBm (RF ATT: 0 dB, input: 50 Ω terminated, 1 MHz to 8.1 GHz)
	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) ∗After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) ∗Manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) ∗After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	Relative: ±1.5 dB (9 to 100 kHz, band 0), ±1.0 dB (100 kHz to 3.2 GHz, band 0), ±1.5 dB (2.92 to 8.1 GHz, band 1), ±3.0 dB (8 to 15.3 GHz, band 2), ±4.0 dB (15.2 to 21.2 GHz, band 3) ∗After pre-selector tuning at band 1, 2 and 3, referenced to midpoint between highest and lowest frequency deviation in each band Absolute: ±5.0 dB (9 kHz to 21.2 GHz, RF ATT: 10 dB, referenced to 100 MHz) ∗After pre-selector tuning at band 1, 2 and 3, referenced to midpoint between highest and lowest frequency deviation in each band
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±2.5 dB (0 to –90 dB) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB; Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer input: –30 dBm), ≤–70 dBc (0.2 to 1.55 GHz, band 0, mixer input: –30 dBm), ≤–100 dBc or noise level (1.46 to 10.6 GHz, band 1/2/3, mixer input: –10 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz), –75 dBc or noise level (8.1 to 21.2 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (>18 GHz) Multiple response: ≤–60 dBc
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW, and VBW) Accuracy: ±15% (20 ms to 100 s), ±25% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable), Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies. Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously Trace A/Time: Displays frequency spectrum and time domain waveform at center frequency simultaneously Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A

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Functions	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled. RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth) *RBW: ≥1 kHz to 3 MHz usable
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical, from lower edge to upper edge at 10 dB/div), 0 to 0.4 V ±0.1 V (typical, from lower edge to upper edge at 10%/div), BNC connector *75 Ω terminated at 100 MHz input COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, Δ MARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface. Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface.
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system function.
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) *Typical value
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM (Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS.) Connector: Meets the PCMCIA Rel. 2.0; 2 slots
Others	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category Ⅱ, Pollution degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤330 VA
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤13 kg (without option)
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0° to 50°C, with reference to 25°C)
Buffer output	10 MHz, >2 Vp-p (200 Ω termination), BNC connector

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20% (100, 300 Hz)
Selectivity (60 dB:3 dB)	≤15:1 (RBW: 100, 300 Hz), ≤20:1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable), 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	Log scale: 0.1 dB; Linear scale: 0.2% (relative to reference level)

• Option 06: Trigger/gate circuit

Trigger switch	FREERUN, TRIGGERED
Trigger source	EXT Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/fall Connector: BNC VIDEO Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/fall WIDE IF VIDEO Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/fall LINE Frequency: 47.5 to 63 Hz (line lock)
Trigger delay	Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 µs
Gate sweep	In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface*1

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

∗1: GPIB interface can not be installed simultaneously.

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Main frame	
MS2665C	Spectrum Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0013	Fuse, 5 A:	2 pcs
W1335AE	MS2665C/MS2667C operation manual:	1 copy
B0329G	Front cover (3/4MW4U)	
	Options	
MS2665C-01	Reference crystal oscillator	
MS2665C-02	Narrow resolution bandwidth	
MS2665C-04	High-speed time domain sweep	
MS2665C-06	Trigger/gate circuit	
MS2665C-07	AM/FM demodulator (outputs to loudspeaker or earphone connector)	
MS2665C-10	Centronics interface (GPIB interface cannot be installed simultaneously)	
MS2665C-15	Sweep signal output	
	Application parts	
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m	
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P) , 1 m	
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)	
B0395A	Rack mount kit (IEC)	
B0395B	Rack mount kit (JIS)	
B0391A	Carrying case (hard type, with casters)	
B0391B	Carrying case (hard type, without casters)	
MP612A	RF Fuse Holder	
MP613A	Fuse Element	
J0805	DC block (Model 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product, N-type)	
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V, N-type)	
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V, N-type)	
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V, NC-type)	
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V, NC-type)	
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 to 1200 MHz, transformer type, NC-type)	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0742A	RS-232C cable, 1 m (for PC-98 Personal Computer and VP-600, D-sub 25 pins, straight)	
J0743A	RS-232C cable, 1 m (for PC/AT compatible, D-sub 9-pins, cross)	
J0064A	7 GHz band coaxial/waveguide adapter (5.8 to 8.6 GHz, N-J · BRJ-7)	
J0064C	10 GHz band coaxial/waveguide adapter (8.2 to 12.4 GHz, N-J · BRJ-10)	
J0004	Coaxial adapter (N-P · SMA-J)	
DGM010-02000EE	Coaxial cord, 2 m (N-type connector, general use)	
DGM024-02000EE	Coaxial cord, 2 m (N-type connector, low-loss type)	

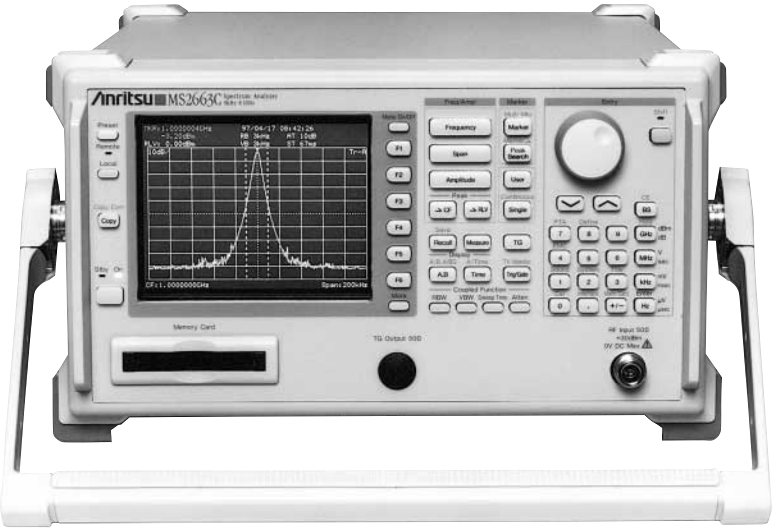
SPECTRUM ANALYZER

MS2663C

9 kHz to 8.1 GHz

GPIB

For Measuring up to 3rd Order Spurious of Mobile Communications Band



The MS2663C covers a frequency range of 9 kHz to 8.1 GHz. This allows measurement of spurious frequencies of up to three times greater than the frequency bands used worldwide for mobile communications. The MS2663C has superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and are easy to operate. The MS2663C has a “Measure” function for evaluation of radio equipment (frequency counter, C/N, adjacent channel power, occupied frequency bandwidth, burst average power, and template decision function), and enables the Two-screen display and FM demodulation waveform display. The large selection of options means that a wider range of applications can be handled at reasonable cost.

Specifications

Except where noted otherwise, specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 8.1 GHz
	Frequency band	Band 0 (0 to 3.2 GHz); Band 1 – (2.92 to 6.5 GHz); Band 1 + (6.4 to 8.1 GHz)
	Pre-selector range	2.92 to 8.1 GHz (band 1–, 1+)
	Display frequency accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz) ∗Span: ≥10 kHz, after calibration
	Marker frequency display accuracy	Normal: Same as display frequency accuracy; Delta: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 1 kHz to 8.2 GHz Accuracy: ±2.5% (span: ≥10 kHz), ±5% (span: <10 kHz, Option 02 installed)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) ∗Option 02: 30 Hz, 100 Hz, and 300 Hz are added. Measurements of noise, C/N, adjacent channel power, and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15 : 1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF ∗Manually settable, or automatically settable according to RBW
	Noise sideband, stability	Noise sidebands: ≤–100 dBc/Hz (1 GHz, 10 kHz offset) Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1 hour warm-up at constant ambient temperature
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5} (typical, 0˚ to 50˚C); Option 01: ±5 x 10^{-8} (0˚ to 50˚C) ∗Referenced to frequency at 25˚C

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Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: [Without Option 08] ≤–115 dBm (1 MHz to 1 GHz, band 0), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–115 dBm + 0.5f [GHz] dB (2.92 to 8.1 GHz, band 1) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB [With Option 08, pre-amplifier: off] ≤114 dBm (1 MHz to 1 GHz, Band 0), ≤–114 dBm + 1.5 x f [GHz] dB (1 to 3.1 GHz, Band 0), –115 dBm + 0.5 x f [GHz] dB (2.92 to 8.1 GHz, Band 1) Residual response: ≤–100 dBm (RF ATT: 0 dB, input: 50 Ω termination, 1 MHz to 8.1 GHz)
	Total level accuracy	±1.3 dB (100 kHz to 3.1 GHz band 0), ±2.3 dB (2.92 to 8.1 GHz, band 1) ∗Level measurement accuracy after calibration using internal calibration signal Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dB) + calibrated signal source accuracy
	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W, dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) ∗After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) ∗Manually settable, or automatically settable according to reference level Accuracy: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) ∗After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	±0.5 dB (100 kHz to 3.2 GHz, band 0, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C) ±1.5 dB (9 to 100 kHz, band 0, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C) ±1.5 dB (2.92 to 8.1 GHz, band 1, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C) ±1.0 dB (100 kHz to 3.2 GHz, band 0, RF ATT: 10 to 50 dB) ±3.0 dB (2.92 to 8.1 GHz, band 1, RF ATT: 10 to 50 dB) ∗At band 1, after pre-selector tuning
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer input: –30 dBm), ≤–75 dBc (0.2 to 1.3 GHz, band 0, mixer input: –30 dBm), ≤–70 dBc (1.3 to 1.55 GHz, band 0, mixer input: –30 dBm), ≤–80 dBc (0.8 to 1 GHz, band 0, mixer input: –30 dBm), ≤–100 dBc (1.46 to 4.05 GHz, band 1, mixer input: –20 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–70 dBc, Multiple response: ≤–70 dBc (band 1)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)
	Maximum dynamic range	1 dB gain compression level to average noise level: >110 dB (0.1 to 1 GHz, band 0), >110 dB – 1.5f [GHz] dB (1 to 3.1 GHz, band 0), >110 dB – 0.5f [GHz] dB (2.92 to 8.1 GHz, band 1) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz), >80 – 0.75f [GHz] dB (0.5 to 1.3 GHz), >82.5 – 0.75f [GHz] dB (0.8 to 1 GHz), >77.5 – 0.75f [GHz] dB (1.3 to 1.55 GHz, band 0), >97.5 – 0.25f [GHz] dB (1.46 to 4.05 GHz, band 1) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 – f [GHz] dB (1 to 3.1 GHz, band 0), >83.3 – (1/3)f [GHz] dB (2.92 to 8.1 GHz, band 1)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW, and VBW) Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweep only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch; Number of colors: 17 (RGB, each 64-scale settable); Intensity adjustment: 5 steps settable

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Functions	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously, alternate sweep Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously, alternate sweep Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled. RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency range: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth) ∗RBW: >1 kHz usable
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz, from lower edge to upper edge at 10 dB/div or 10%/div, 75 Ω terminated), BNC connector COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz, typical) Antenna correction coefficients: Correct display and measurement of field strengths (dBμV/m) for specified antennas, Internal antenna correction coefficients (MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, and four antennas user-defined; writes via GPIB or RS-232C, saves/loads to/from memory card)
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM ∗Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS. Connector: Meets the PCMCIA Rel. 2.0, 2 slots
Others	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤330 VA
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤13.5 kg (without option)
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0° to 50°C, with reference to 25°C)
Buffer output	10 MHz, >2 Vp-p (200 Ω termination), BNC connector

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20% (100, 300 Hz)
Selectivity (60 dB:3 dB)	≤15 : 1 (RBW: 100, 300 Hz), ≤20 : 1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	0.1 dB (log scale), 0.2% (linear scale, relative to reference level)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface*1

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

*1: GPIB interface cannot be installed simultaneously.

• Option 06: Trigger/gate circuit

Trigger switch		FREERUN, TRIGGERED
Trigger source	EXT	Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/Fall Connector: BNC
	VIDEO	Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/Fall
	WIDE IF VIDEO	Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/Fall
	LINE	Frequency: 47.5 to 63 Hz (line lock)
	TV	Method: M-NTSC, B/G/H PAL Sync: V-SYNC, H-SYNC Sync line (NTSC) H-SYNC (ODD): 7 to 262 line, H-SYNC (EVEN): 1 to 263 line Sync line (PAL) H-SYNC (ODD): 1 to 312 line, H-SYNC (EVEN): 317 to 625 line *Option 16 required
Trigger delay		Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 ms
Gate sweep		In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 08: Pre-amplifier*1,*2

Frequency range		100 kHz to 3 GHz
Noise figure		≤8 dB (typical, <2 GHz), ≤13 dB (typical, ≥2 GHz)
Amplitude	Measurement range	Average noise level to +10 dBm
	Max. input level	CW average power: +10 dBm, ±0 Vdc
	Average noise level	≤–132 dBm (1 MHz to 1 GHz), ≤–132 dBm + 2f [GHz] dB (>1 GHz) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
	Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 22.4 µV to 707 mV Reference level accuracy: ±0.5 dB (–69.9 to –20 dBm), ±0.75 dB (–89.9 to –70 dBm, –19.9 to +10 dBm) *After calibration, referenced to 100 MHz, 1 MHz span (RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB *After calibration, referenced to 3 kHz RBW RF ATT switching uncertainty: ±0.5 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, referenced to 100 MHz, RF ATT: 10 dB
	Frequency response	±2.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB)
	Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB), ±1.0 dB (0 to –60 dB), ±1.5 dB (0 to –75 dB) Linear scale (after calibration): ±5% (according to reference level)
	Spurious response	Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz) *Frequency difference of two signals: ≥50 kHz, Pre-amplifier input*3: –55 dBm
	1 dB gain compression	≥–35 dBm (≥100 MHz, at pre-amplifier input level*3)

*1: Overall specification with pre-amplifier on (Noise figure is the simple performance)
*2: Option 20 cannot be installed simultaneously
*3: Pre-amplifier input level = RF input level – RF ATT setting level

• Option 12: QP detector

Functions	QP detection ∗Requires Option 02.
6 dB bandwidth	200 Hz, 9 kHz, 120 kHz Accuracy: ±30% (18˚ to 28˚C)
Display	LOG scale, 5 dB/div (10 divisions) Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBµV, RF ATT: 0 dB, 18˚ to 28˚C)
Pulse response characteristics	Response to CISPR pulse (DET mode: QP, 18˚ to 28˚C)

Repetition frequency	Bandwidth		
	120 kHz	9 kHz	200 Hz
1 kHz	≤–8.0 ±1.0 dB	≤–4.5 ±1.0 dB	–
100 Hz	Referenced	Referenced	≤–4.0 ±1.0 dB
60 Hz	–	–	≤–3.0 ±1.0 dB
25 Hz	–	–	Referenced
20 Hz	≤+9.0 ±1.0 dB	≤+6.5 ±1.0 dB	–
10 Hz	≤+14.0 ±1.5 dB	≤+10.0 ±1.5 dB	≤+4.0 ±1.0 dB
5 Hz	–	–	≤+7.5 ±1.5 dB
2 Hz	≤+26.0 ±2.0 dB	≤+20.5 ±2.0 dB	≤+13.0 ±2.0 dB
1 Hz	≤+28.5 ±2.0 dB	≤+22.5 ±2.0 dB	≤+17.0 ±2.0 dB

QP on/off switching uncertainty (PEAK, QP)	≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18˚ to 28˚C)
Detection mode	QP, AVERAGE
Field strength measurement	Waveform data compensation data display for specified antenna factor, field strength (dBµV/m) Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)

• Option 14: PTA parallel I/O

Functions	Controls external devices from PTA, cannot be installed when Option 10 installed
System variables	As follows using PTA system variables IOA: Controls 8-bit parallel output port A IOB: Controls 8-bit parallel output port B IOC: Controls 4-bit parallel input/output port C IOD: Controls 4-bit parallel input/output port D EIO: Controls I/O switching of ports C/D EXO: Controls I/O trigger
PTL statements	External interrupt control of input to I/O ports using PTA-PTL statements IOEN statement: Enables interrupt input IODI statement: Disables interrupt input IOMA statement: Masks interrupt input ON TO GOTO statement: Changes program flow at interrupt generation ON TO GOSUB statement: Changes program flow at interrupt generation
Write strobe signal	Write strobe signal (negative pulse) output externally at control of output ports C/D
Power supply	External +5 ±0.5 Vdc (max. 100 mA) supply
Signal logic levels	Negative logic, TTL level Specified current: Output ports A/B (max. output current Hi: 2.6 mA, Lo: 24 mA) Output ports C/D (max. output current Hi: 15 mA, Lo: 24 mA) Other control output lines (max. output current Hi: 0.4 mA, Lo: 8 mA)
Connection cable connectors	Amphenol 36 pins
Connector pin layout	

No.	Item	No.	Item	No.	Item
1	GND	13	Output port B (0) LSB	25	I/O port D (0) LSB
2	Trigger input	14	Output port B (1)	26	I/O port D (1)
3	Trigger output 1	15	Output port B (2)	27	I/O port D (2)
4	Trigger output 2	16	Output port B (3)	28	I/O port D (3) MSB
5	Output port A (0) LSB	17	Output port B (4)	29	Port C status 0/1: I/O
6	Output port A (1)	18	Output port B (5)	30	Port D status 0/1: I/O
7	Output port A (2)	19	Output port B (6)	31	Write strobe signal
8	Output port A (3)	20	Output port B (7) MSB	32	Interruption signal
9	Output port A (4)	21	I/O port C (0) LSB	33	Not used
10	Output port A (5)	22	I/O port C (1)	34	+5 V power supply
11	Output port A (6)	23	I/O port C (2)	35	Not used
12	Output port A (7) MSB	24	I/O port C (3) MSB	36	Not used

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• Option 20: Tracking generator*1

Frequency range	9 kHz to 3 GHz
Output level range	0 to –60 dBm
Setting resolution	0.1 dB
Output level accuracy	≤±1.0 dB (at 100 MHz, 0 dBm)
Output level flatness	≤±1.5 dB (100 kHz to 3 GHz, output level: 0 dBm, referenced to 100 MHz frequency)
Output level linearity	≤±1.0 dB (0 to –30 dBm), ≤±2.0 (–30 to –60 dBm) *100 kHz to 3 GHz, 0 dBm output level reference
Spurious	Harmonic: ≤–15 dBc (9 to 100 kHz), ≤–20 dBc (100 kHz to 3 GHz) Non-harmonic: ≤–15 dBc (9 to 100 kHz), ≤–35 dBc (100 kHz to 2 GHz), ≤–30 dBc (2 to 3 GHz)
Tracking generator feed through	≤–95 dBm (spectrum analyzer input and tracking generator output connectors terminated at 50 Ω)
Output connector	N-J, 50 Ω

*1: Option 08 can not be installed simultaneously.

• Option 21: Television monitor (Multi)*1

Video	M-NTSC, B/G/H/I/D PAL, color
Audio	Simultaneous monitoring of video and audio *Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan, USA, Italy, UK and China; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC *Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

*1: Requires Option 08

• Option 24: Television monitor (Brazil)*1

Video	M-NTSC, M PAL, color
Audio	Simultaneous monitoring of video and audio *Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan and USA; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC *Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

*1: Requires Option 08

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name
	Main frame
MS2663C	Spectrum Analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0013	Fuse, 5 A: 2 pcs
W1251AE	MS2650B, MS2660B/C series operation manual: 1 copy
B0329G	Front cover (3/4MW4U)
	Options
MS2663C-01	Reference crystal oscillator
MS2663C-02	Narrow resolution bandwidth
MS2663C-04	High-speed time domain sweep
MS2663C-06	Trigger/gate circuit
MS2663C-07	AM/FM demodulator
MS2663C-08	Pre-amplifier (Option 20 cannnot be installed simultaneously)
MS2663C-10	Centronics interface (GPIB cannot be installed simultaneously)
MS2663C-12	QP detector (requires Option 02, QP-BW: 0.2/9/120 kHz)
MS2663C-14	PTA parallel I/O (Option 10 cannot be installed simultaneously)
MS2663C-15	Sweep signal output
MS2663C-20	Tracking generator (Option 08 cannot be installed simultaneously)
MS2663C-21	Television monitor (Multi)
MS2663C-24	Television monitor (Brazil)
	Measurement softwares
MX260002A	CDMA Cellular System Measurement Software
MX260003A	PDC Measurement Software (for base station)
MX260004A	GSM Measurement Software
MX261001A	Low-Power Data Communication System Measurement Software conforming to issue of Direct Spread Spectrum System
MX261002A	Low-Power Data Communication System Measurement Software conforming to issue of Frequency Hopping System
MX262001A	CATV Measurement Software
MX264001A	EMI Measurement Software
	Application parts
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P), 1 m
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)

Model/order No.	Name
J0055	Coaxial adapter (NC-P · BNC-J)
J0076	Coaxial adapter (NC-P · F-J)
B0391A	Carrying case (hard type, with casters)
B0391B	Carrying case (hard type, without casters)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC Block (MODEL 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer
J0121	Coaxial cord (NC-P-3W · 3C-2WS · NC-P-3W), 1 m
J0308	Coaxial cord (BNC-P · 3C-2WS · NC-P-3W), 1 m
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz)
MP640A	Branch
MP654A	Branch
MP520A	CM Directional Coupler
MP520B	CM Directional Coupler
MP520C	CM Directional Coupler
MP520D	CM Directional Coupler
MP526A	High Pass Filter
MP526B	High Pass Filter
MP526C	High Pass Filter
MP526D	High Pass Filter
MP526G	High Pass Filter
MA1601A	High Pass Filter (800/900 MHz band, N)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m [for PC-98 Personal Computer and VP-600, D-sub 25 pins (straight)]
J0743A	RS-232C cable, 1 m [for AT compatible, D-sub 9-pins (cross)]
MH648A	Pre-Amplifier
MP534A	Dipole Antenna
MP651A	Dipole Antenna
BBA9106/VHA9103	Biconical Antenna
MP635A	Log-Periodic Antenna
MP666A	Log-Periodic Antenna
MB9A	Tripod
MB19A	Tripod
MA2601B	EMI Probe
MA2601C	EMI Probe
KT-10	EMI Clamp
KT-20	EMI Clamp

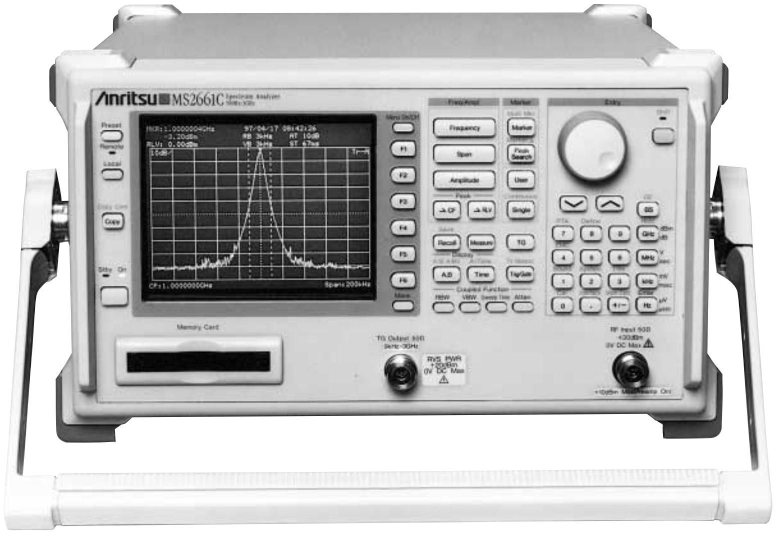
SPECTRUM ANALYZER

MS2661C

9 kHz to 3 GHz

GPIB

For Analyzing Digital Radio Equipment and CATV Signals



The MS2661C Portable Spectrum Analyzer is for signal analysis of radio and other equipment related to improving frequency usage efficiency, higher modulation, and digitalization. This is a synthesized spectrum analyzer covering a wide frequency range from 9 kHz to 3 GHz. It has superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and is easy to operate. It has a "Measure" function for evaluation of radio equipment (frequency counter, C/N, adjacent channel power, occupied frequency bandwidth, burst average power, and template decision function), and which enables the two-screen display and FM demodulation waveform display. The large selection of options means that a wider range of applications can be handled at reasonable cost.

Specifications

Except where noted otherwise, specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 3 GHz
	Display frequency accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz) ∗Span: ≥10 kHz, after calibration
	Marker frequency display accuracy	Normal: Same as display frequency accuracy; Delta: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5% (span: ≥10 kHz), ±5% (span: <10 kHz, with option 02)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) ∗Option 02 : 30 Hz, 100 Hz, and 300 Hz are added. Measurements of noise, C/N, adjacent channel power and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF (manually settable, or automatically settable according to RBW)
	Noise sideband, stability	Noise sideband: ≤–100 dBc/Hz (1 GHz, 10 kHz offset) Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1-hour warm-up at constant ambient temperature
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5} (typical, 0° to 50°C); Option 01: ±5 x 10^{-8} (0° to 50°C) ∗Referenced to frequency at 25°C
Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±50 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz), ≤–115 dBm + f [GHz] dB (>1 GHz), ≤–114 dBm (1 MHz to 1 GHz, at Option 08 pre-amplifier installed), ≤–114 dBm + 1.5f [GHz] dB (>1 GHz, at Option 08 pre-amplifier installed) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–100 dBm (RF ATT: 0 dB, input: 50 Ω termination,1 MHz to 3 GHz)
	Total level accuracy	±1.3 dB (100 kHz to 3 GHz) ∗Level measurement accuracy after calibration using internal calibration signal Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dB) + calibration signal source accuracy

Continued on next page

Amplitude	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W, dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) ∗After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) ∗Manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) ∗After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C) ±1.5 dB (9 to 100 kHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C) ±1.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB)
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±2.5 dB (0 to –90 dB) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB; Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz), ≤–75 dBc (0.2 to 1.5 GHz), ≤–80 dBc (0.8 to 1 GHz) ∗Mixer input: –30 dBm Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 3 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)
	Maximum dynamic range	1 dB gain compression level to average noise level: >110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz), >109 dB (0.1 to 1 GHz, at Option 08 pre-amplifier installed), >109 dB – 1.5f [GHz] (>1 GHz, at Option 08 pre-amplifier installed) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz), >80 – f [GHz] dB (0.5 to 1.5 GHz), >82.5 – f [GHz] dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 – (2/3)f [GHz] dB (1 to 3 GHz)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (Manually settable, or automatically settable according to span, RBW and VBW) Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable); Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously at alternate sweep Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously at alternate sweep Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display accuracy: ±5% of full scale (referenced to center frequency, DC-coupled, RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz ∗Range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth DC (50 Hz at AC-coupled) to 500 kHz ∗Range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth ∗RBW: ≥1 kHz usable
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz, from lower edge to upper edge at 10 dB/div or 10%/div, 75 Ω terminated, BNC connector) COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP

Continued on next page

Functions	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface Plotter (HP-GL, GP-GL compatible models): Display can be output via RS-232C and GPIB interface
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using editor of external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function : SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) ∗Typical value Antenna correction coefficients: Correct display and measurement of field strengths (dBµV/m) for specified antennas, Internal antenna correction coefficients (MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, and four antennas user-defined; writes via GPIB or RS-232C interface, saves/loads to/from memory card)
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM ∗Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS. Connector: Meets the PCMCIA Rel. 2.0, 2 slots
Others	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤330 VA
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤10.8 kg (without option)
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0° to 50°C, with reference to 25°C)
Buffer output	BNC connector, 10 MHz, >2 Vp-p (200 Ω terminated)

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20% (100, 300 Hz)
Selectivity (60 dB:3 dB)	≤15:1 (RBW: 100, 300 Hz), ≤20:1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	0.1 dB (log scale), 0.2% (linear scale, relative to reference level)

• Option 06: Trigger/gate circuit

Trigger switch		FREERUN, TRIGGERED
Trigger source	EXT	Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/Fall Connector: BNC
	VIDEO	Trigger level (at log scale): –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/Fall
	WIDE IF VIDEO	Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/Fall
	LINE	Frequency: 47.5 to 63 Hz (line lock)
	TV	Method: M-NTSC, B/G/H PAL Sync: V-SYNC, H-SYNC Sync line (NTSC) H-SYNC (ODD): 7 to 262 line, H-SYNC (EVEN): 1 to 263 line Sync line (PAL) H-SYNC (ODD): 1 to 312 line, H-SYNC (EVEN): 317 to 625 line ∗Option 16 required
Trigger delay		Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 µs
Gate sweep		In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface

Function	Outputs data to printer (Centronics standard). GPIB interface cannot be installed simultaneously.
Connector	D-sub 25-pin (jack)

• Option 08: Pre-amplifier[*1]

Frequency range		100 kHz to 3 GHz, 100 kHz to 2.5 GHz (with Option 22)
Noise figure		≤7 dB (typical, <2 GHz), ≤12 dB (typical, ≥2 GHz), ≤9 dB (typical, <2 GHz, with Option 22), ≤14 dB (typical, ≥2 GHz, with Option 22)
Amplitude	Measurement range	Average noise level to +10 dBm
	Max. input level	CW average power: +10 dBm, ±50 Vdc
	Average noise level	≤–134 dBm (1 MHz to 1 GHz), ≤–134 dBm + 2f [GHz] dB (>1 GHz), ≤–132 dBm (1 MHz to 1 GHz, with Option 22), ≤–132 dBm + 2f [GHz] dB (≥1 GHz, with Option 22) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
	Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 22.4 µV to 707 mV, 27.4 µV to 487 mV with Option 22 Reference level accuracy: ±0.5 dB (–69.9 to –20 dBm), ±0.75 dB (–89.9 to –70 dBm, –19.9 to +10 dBm) *After calibration, referenced to 100 MHz, 1 MHz span (RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB *After calibration, referenced to 3 kHz RBW RF ATT switching uncertainty: ±0.5 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, referenced to 100 MHz, RF ATT: 10 dB
	Frequency response	±2.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB) ±2.0 dB (with Option 22, 100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
	Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB), ±1.0 dB (0 to –60 dB), ±1.5 dB (0 to –75 dB) Linear scale (after calibration): ±5% (according to reference level)
	Spurious response	Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz, 10 MHz to 2.5 GHz with Option 22) *Frequency difference of two signals: ≥50 kHz, Pre-amplifier input[*2]: –55 dBm
	1 dB gain compression	≥–35 dBm (≥100 MHz, at pre-amplifier input level[*2])

*1: Overall specification with pre-amplifier on (Noise figure is the simple performance)
*2: Pre-amplifier input level = RF input level – RF ATT setting level

• Option 12: QP detector

Functions	QP detection *Requires Option 02.
6 dB bandwidth	200 Hz, 9 kHz, 120 kHz Accuracy: ±30% (18° to 28°C)
Display	LOG scale, 5 dB/div (10 divisions) Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBµV, RF ATT: 0 dB, 18° to 28°C)
Pulse response characteristics	Response to CISPR pulse (DET mode: QP, 18° to 28°C)

Repetition frequency	Bandwidth		
	120 kHz	9 kHz	200 Hz
1 kHz	≤–8.0 ±1.0 dB	≤–4.5 ±1.0 dB	–
100 Hz	Referenced	Referenced	≤–4.0 ±1.0 dB
60 Hz	–	–	≤–3.0 ±1.0 dB
25 Hz	–	–	Referenced
20 Hz	≤+9.0 ±1.0 dB	≤+6.5 ±1.0 dB	–
10 Hz	≤+14.0 ±1.5 dB	≤+10.0 ±1.5 dB	≤+4.0 ±1.0 dB
5 Hz	–	–	≤+7.5 ±1.5 dB
2 Hz	≤+26.0 ±2.0 dB	≤+20.5 ±2.0 dB	≤+13.0 ±2.0 dB
1 Hz	≤+28.5 ±2.0 dB	≤+22.5 ±2.0 dB	≤+17.0 ±2.0 dB

QP on/off switching uncertainty (PEAK, QP)	≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18° to 28°C)
Detection mode	QP, AVERAGE
Field strength measurement	Waveform data compensation data display for specified antenna factor, field strength (dBµV/m) Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)

• Option 14: PTA parallel I/O

Functions	Controls external devices from PTA, cannot be installed when Option 10 installed
System variables	As follows using PTA system variables IOA: Controls 8-bit parallel output port A IOB: Controls 8-bit parallel output port B IOC: Controls 4-bit parallel input/output port C IOD: Controls 4-bit parallel input/output port D EIO: Controls I/O switching of ports C/D EXO: Controls I/O trigger
PTL statements	External interrupt control of input to I/O ports using PTA-PTL statements IOEN statement: Enables interrupt input IODI statement: Disables interrupt input IOMA statement: Masks interrupt input ON TO GOTO statement: Changes program flow at interrupt generation ON TO GOSUB statement: Changes program flow at interrupt generation
Write strobe signal	Write strobe signal (negative pulse) output externally at control of output ports C/D
Power supply	External +5 ±0.5 Vdc (max. 100 mA) supply
Signal logic levels	Negative logic, TTL level Specified current: Output ports A/B (max. output current Hi: 2.6 mA, Lo: 24 mA) Output ports C/D (max. output current Hi: 15 mA, Lo: 24 mA) Other control output lines (max. output current Hi: 0.4 mA, Lo: 8 mA)
Connection cable connectors	Amphenol 36 pins
Connector pin layout	

No.	Item	No.	Item	No.	Item
1	GND	13	Output port B (0) LSB	25	I/O port D (0) LSB
2	Trigger input	14	Output port B (1)	26	I/O port D (1)
3	Trigger output 1	15	Output port B (2)	27	I/O port D (2)
4	Trigger output 2	16	Output port B (3)	28	I/O port D (3) MSB
5	Output port A (0) LSB	17	Output port B (4)	29	Port C status 0/1: I/O
6	Output port A (1)	18	Output port B (5)	30	Port D status 0/1: I/O
7	Output port A (2)	19	Output port B (6)	31	Write strobe signal
8	Output port A (3)	20	Output port B (7) MSB	32	Interruption signal
9	Output port A (4)	21	I/O port C (0) LSB	33	Not used
10	Output port A (5)	22	I/O port C (1)	34	+5 V power supply
11	Output port A (6)	23	I/O port C (2)	35	Not used
12	Output port A (7) MSB	24	I/O port C (3) MSB	36	Not used

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• Option 19: DC coupled input

Functions	DC-couples input circuit of main unit and expands lower limit of receiver frequency range to 500 Hz ∗Can only be installed with narrow RBW (Option 02)
Electrical characteristics	The standard specifications of the main unit are supplemented and changed as follows: Frequency range: 500 Hz to 3.0 GHz Max. input level: +30 dBm (CW, RF ATT: ≥10 dB), ±0 Vdc Average noise level: <–80 dBm (500 Hz to 10 kHz), ≤–90 dBm (10 kHz to 200 kHz), ≤–110 dBm (200 kHz to 1 MHz) ∗RBW: 30 Hz, VBW: 1 Hz, RF ATT: 0 dB Frequency response: ±1.2 dB (500 Hz to 100 kHz), ±0.5 dB (100 kHz to 3 GHz) ∗Referenced to 100 MHz frequency, RF ATT: 10 dB, 18° to 28°C

• Option 20: Tracking generator

Frequency range	9 kHz to 3 GHz
Output level range	0 to –60 dBm
Setting resolution	0.1 dB
Output level accuracy	≤±1.0 dB (at 100 MHz, 0 dBm)
Output level flatness	≤±1.5 dB (100 kHz to 3 GHz, output level: 0 dBm, referenced to 100 MHz frequency)
Output level linearity	≤±1.0 dB (0 to –30 dBm), ≤±2.0 (–30 to –60 dBm) ∗100 kHz to 3 GHz, 0 dBm output level reference
Spurious	Harmonic: ≤–20 dBc (100 kHz to 3 GHz), Non-harmonic: ≤–35 dBc (100 kHz to 3 GHz)
Tracking generator feed through	≤–95 dBm (spectrum analyzer input and tracking generator output connectors terminated at 50 Ω)
Output connector	N-J, 50 Ω

• Option 21: Television monitor (Multi)

Video	M-NTSC, B/G/H/I/D PAL, color
Audio	Simultaneous monitoring of video and audio ∗Needs Option 07
Function	Channel: Automatic setting to broadcast wave of CCIR, Japan, USA, Italy, UK and China; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC ∗Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal; Connector: BNC

• Option 22: 75 Ω input (Option 12, 19, and 20 cannot be installed simultaneously)

Frequency range		100 kHz to 2.5 GHz
Amplitude	Level measurement	Measurement range: Average noise level to +25 dBm (+133.8 dBµV) Max. input level: +25 dBm (+133.8 dBµV, CW average power, RF ATT: ≥10 dB), ±100 Vdc Residual response: ≤–95 dBm (+13.8 dBµV, RF ATT: 0 dB, input: 75 Ω terminated, 1 MHz to 2.5 GHz)
	Total level accuracy	±1.8 dB (100 kHz to 2.5 GHz, level measurement accuracy after calibration using internal calibration signal) Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dBm) + calibration signal source accuracy
	Reference level	Setting range Log scale: +8.8 to +133.8 dBµV, Linear scale: 274 µV to 4.87 V
	Frequency response	±1.0 dB (100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C)
	Waveform display	Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB) Linear scale: ±4% (according to reference level) Marker level resolution Log scale: 0.01 dB Linear scale: 0.02% (according to reference level)
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, mixer input: –30 dBm), ≤–75 dBc (0.2 to 1.25 GHz, band 0, mixer input: –30 dBm), ≤–80 dBc (0.8 to 1 GHz, mixer input: –30 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 2.5 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm
	Max. dynamic range	1 dB gain compression level to average noise level: >110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz), >109 dB (0.1 to 1 GHz, with Option 08), >109 dB – 1.5f [GHz] dB (>1 GHz with Option 08) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz) , >80 – f [GHz] dB (0.5 to 1.25 GHz), >82.5 – f [GHz] dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 dB – (2/3)f [GHz] dB (1 to 2.5 GHz)
Functions	Input connector	NC-J, 75 Ω
	Auxiliary I/O	VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical; from lower edge to upper edge at 10 dB/div, 100 MHz, 75 Ω terminated) 0 to 0.4 V ±0.1 V (typical; from lower edge to upper edge at 10%/div, 100 MHz, 75 Ω terminated), BNC connector

• Option 23: 75 Ω tracking generator (Option 12, 19, and 20 cannot be installed simultaneously)

Frequency range	100 kHz to 2.5 GHz
Output level range	+44 to +104 dBµV (setting resolution: 0.1 dB)
Output level accuracy	≤±1.5 dB (100 MHz, output level: +104 dBµV)
Output level flatness	≤±1.75 dB (100 kHz to 2.5 GHz, output level: +104 dBµV, referenced to 100 MHz)
Output level linearity	≤±1.0 dB (+74 to +104 dBµV), ≤±2.0 dB (+44 to +74 dBµV) ∗100 kHz to 2.5 GHz, referenced to +104 dBµV
Spurious	Harmonics: ≤–20 dBc (100 kHz to 2.5 GHz), Non-harmonics: ≤–30 dBc (100 kHz to 2.5 GHz)
Tracking generator feed through	≤13.8 dBµV (spectrum analyzer input and tracking generator output connectors terminated at 75 Ω)
Output connector	NC-J, 75 Ω

• Option 24: Television monitor (Brazil)

Video	M-NTSC, M PAL, color
Audio	Simultaneous monitoring of video and audio ∗Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan and USA; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC ∗Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name
	Main frame
MS2661C	Spectrum Analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0013	Fuse, 5 A: 2 pcs
W1251AE	MS2650B, MS2660B/C series operation manual: 1 copy
B0329G	Front cover (3/4MW4U)
	Options
MS2661C-01	Reference crystal oscillator
MS2661C-02	Narrow resolution bandwidth
MS2661C-04	High-speed time domain sweep
MS2661C-06	Trigger/gate circuit
MS2661C-07	AM/FM demodulator
MS2661C-08	Pre-amplifier
MS2661C-10	Centronics interface (GPIB cannot be installed simultaneously.)
MS2661C-12	QP detector (requires Option 02, QP-BW: 0.2/9/120 kHz)
MS2661C-14	PTA parallel I/O (Option 10 cannot be installed simultaneously.)
MS2661C-15	Sweep signal output
MS2661C-19	DC coupled input (requires Option 02)
MS2661C-20	Tracking generator
MS2661C-21	Television monitor (Multi)
MS2661C-22	75 Ω input (Option 12, 19 and 20 can not be installed simultaneously.)
MS2661C-23	75 Ω tracking generator (Option 12, 19 and 20 can not be installed simultaneously.)
MS2661C-24	Television monitor (Brazil)
	Measurement softwares
MX260002A	CDMA Cellular System Measurement Software
MX260003A	PDC Measurement Software (for base station)
MX260004A	GSM Measurement Software
MX261001A	Low-Power Data Communication System Measurement Software conforming to issue of Direct Spread Spectrum System
MX261002A	Low-Power Data Communication System Measurement Software conforming to issue of Frequency Hopping System
MX262001A	CATV Measurement Software
MX264001A	EMI Measurement Software
	Application parts
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P), 1 m
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)

Model/order No.	Name
J0055	Coaxial adapter (NC-P · BNC-J)
J0076	Coaxial adapter (NC-P · F-J)
B0391A	Carrying case (hard type, with casters)
B0391B	Carrying case (hard type, without casters)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC Block (MODEL 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer
J0121	Coaxial cord (NC-P-3W · 3C-2WS · NC-P-3W), 1 m
J0308	Coaxial cord (BNC-P · 3C-2WS · NC-P-3W), 1 m
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz)
MP640A	Branch
MP654A	Branch
MP520A	CM Directional Coupler
MP520B	CM Directional Coupler
MP520C	CM Directional Coupler
MP520D	CM Directional Coupler
MP526A	High Pass Filter
MP526B	High Pass Filter
MP526C	High Pass Filter
MP526D	High Pass Filter
MP526G	High Pass Filter
MA1601A	High Pass Filter (800/900 MHz band, N)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m [for PC-98 Personal Computer and VP-600, D-sub 25 pins (straight)]
J0743A	RS-232C cable, 1 m [for AT compatible, D-sub 9-pins (cross)]
60N50-1	Reflection bridge
60NF50-1	Reflection bridge
87A50	Reflection bridge
62N75	Reflection bridge
62NF75	Reflection bridge
MH648A	Pre-Amplifier
MP534A	Dipole Antenna
MP651A	Dipole Antenna
BBA9106/VHA9103	Biconical Antenna
MP635A	Log-Periodic Antenna
MP666A	Log-Periodic Antenna
MB9A	Tripod
MB19A	Tripod
MA2601B	EMI Probe
MA2601C	EMI Probe
KT-10	EMI Clamp
KT-20	EMI Clamp

SPECTRUM ANALYZER
MS2651B/2661B

9 kHz to 3 GHz

CE GPIB
(MS2651B)

For Maintaining CATV Circuits

The MS2651B/2661B Portable Spectrum Analyzers are for use in signal analysis of radio and other equipment related to improving frequency usage efficiency, higher modulation, and digitalization. They are synthesized spectrum analyzers covering a wide frequency range from 9 kHz to 3 GHz. They have superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and are easy to operate. They have the “Measure” function for evaluation of radio equipment (frequency counter, C/N, adjacent channel power, occupied frequency bandwidth, burst average power, and template decision function) and which enables the two-screen display and FM demodulation waveform display. The large selection of options means a wider range of applications can be handled at reasonable cost.

The MS2661B is designed for manufacture and installation of radio equipment and devices, while the MS2651B is used for maintenance applications.

Specifications

Except where noted otherwise, specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Model		MS2651B	MS2661B
Frequency	Frequency range	9 kHz to 3 GHz	
	Display frequency accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz) ∗Span: ≥10 kHz, after calibration	
	Marker frequency display accuracy	Normal: Same as display frequency accuracy; Delta: Same as frequency span accuracy	
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)	
	Frequency span	Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5% (span: ≥10 kHz)	Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5% (span: ≥10 kHz) ±5% (span: <10 kHz, with option 02)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 5 MHz (manually settable, or automatically settable according to frequency span) ∗Option 02 (MS2661B only): 30 Hz, 100 Hz, and 300 Hz are added. Measurements of noise, C/N, adjacent channel power, and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Selectivity (60 dB : 3 dB): ≤10:1 (RBW: 1 to 300 kHz), ≤15:1 (RBW: 1, 5 MHz)	
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF (manually settable, or automatically settable according to RBW)	
	Noise sideband, stability	Noise sideband: ≤–90 dBc/Hz (1 GHz, 10 kHz offset)	Noise sideband: ≤–100 dBc/Hz (1 GHz, 10 kHz offset)
		Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1 hour warm-up at constant ambient temperature	
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5} (typical, 0° to 50°C); Option 01: ±5 x 10^{-8} (0° to 50°C, referenced to 25°C)	

Continued on next page

<table>
<tr><th colspan="2">Model</th><th>MS2651B</th><th>MS2661B</th></tr>
<tr><td rowspan="9">Amplitude</td><td rowspan="2">Level measurement</td><td colspan="2">Measurement range: Average noise level to +30 dBm
Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±50 Vdc</td></tr>
<tr><td>Average noise level:
≤–110 dBm (1 MHz to 1 GHz),
≤–110 dBm + f [GHz] dB (>1 GHz)
*RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
Residual response:
≤–95 dBm (RF ATT: 0 dB, input: 50 Ω termination, 1 MHz to 3 GHz)</td><td>Average noise level:
≤–115 dBm (1 MHz to 1 GHz),
≤–115 dBm + f [GHz] dB (>1 GHz),
≤–114 dBm (1 MHz to 1 GHz, at Option 08 pre-amplifier installed),
≤–114 dBm + 1.5f [GHz] dB (>1 MHz, at Option 08 pre-amplifier installed)
*RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
Residual response:
≤–100 dBm (RF ATT: 0 dB, input: 50 Ω termination, 1 MHz to 3 GHz)</td></tr>
<tr><td>Total level accuracy</td><td colspan="2">±1.3 dB (100 kHz to 3 GHz) *Level measurement accuracy after calibration using internal calibration signal
Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dB) + calibration signal source accuracy</td></tr>
<tr><td>Reference level</td><td colspan="2">Setting range
Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V
Unit
Log scale: dBm, dBµV, dBmV, V, dBµVemf, W, dBµV/m
Linear scale: V
Reference level accuracy:
±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm)
*After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO)
RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (5 MHz) *After calibration, referenced to RBW: 3 kHz
Input attenuator (RF ATT)
Setting range: 0 to 70 dB (10 dB steps) *Manually settable, or automatically settable according to reference level
Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB)
*After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB</td></tr>
<tr><td>Frequency response</td><td colspan="2">±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
±1.5 dB (9 to 100 kHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
±1.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB)</td></tr>
<tr><td>Waveform display</td><td colspan="2">Scale (10 div)
Log scale: 10, 5, 2, 1 dB/div
Linear scale: 10, 5, 2, 1%/div
Linearity (after calibration)
Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz),
±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz)
Linear scale: ±4% (compared to reference level)
Marker level resolution
Log scale: 0.01 dB, Linear scale: 0.02% of reference level</td></tr>
<tr><td>Spurious response</td><td>2nd harmonic distortion:
≤–55 dBc (10 to 100 MHz), ≤–60 dBc (0.1 to 1.5 GHz)
*Mixer input: –30 dBm
Two signals 3rd order intermodulation distortion:
≤–70 dBc (10 MHz to 3 GHz)
*Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm)</td><td>2nd harmonic distortion:
≤–60 dBc (10 to 200 MHz), ≤–75 dBc (0.2 to 1.5 GHz),
≤–80 dBc (0.8 to 1 GHz) *Mixer input: –30 dBm
Two signals 3rd order intermodulation distortion:
≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 3 GHz)
*Frequency difference of two signals: ≥50 kHz, mixer input : –30 dBm</td></tr>
<tr><td>1 dB gain compression</td><td colspan="2">≥–5 dBm (≥100 MHz, at mixer input)</td></tr>
<tr><td>Maximum dynamic range</td><td>1 dB gain compression level to average noise level:
>105 dB (0.1 to 1 GHz), >105 dB – f [GHz] dB (>1 GHz)
Distortion characteristics (RBW: 1 kHz)
2nd harmonic: >67.5 dB (10 to 100 MHz),
>70 dB (100 to 500 MHz),
>70 – f [GHz] dB (0.5 to 1.5 GHz)
3rd order intermodulation :
>76.6 dB (10 MHz to 1 GHz),
>76.6 – (2/3)f [GHz] dB (1 to 3 GHz)</td><td>1 dB gain compression level to average noise level:
>110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz),
>109 dB (0.1 to 1 GHz, at Option 08 pre-amplifier installed)
>109 dB – 1.5f [GHz] (>1 GHz, at Option 08 pre amplifier installed)
Distortion characteristics (RBW: 1 kHz)
2nd harmonic:>72.5 dB (10 to 200 MHz),
>80 dB (200 to 500 MHz),
>80 – f [GHz] dB (0.5 to 1.5 GHz)
>82.5 – f [GHz] dB (0.8 to 1 GHz)
3rd order intermodulation:
>80 dB (10 to 100 MHz),
>83.3 dB (0.1 to 1 GHz),
>83.3 – (2/3)f [GHz] dB (1 to 3 GHz)</td></tr>
<tr><td rowspan="5">Sweep</td><td>Sweep time</td><td colspan="2">Setting range : 20 ms to 1000 s (Manually settable, or automatically settable according to span, RBW and VBW)
Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)</td></tr>
<tr><td>Sweep mode</td><td colspan="2">Continuous, single</td></tr>
<tr><td>Time domain sweep mode</td><td colspan="2">Analog zero span, digital zero span</td></tr>
<tr><td>Zone sweep</td><td colspan="2">Sweeps only in frequency range indicated by zone marker</td></tr>
<tr><td>Tracking sweep</td><td colspan="2">Sweeps while tracing peak points within zone marker (zone sweep also possible)</td></tr>
<tr><td rowspan="3">Functions</td><td>Number of data points</td><td colspan="2">501</td></tr>
<tr><td>Detection mode</td><td colspan="2">NORMAL: Simultaneously displays max. and min. points between sample points
POS PEAK: Displays max. point between sample points
NEG PEAK: Displays min. point between sample points
SAMPLE: Displays momentary value at sample points
Detection mode switching uncertainty: ±0.5 dB (at reference level)</td></tr>
<tr><td>Display</td><td colspan="2">Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable); Intensity adjustment: 5 steps settable</td></tr>
</table>

Continued on next page

Model		MS2651B	MS2661B
Functions	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously at alternate sweep Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously at alternate sweep Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A	
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE	
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display accuracy: ±5% of full scale (referenced to center frequency, DC-coupled, RBW: 5 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz ∗Range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth DC (50 Hz at AC-coupled) to 500 kHz ∗Range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth ∗RBW: ≥100 kHz usable	
	Input connector	N-J, 50 Ω	
	Auxiliary signal input and output	IF OUTPUT: 455 kHz (RBW: ≤30 kHz), 10.695 MHz (RBW: ≥100 kHz), BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz, from lower edge to upper edge at 10 dB/div or 10%/div, 75 Ω terminated, BNC connector) COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector	
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL	
	Zone marker	NORMAL, DELTA	
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN	
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP	
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)	
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)	
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card	
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface Plotter (HP-GL, GP-GL compatible models): Display can be output via RS-232C and GPIB interface	
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using editor of external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 kB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions	
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)	
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28	
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) ∗Typical value Antenna correction coefficients: Correct display and measurement of field strengths (dBµV/m) for specified antennas. Internal antenna correction coefficients (MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, and four antennas user-defined; writes via GPIB or RS-232C interface, saves/loads to/from memory card)	
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM ∗Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS. Connector: Meets the PCMCIA Rel. 2.0, 2 slots	
Others	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)	–
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)	–
	Vibration	Meets the MIL-STD-810D	
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤320 VA	
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤10.8 kg (without option)	
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)	

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0° to 50°C, with reference to 25°C)
Buffer output	BNC connector, 10 MHz, >2 Vp-p (200 Ω terminated)

• Option 02: Narrow resolution bandwidth (MS2661B only)

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Selectivity (60 dB:3 dB)	≤15:1 (RBW: 100, 300 Hz), ≤20:1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	0.1 dB (log scale), 0.2% (linear scale, relative to reference level)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 06: Trigger/gate circuit

Trigger switch		FREERUN, TRIGGERED
Trigger source	EXT	Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/Fall Connector: BNC
	VIDEO	Trigger level (at log scale): –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/Fall
	WIDE IF VIDEO	Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/Fall
	LINE	Frequency: 47.5 to 63 Hz (line lock)
	TV	Method: M-NTSC, B/G/H PAL Sync: V-SYNC, H-SYNC Sync line (NTSC) H-SYNC (ODD): 7 to 262 line, H-SYNC (EVEN): 1 to 263 line Sync line (PAL) H-SYNC (ODD): 1 to 312 line, H-SYNC (EVEN): 317 to 625 line ∗Option 16 required
Trigger delay		Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 µs
Gate sweep		In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 08: Pre-amplifier[*1]

Frequency range		100 kHz to 3 GHz, 100 kHz to 2.5 GHz (with Option 22)
Noise figure		≤7 dB (typical, <2 GHz), ≤12 dB (typical, ≥2 GHz), ≤9 dB (typical, <2 GHz, with Option 22), ≤14 dB (typical, ≥2 GHz, with Option 22)
Amplitude	Measurement range	Average noise level to +10 dBm
	Max. input level	CW average power: +10 dBm, ±50 Vdc
	Average noise level	MS2651B: ≤–130 dBm (1 MHz to 1 GHz), ≤–130 dBm + 1.5f [GHz] dB (>1 GHz) MS2661B: ≤–134 dBm (1 MHz to 1 GHz), ≤–134 dBm + 2f [GHz] dB (>1 GHz), ≤–132 dBm (1 MHz to 1 GHz, with Option 22), ≤–132 dBm + 2f [GHz] dB (≥1 GHz, with Option 22) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
	Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 22.4 µV to 707 mV, 27.4 µV to 487 mV with Option 22 Reference level accuracy: ±0.5 dB (–69.9 to –20 dBm), ±0.75 dB (–89.9 to –70 dBm, –19.9 to +10 dBm) ∗After calibration, referenced to 100 MHz, span: 1 MHz (RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB ∗After calibration, referenced to RBW: 3 kHz RF ATT switching uncertainty: ±0.5 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) ∗After calibration, referenced to 100 MHz, RF ATT: 10 dB
	Frequency response	±2.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB) ±2.0 dB (with Option 22, 100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
	Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB), ±1.0 dB (0 to –60 dB), ±1.5 dB (0 to –75 dB) Linear scale (after calibration): ±5% (according to reference level)
	Spurious response	Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz, 10 MHz to 2.5 GHz with Option 22) ∗Frequency difference of two signals: ≥50 kHz; Pre-amplifier input[*2]: –55 dBm
	1 dB gain compression	≥–35 dBm (≥100 MHz, at pre-amplifier input[*2])

∗1: Overall specification with pre-amplifier on (Noise figure is the simple performance)
∗2: Pre-amplifier input level = RF input level – RF ATT setting level

• Option 10: Centronics interface

Function	Outputs data to printer (Centronics standard). GPIB interface cannot be installed simultaneously.
Connector	D-sub 25-pin (jack)

• Option 12: QP detector (MS2661B only)

<table>
<tr><td>Functions</td><td>QP detection ∗Requires Option 02. When Option 12 installed, Option 02 RBW 100 Hz 3 dB bandwidth changed to 150 Hz (typical)</td></tr>
<tr><td>6 dB bandwidth</td><td>200 Hz, 9 kHz, 120 kHz
Accuracy: ±30% (18° to 28°C)</td></tr>
<tr><td>Display</td><td>LOG scale, 5 dB/div (10 divisions)
Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBµV, RF ATT: 0 dB, 18° to 28°C)</td></tr>
<tr><td>Pulse response characteristics</td><td>Response to CISPR pulse (DET mode: QP, 18° to 28°C)
<table>
<tr><td rowspan="2">Repetition frequency</td><td colspan="3">Bandwidth</td></tr>
<tr><td>120 kHz</td><td>9 kHz</td><td>200 Hz</td></tr>
<tr><td>1 kHz</td><td>≤–8.0 ±1.0 dB</td><td>≤–4.5 ±1.0 dB</td><td>–</td></tr>
<tr><td>100 Hz</td><td>Referenced</td><td>Referenced</td><td>≤–4.0 ±1.0 dB</td></tr>
<tr><td>60 Hz</td><td>–</td><td>–</td><td>≤–3.0 ±1.0 dB</td></tr>
<tr><td>25 Hz</td><td>–</td><td>–</td><td>Referenced</td></tr>
<tr><td>20 Hz</td><td>≤+9.0 ±1.0 dB</td><td>≤+6.5 ±1.0 dB</td><td>–</td></tr>
<tr><td>10 Hz</td><td>≤+14.0 ±1.5 dB</td><td>≤+10.0 ±1.5 dB</td><td>≤+4.0 ±1.0 dB</td></tr>
<tr><td>2 Hz</td><td>≤+26.0 ±2.0 dB</td><td>≤+20.5 ±2.0 dB</td><td>≤+13.0 ±2.0 dB</td></tr>
<tr><td>1 Hz</td><td>≤+28.5 ±2.0 dB</td><td>≤+22.5 ±2.0 dB</td><td>≤+17.0 ±2.0 dB</td></tr>
</table></td></tr>
<tr><td>QP on/off switching uncertainty (PEAK, QP)</td><td>≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18° to 28°C)</td></tr>
<tr><td>Detection mode</td><td>QP, AVERAGE</td></tr>
<tr><td>Field strength measurement</td><td>Waveform data compensation data display for specified antenna factor, field strength (dBµV/m)
Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)</td></tr>
</table>

• Option 13: QP detector (MS2651B only)

<table>
<tr><td>6 dB bandwidth</td><td>9 kHz, 120 kHz
Accuracy: ±30% (18° to 28°C)</td></tr>
<tr><td>Display</td><td>LOG scale, 5 dB/div (10 divisions)
Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBµV, RF ATT: 0 dB, 18° to 28°C)</td></tr>
<tr><td>Pulse response characteristics</td><td>Response to CISPR pulse (DET mode: QP, 18° to 28°C)
<table>
<tr><td rowspan="2">Repetition frequency</td><td colspan="2">Bandwidth</td></tr>
<tr><td>120 kHz</td><td>9 kHz</td></tr>
<tr><td>1 kHz</td><td>≤–8.0 ±1.0 dB</td><td>≤–4.5 ±1.0 dB</td></tr>
<tr><td>100 Hz</td><td>Referenced</td><td>Referenced</td></tr>
<tr><td>20 Hz</td><td>≤+9.0 ±1.0 dB</td><td>≤+6.5 ±1.0 dB</td></tr>
<tr><td>10 Hz</td><td>≤+14.0 ±1.5 dB</td><td>≤+10.0 ±1.5 dB</td></tr>
<tr><td>2 Hz</td><td>≤+26.0 ±2.0 dB</td><td>≤+20.5 ±2.0 dB</td></tr>
<tr><td>1 Hz</td><td>≤+28.5 ±2.0 dB</td><td>≤+22.5 ±2.0 dB</td></tr>
</table></td></tr>
<tr><td>QP on/off switching uncertainty (PEAK, QP)</td><td>≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18° to 28°C)</td></tr>
<tr><td>Detection mode</td><td>QP, AVERAGE</td></tr>
<tr><td>Field strength measurement</td><td>Waveform data compensation data display for specified antenna factor, field strength (dBµV/m)
Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)</td></tr>
</table>

• Option 14: PTA parallel I/O

Functions	Controls external devices from PTA, cannot be installed when Option 10 installed
System variables	As follows using PTA system variables IOA: Controls 8-bit parallel output port A IOB: Controls 8-bit parallel output port B IOC: Controls 4-bit parallel input/output port C IOD: Controls 4-bit parallel input/output port D EIO: Controls I/O switching of ports C/D EXO: Controls I/O trigger
PTL statements	External interrupt control of input to I/O ports using PTA-PTL statements IOEN statement: Enables interrupt input IODI statement: Disables interrupt input IOMA statement: Masks interrupt input ON TO GOTO statement: Changes program flow at interrupt generation ON TO GOSUB statement: Changes program flow at interrupt generation
Write strobe signal	Write strobe signal (negative pulse) output externally at control of output ports C/D
Power supply	External +5 ±0.5 Vdc (max. 100 mA) supply
Signal logic levels	Negative logic, TTL level Specified current: Output ports A/B (max. output current Hi: 2.6 mA, Lo: 24 mA) Output ports C/D (max. output current Hi: 15 mA, Lo: 24 mA) Other control output lines (max. output current Hi: 0.4 mA, Lo: 8 mA)

Continued on next page

<table>
<tr><td>Connection cable connectors</td><td>Amphenol 36 pins</td></tr>
<tr><td>Connector pin layout</td><td>
<table>
<tr><th>No.</th><th>Item</th><th>No.</th><th>Item</th><th>No.</th><th>Item</th></tr>
<tr><td>1</td><td>GND</td><td>13</td><td>Output port B (0) LSB</td><td>25</td><td>I/O port D (0) LSB</td></tr>
<tr><td>2</td><td>Trigger input</td><td>14</td><td>Output port B (1)</td><td>26</td><td>I/O port D (1)</td></tr>
<tr><td>3</td><td>Trigger output 1</td><td>15</td><td>Output port B (2)</td><td>27</td><td>I/O port D (2)</td></tr>
<tr><td>4</td><td>Trigger output 2</td><td>16</td><td>Output port B (3)</td><td>28</td><td>I/O port D (3) MSB</td></tr>
<tr><td>5</td><td>Output port A (0) LSB</td><td>17</td><td>Output port B (4)</td><td>29</td><td>Port C status 0/1: I/O</td></tr>
<tr><td>6</td><td>Output port A (1)</td><td>18</td><td>Output port B (5)</td><td>30</td><td>Port D status 0/1: I/O</td></tr>
<tr><td>7</td><td>Output port A (2)</td><td>19</td><td>Output port B (6)</td><td>31</td><td>Write strobe signal</td></tr>
<tr><td>8</td><td>Output port A (3)</td><td>20</td><td>Output port B (7) MSB</td><td>32</td><td>Interruption signal</td></tr>
<tr><td>9</td><td>Output port A (4)</td><td>21</td><td>I/O port C (0) LSB</td><td>33</td><td>Not used</td></tr>
<tr><td>10</td><td>Output port A (5)</td><td>22</td><td>I/O port C (1)</td><td>34</td><td>+5 V power supply</td></tr>
<tr><td>11</td><td>Output port A (6)</td><td>23</td><td>I/O port C (2)</td><td>35</td><td>Not used</td></tr>
<tr><td>12</td><td>Output port A (7) MSB</td><td>24</td><td>I/O port C (3) MSB</td><td>36</td><td>Not used</td></tr>
</table>
</td></tr>
</table>

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• Option 19: DC coupled input (MS2661B only)

Functions	DC-couples input circuit of main unit and expands lower limit of receiver frequency range to 500 Hz ∗Can only be installed with narrow RBW (Option 02)
Electrical characteristics	The standard specifications of the main unit are supplemented and changed as follows: Frequency range: 500 Hz to 3.0 GHz Max. input level: +30 dBm (CW, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤80 dBm (500 Hz to 10 kHz), ≤90 dBm (10 kHz to 200 kHz), ≤–110 dBm (200 kHz to 1 MHz) ∗RBW: 30 Hz, VBW: 1 Hz, RF ATT: 0 dB Frequency response: ±1.2 dB (500 Hz to 100 kHz), ±0.5 dB (100 kHz to 3 GHz) ∗Referenced to 100 MHz frequency, RF ATT: 10 dB, 18° to 28°C

• Option 20: Tracking generator

Frequency range	9 kHz to 3 GHz
Output level range	0 to –60 dBm
Setting resolution	0.1 dB
Output level accuracy	≤±1.0 dB (at 100 MHz, 0 dBm)
Output level flatness	≤±1.5 dB (100 kHz to 3 GHz, output level: 0 dBm, referenced to 100 MHz frequency)
Output level linearity	≤±1.0 dB (0 to –30 dBm), ≤±2.0 (–30 to –60 dBm) ∗100 kHz to 3 GHz, 0 dBm output level reference
Spurious	Harmonic: ≤–20 dBc (100 kHz to 3 GHz), Non-harmonic: ≤–35 dBc (100 kHz to 3 GHz)
Tracking generator feed through	≤–95 dBm (spectrum analyzer input and tracking generator output connectors terminated at 50 Ω)
Output connector	N-J, 50 Ω

• Option 21: Television monitor (Multi)

Video	M-NTSC, B/G/H/I/D PAL, color
Audio	Simultaneous monitoring of video and audio ∗Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan, USA, Italy, UK and China; automatic setting to CATV of CCIR, Japan, and USA Trigger: Triggered sweep by V-SYNC, H-SYNC ∗Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

• Option 22: 75 Ω input (Option 12, 13, 19, and 20 cannot be installed simultaneously)

Frequency range		100 kHz to 2.5 GHz
Amplitude	Level measurement	Measurement range: Average noise level to +25 dBm (+133.8 dBµV) Max. input level: +25 dBm (+133.8 dBµV, CW average power, RF ATT: ≥10 dB), ±100 Vdc Residual response: ≤–95 dBm (+13.8 dBµV, RF ATT: 0 dB, input: 75 Ω terminated, 1 MHz to 2.5 GHz)
	Total level accuracy	±1.8 dB (100 kHz to 2.5 GHz, level measurement accuracy after calibration using internal calibration signal) Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dBm) + calibration signal source accuracy
	Reference level	Setting range Log scale: +8.8 to +133.8 dBµV, Linear scale: 274 µV to 4.87 V
	Frequency response	±1.0 dB (100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C)
	Waveform display	Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz) Linear scale: ±4% (according to reference level) Marker level resolution Log scale: 0.01 dB Linear scale: 0.02% (according to reference level)
	Spurious response	2nd harmonic distortion (MS2651B): ≤–55 dBc (10 to 100 MHz, mixer input: –30 dBm) , ≤–60 dBc (0.1 to 1.25 GHz, mixer input: –30 dBm) 2nd harmonic distortion (MS2661B): ≤–60 dBc (10 to 200 MHz, mixer input: –30 dBm) , ≤–75 dBc (0.2 to 1.25 GHz, band 0, mixer input: –30 dBm), ≤–80 dBc (0.8 to 1 GHz, mixer input: –30 dBm) Two signals 3rd order intermodulation distortion (MS2651B): ≤–70 dBc (10 to 2.5 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Two signals 3rd order intermodulation distortion (MS2661B): ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 2.5 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm
	Max. dynamic range	1 dB gain compression level to average noise level (MS2651B): >105 dB (0.1 to 1 GHz), >105 dB – f [GHz] dB (>1 GHz) 1 dB gain compression level to average noise level (MS2661B): >110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz), >109 dB (0.1 to 1 GHz, with Option 08), >109 dB – 1.5f [GHz] dB (>1 GHz with Option 08) Distortion characteristics (MS2651B RBW: 1 kHz) 2nd harmonic: >67.5 dB (10 to 100 MHz), >70 dB (100 to 500 MHz) , >70 – f [GHz] dB (0.5 to 1.25 GHz) 3rd order intermodulation: >76.6 dB (0.1 to 1 GHz), >76.6 dB – (2/3)f [GHz] dB (1 to 2.5 GHz) Distortion characteristics (MS2661B RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz) , >80 – f [GHz] dB (0.5 to 1.25 GHz), >82.5 – f [GHz] dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 dB – (2/3)f [GHz] dB (1 to 2.5 GHz)
Functions	Input connector	NC-J, 75 Ω
	Auxiliary I/O	VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical, from lower edge to upper edge at 10 dB/div, 100 MHz, 75 Ω terminated) 0 to 0.4 V ±0.1 V (typical, from lower edge to upper edge at 10%/div, 100 MHz, 75 Ω terminated), BNC connector

• Option 23: 75 Ω tracking generator (Option 12, 13, 19, and 20 cannot be installed simultaneously)

Frequency range	100 kHz to 2.5 GHz
Output level range	+44 to +104 dBµV (setting resolution: 0.1 dB)
Output level accuracy	≤±1.5 dB (100 MHz, output level: +104 dBµV)
Output level flatness	≤±1.75 dB (100 kHz to 2.5 GHz, output level: +104 dBµV, referenced to 100 MHz)
Output level linearity	≤±1.0 dB (+74 to +104 dBµV), ≤±2.0 dB (+44 to +74 dBµV) ∗100 kHz to 2.5 GHz, referenced to +104 dBµV
Spurious	Harmonics: ≤–20 dBc (100 kHz to 2.5 GHz) Non-harmonics: ≤–30 dBc (100 kHz to 2.5 GHz)
Tracking generator feed through	≤13.8 dBµV (spectrum analyzer input and tracking generator output connectors terminated at 75 Ω)
Output connector	NC-J, 75 Ω

• Option 24: Television monitor (Brazil)

Video	M-NTSC, M PAL, color
Audio	Simultaneous monitoring of video and audio ∗Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan and USA; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC ∗Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name
	Main frame
MS2651B	Spectrum Analyzer
MS2661B	Spectrum Analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0014	Fuse, 6.3 A: 2 pcs
W1251AE	MS2650B, MS2660B/C series operation manual: 1 copy
B0329G	Front cover(3/4MW4U)
	Options
MS2651B/2661B-01	Reference crystal oscillator
MS2661B-02	Narrow resolution bandwidth
MS2651B/2661B-04	High-speed time domain sweep
MS2651B/2661B-06	Trigger/gate circuit
MS2651B/2661B-07	AM/FM demodulator
MS2651B/2661B-08	Pre-amplifier
MS2651B/2661B-10	Centronics interface (GPIB cannot be installed simultaneously)
MS2661B-12	QP detector (requires Option 02, QP-BW: 0.2/9/120 kHz)
MS2651B-13	QP detector (QP-BW: 9/120 kHz)
MS2651B/2661B-14	PTA parallel I/O (Option 10 cannot be installed simultaneously)
MS2651B/2661B-15	Sweep signal output
MS2661B-19	DC coupled input (MS2661B only, requires Option 02)
MS2651B/2661B-20	Tracking generator
MS2651B/2661B-21	Television monitor (Multi)
MS2651B/2661B-22	75 Ω input (Option 12, 13, 19, and 20 cannot be installed simultaneously)
MS2651B/2661B-23	75 Ω tracking generator (Option 12, 13, 19, and 20 cannot be installed simultaneously)
MS2651B/2661B-24	Television monitor (Brazil)
	Measurement softwares
MX260002A	CDMA Cellular System Measurement Software
MX260003A	PDC Measurement Software (for base station)
MX260004A	GSM Measurement Software
MX261001A	Low-Power Data Communication System Measurement Software conforming to issue of Direct Spread Spectrum System
MX261002A	Low-Power Data Communication System Measurement Software conforming to issue of Frequency Hopping System
MX262001A	CATV Measurement Software
MX264001A	EMI Measurement Software
	Application parts
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P) , 1 m
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)

Model/order No.	Name
J0055	Coaxial adapter (NC-P · BNC-J)
J0076	Coaxial adapter (NC-P · F-J)
B0391A	Carrying case (hard type, with casters)
B0391B	Carrying case (hard type, without casters)
B0436A	Carrying case (soft type)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC Block (Model 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer
J0121	Coaxial cord (NC-P-3W · 3C-2WS · NC-P-3W), 1 m
J0308	Coaxial cord (BNC-P · 3C-2WS · NC-P-3W), 1 m
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz)
J0395	Fixed attenuator for high power (30 dB , 30 W, DC to 9 GHz)
MP640A	Branch
MP654A	Branch
MP520A	CM Directional Coupler
MP520B	CM Directional Coupler
MP520C	CM Directional Coupler
MP520D	CM Directional Coupler
MP526A	High Pass Filter
MP526B	High Pass Filter
MP526C	High Pass Filter
MP526D	High Pass Filter
MP526G	High Pass Filter
MA1601A	High Pass Filter (800/900 MHz band, N)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m [for PC-98 Personal Computer and VP-600, D-sub 25 pins (straight)]
J0743A	RS-232C cable, 1 m [for AT compatible, D-sub 9-pins (cross)]
60N50-1	Reflection bridge
60NF50-1	Reflection bridge
87A50	Reflection bridge
62N75	Reflection bridge
62NF75	Reflection bridge
MH648A	Pre-Amplifier
MP534A	Dipole Antenna
MP651A	Dipole Antenna
BBA9106/VHA9103	Biconical Antenna
MP635A	Log-Periodic Antenna
MP666A	Log-Periodic Antenna
MB9A	Tripod
MB19A	Tripod
MA2601B	EMI Probe
MA2601C	EMI Probe
KT-10	EMI Clamp
KT-20	EMI Clamp

SPECTRUM MASTER

MS2711B/D

100 kHz to 3.0 GHz

CE

Fast, Accurate, Repeatable, Portable Spectrum Analysis

NEW

The MS2711B/D Handheld Spectrum Analyzer provides the "ultimate" in measurement flexibility for field environments and applications requiring mobility. Unlike traditional spectrum analyzers, the MS2711B/D features a rugged, ultra-lightweight, battery-operated design that enables users to conduct spectrum analysis measurements – anywhere, anytime.

Providing complete freedom from AC/DC power requirements, the MS2711B/D enables you to locate, identify, record and solve communication systems problems quickly and easily, without sacrificing measurement accuracy.

Whether you are installing, maintaining, or troubleshooting a modern wireless communication system, the MS2711B/D provides exceptional performance combined with ease-of-use and broad functionality – making it an ideal solution for engineers and technicians who conduct field measurements in the 100 kHz to 3.0 GHz frequency range. In fact, it is ideal for finding the source of interfering signals in modern wireless systems.

Rugged and Reliable

Because the MS2711B/D was designed specifically for field environments, it can easily withstand the day-to-day punishment of field use. Rugged packaging also keeps the MS2711B/D performing in harsh environments.

Easy-to-Use

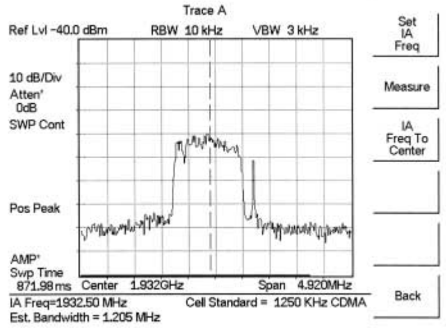
Not only is the MS2711B/D the lightest fully-functional spectrum analyzer available at 4.5 pounds (base model including battery), operation is straight-forward and driven by firmware that simplifies the process of making measurements and interpreting the results shown on the large, high-resolution LCD display. The menu-driven user interface is easy to use and requires little training.

A full range of marker capabilities such as peak, center and delta functions are also provided, giving users a faster and more comprehensive measurement of displayed signals. Limit lines simplify amplitude measurements, giving users the capability to create quick, simple, pass/fail measurements. Frequency, span and amplitude functions are easily configured for optimum performance. Used together with the Save Setup feature, these functions can help to make testing easier and faster for less experienced users.

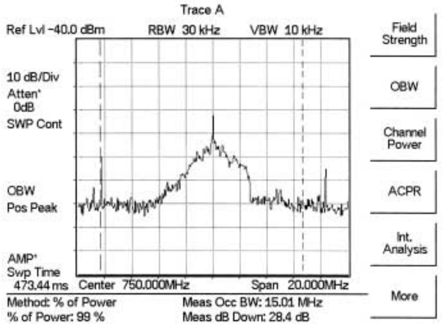
Powerful Trace Management

Users are able to store ten test setups along with 200 measurement traces internally in the unit's memory. The stored data can be easily downloaded to a personal computer (PC) or a printer via an RS-232 serial cable for further analysis. A notebook computer can be used with the RS-232 interface for automated control and data collection in the field.

A standard preamplifier (option 8) plus a number of available options including an internal tracking generator (option 20, MS2711B) or transmission measurement (option 21, MS2711D) expand the MS2711B/D's capabilities.



Trace A
Ref Lvl -40.0 dBm RBW 10 kHz VBW 3 kHz
10 dB/Div
Atten' 0dB
SWP Cont
Pos Peak
AMP'
Swp Time 871.98 ms
Center 1.932GHz
Span 4.920MHz
IA Freq=1932.50 MHz
Cell Standard = 1250 KHz CDMA
Est. Bandwidth = 1.205 MHz



Trace A
Ref Lvl -40.0 dBm RBW 30 kHz VBW 10 kHz
10 dB/Div
Atten' 0dB
SWP Cont
OBW
Pos Peak
AMP'
Swp Time 473.44 ms
Center 750.000MHz
Span 20.000MHz
Method: % of Power
% of Power: 99 %
Meas Occ BW: 15.01 MHz
Meas dB Down: 28.4 dB

To meet the challenges of today's wireless market, Anritsu Company has incorporated a pre-amp (standard) for its revolutionary MS2711B/D Handheld Spectrum Analyzer which increases the analyzer's sensitivity and dynamic range while improving measurement time. With the built-in pre-amp feature, the MS2711B/D is particularly effective in measuring low-level signals. The handheld spectrum analyzer's sensitivity is improved to –115 dBm for MS2711B and –135 dBm for MS2711D (100 Hz RBW) (full span). With this option, the MS2711B/D can identify and make measurements on low-level signals much faster than previously possible.

The improved sensitivity, dynamic range, and measurement speed complement the existing benefits of the MS2711B/D. Weighing only 4.9 pounds (including a NiMH battery, fully loaded, base model only 4.5 pounds), the MS2711B/D is the world's lightest fully functional handheld spectrum analyzer with the built-in tracking generator option (option 20).

MS2711B/D has been enhanced so that it can make highly accurate channel power measurements, occupied bandwidth and Adjacent Channel Power Ratio (ACPR) measurements. These are increasingly critical measurements, particularly for power amplifiers used in wireless communication systems. With the enhancements, the MS2711B/D has dedicated one button channel power, occupied bandwidth, and ACPR measurement capability to significantly reduce test time and expense. The MS2711B/D also features local language graphical user interface support (in Chinese, Japanese, French, German, and Spanish).

Features

- Lightweight (4.5 lbs - base model, 4.9 lbs with tracking generator - option 20, or transmission measurement, option 21)
- Synthesizer-based performance
- Wide dynamic range
- One button, ACPR, OBW, channel power, C/I measurement
- Quick zoom-in, zoom-out display
- 5 minute warm up
- Manual and automatic attenuator control
- Improved user interface, with local language support in five different languages
- Automatic overload and ESD protection
- Built-in AM/FM demodulation
- Built-in field strength measurement
- Built-in interference analysis
- Ability to store and recall up to six antenna factors
- Full range of marker capabilities including peak, center, and delta functions
- Limit lines for quick, simple pass/fail measurements
- Rugged, reliable packaging
- Battery operated design
  - 2.5 hours of continuous operation
  - Built-in energy conservation that extends battery life beyond an eight-hour workday
  - Operation using a 12.5 Vdc source AC-DC adapter or automotive cigarette lighter adapter, which simultaneously charges the battery
  - Field replaceable battery
- Built in clock and calender
- Low cost ownership, global warranty
- Data storage and memory
  - Store up to ten test setups and 200 measurement traces in non-volatile memory
  - Stored data is easily and quickly downloaded to a personal computer (PC) or printer
- Powerful trace management
  - Automatically date/time stamped
  - Alphanumeric labeling
- PC reporting software
  - Windows® 95/98/2000/ME, XP, NT Workstation compatible
  - Supports long file names for descriptive labeling
  - Can display an unlimited number of traces for comparison to historical performance
- Optional Monochrome or Color LCD with backlight capability display
- Direct printer control via RS232 serial port

Applications

Convenient operating procedures, high sensitivity, and excellent repeatability enable the MS2711B/D to pinpoint the smallest system performance degradation and allow for easy verification of system compliance. Typical applications include:

- Transmitter Spectrum Analysis – occupied bandwidth, power, modulation measurements, location and identification of in-band, out-of-channel spurious and out-of-band spurious signals
- Receive Signal Analysis – measure receiver sensitivity, locate and identify sources of interfering signals
- Modulation identification, modulation depth, deviation, and spectral mask
- Signal Strength Mapping – to determine the most suitable location for antennas, base stations, and repeaters; or pinpoint Electromagnetic (EM) leakage in broadcast systems

Specifications

	Model	MS2711B	MS2711D
Frequency	Frequency range	100 kHz to 3.0 GHz	
	Frequency reference	Aging: ±1 ppm/yr Accuracy: ±2 ppm	
	Frequency span	1 kHz to 3 GHz in 1, 2, 5 step selections in auto mode, plus zero span	10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span
	Sweep time	≥6500 msec full span; 500 msec zero span	≤ 1.1 second full span; ≤ 50 msec to 20 second zero span
	Resolution bandwidth (–3dB width)	10 kHz, 30 kHz, 100 kHz, 1 MHz, ±20%	100 Hz to 1 MHz in 1-3 sequence, ±5%
	Video bandwidth (–3dB)	100 Hz to 300 kHz in 1-3 sequence	3 Hz to 1 MHz in 1-3 sequence, ±5%
	SSB Phase Noise (1 GHz) @30 kHz Offset	≤–75 dBc/Hz	
	Spurious responses Input related	≤–45 dBc	
	Spurious residual responses	≤–90 dBm (≥500 kHz)	
Amplitude	Measurement range	+20 dBm to –115 dBm (with preamp on)	+20 dBm to –135 dBm (with preamp on)
	Displayed average noise level	–115 dBm (≥1 MHz typical with preamp on) ≤–95 dBm (≥500 kHz, typical) ≤–80 dBm (< 500 kHz, typical)	≤-135 dBm typical, ≥1 MHz (preamp on) ≤–115 dBm typical, ≥500 kHz to <1 MHz ≤–110 dBm typical, < 500 kHz for input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW
	Dynamic range	>65 dB, typical	
	Total level accuracy	±2 dB, ≥500 kHz, typical; ±3 dB, <500 kHz, typical (For input signal level ≥–60 dBm)	±0.5 dB typical (±1 dB max), ≥10 MHz to 2 GHz ±1 dB typical (±1.5 dB max), >2 GHz to 3 GHz ±2 dB, ≥500 kHz to <10 MHz ±3 dB typical, <500 kHz for input signal levels ≥–60 dBm, excludes input VSWR mismatch
	Display range	1 to 15 dB/div in 1 dB steps, Ten divisions displayed	
	Max input level without damage	+23 dBm, ±50 Vdc	+43 dBm (Peak), ±50 Vdc
	Attenuator Range	0 to 50 dB, selected manually or automatically coupled to the reference level. Resolution in 10 dB steps	0 to 51 dB, selected manually or automatically coupled to the reference level. Resolution in 1 dB steps.
	RF input	VSWR 2.0:1	1.5:1 typical, (≥20 dB atten., 10 MHz to 2.4 GHz)

Continued on next page

	Model	MS2711B	MS2711D
General	Internal trace memory	200 maximum	
	Setup storage	10 test setups	15 test setups
	Display	VGA Monochrome LCD	VGA Color or VGA Monochrome LCD
	Inputs and Outputs Ports RF In RF Out Ext trig In Ext Freq Ref In (2 MHz to 20 MHz) Serial Interface	Type N, female, 50 Ω Type N, female, 50 Ω N/A N/A RS-232 9 pin D-sub, three wire serial	Type N, female, 50 Ω Type N, female, 50 Ω BNC, female (5V TTL) Shared BNC, female, 50 Ω (–15 dBm to +10 dBm) RS-232 9 pin D-sub, three wire serial
	Electromagnetic compatibility	Meets European community requirements for CE marking	
	Safety	Conforms to EN 61010-1 for Class 1 portable equipment	
	Temperature Operating Non-operating	0°C to 50°C, humidity 85% or less –20°C to +75°C (recommend battery stored separately between 0°C to 40°C for any prolonged storage period)	–10°C to 55°C, humidity 85% or less –51°C to +71°C (recommend battery stored separately between 0°C to 40°C for any prolonged storage period)
	Power supply External DC Input Internal	+12.5 to +15 volts dc, 1350 mA max NiMH battery: 10.8 volts, 1800 mA mAH	
	Dimensions Size (W x H x D) Weight	25.4 cm x 17.8 cm x 6.10 cm (10.0 in x 7.0 in x 2.4 in) 2.04 kg (4.5 lbs.) includes battery, 2.2 kg (4.9 lbs) includes tracking generator	25.4 cm x 17.8 cm x 6.10 cm (10.0 in x 7.0 in x 2.4 in) <2.14 kg (4.7 lbs.) includes battery, <2.28 kg (5 lbs) includes transmission measurement

MS2711B/D (Option 10) Bias Tee specifications

Bias Tee	Voltage	+18 Vdc
	Current	1 A peak 200 ms, 300 mA max steady state

MS2711D (Option 21) Transmission Measurement specifications

Frequency	Frequency range Frequency resolution	25 MHz to 3 GHz 10 Hz
Output	Output power level Output impedance	–10 dBm typical 50 Ω

FCN4760 Frequency Converter specifications

Frequency	Frequency range	4.7 GHz to 6 GHz
	Frequency resolution[*1]	10 Hz
	Frequency reference	Aging: ±1 ppm/yr Accuracy: ±2 ppm
	SSB Phase Noise (6 GHz) @30 kHz Offset	≤–65 dBc/Hz
	Spurious responses Input related	≤–45 dBc
	Spurious residual responses[1]	≤–90 dBm
Amplitude	Measurement range	–40 dBm to –100 dBm
	Sensitivity[*1] (displayed avg. noise level)	–100 dBm
	Maximum input level without damage	–5 dBm
	RF input	VSWR 2.0:1 max
General	Inputs and Outputs Ports RF In RF Out Communication Interface	Type N, female, 50 Ω Type N, male, 50 Ω 10 pin D sub
	Electromagnetic compatibility	Meets European community requirements for CE marking
	Safety	Conforms to EN 61010-1 for Class 1 portable equipment
	Temperature Operating Non-operating	–10°C to 50°C, humidity 85% or less –50°C to +80°C
	Power dissipation	850 mW max
	Dimensions Size (W x H x D) Weight	6.6 cm x 10.9 cm x 3.3 cm (2.6 in x 4.3 in x 1.3 in) <0.45 kg (< 1 lb.)

*1: Specifications apply when connected to the MS2711D spectrum analyzer

MS2711B (Option 20) Tracking generator specifications

Frequency	Frequency range	10 MHz to 3 GHz
	Frequency resolution	5 KHz
	Tracking offset range	±5 MHz
Output	Output power level	0 to –60 dBm
	Output power level resolution	0.1 dB
	Absolute level accuracy	±1.5 dB, 0 to –40 dBm ±4 dB, –40 dBm to –60 dBm
	Output flatness	≤±1.5 dB (10 MHz – 3 GHz)
	Output tracking VSWR	<2.0:1, <0 dBm
	Spurious harmonics	≤–20 dBc
	Non-Spurious	≤–20 dBc

MS2711B (Option 29) Power meter specifications

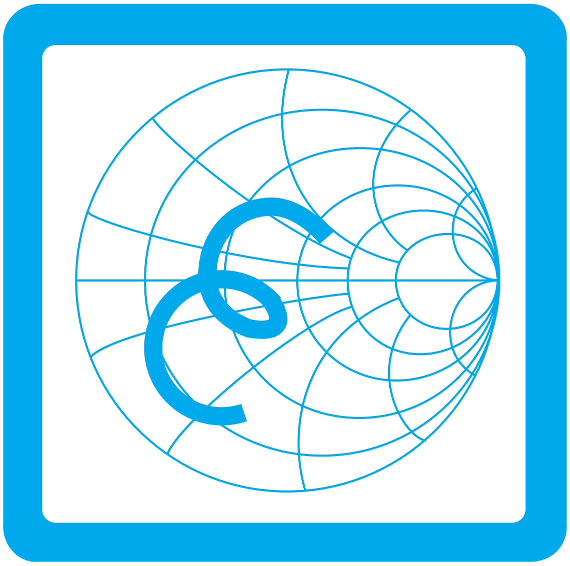
Frequency Range	3 MHz to 3.0 GHz
Total Level Accuracy	± 1 dB max (± 0.5 dB typical) for input signal levels >-60 dBm (10 MHz to 2 GHz, excludes input VSWR) ± 1.5 dB max (± 1 dB typical), >2 GHz to 3 GHz ± 2 dB max, 3 MHz to 10 MHz
Measurement Range	+20 dBm to -80 dBm
Frequency Span	3 MHz to 2.99 GHz
Display Range	+80 dBm to -80 dBm
Offset Range	0 to 60 dB
Maximum Input Power	+20 dBm without input attenuator

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MS2711B/8	Handheld Spectrum Analyzer: 100 kHz to 3.0 GHz
MS2711D	Handheld Spectrum Analyzer: 100 kHz to 3.0 GHz
	Standard Accessories
	User's Guide, MS2711B
	Soft Carrying Case
	AC – DC Adapter
	Automotive Cigarette Lighter/12 Volt DC Adapter
	One Year Warranty
	CD ROM containing Software Management Tools
	Serial Interface Cable
	Rechargeable battery, NiMH
	Pre-amplifier (built-in)
	Option Accessories
Option 3	Color display - MS2711D only
Option 6	Frequency converter controller module for use with FCN4760 (MS2711D only)
Option 10	Bias Tee (built-in)
Option 20	Tracking generator (built-in) - MS2711B only
Option 21	Transmission measurement (built-in) - MS2711D only
Option 29	Power Meter (MS2711D only)
	Optional Accessories
5400-71N50	RF Detector, N(m), 50 Ω, 1 to 3000 MHz
42N50A-30	30 dB, 50 Watt, Bi-directional, DC to 18 GHz, N(m) to N(f) Attenuator
34NN50A	Precision Adapter, DC to 18 GHz, 50 Ω, N(m) to N(m)
34NFNF50C	Precision Adapter, DC to 18 GHz, 50 Ω, N(f) to N(f)
15NN50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(m), 6.0 GHz
15NN50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(m), 6.0 GHz
15NN50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(m), 6.0 GHz
15NNF50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(f), 6.0 GHz
15NNF50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(f), 6.0 GHz
15NNF50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(f), 6.0 GHz
15ND50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(m), 3.5 GHz
15NDF50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(f), 3.5 GHz
510-90	Adapter 7/16 (f) to N(m), 3.5 GHz
510-91	Adapter, 7/16 DIN(f) to N(f), 7.5 GHz
510-92	Adapter, 7/16 DIN(m) to N(m) 7.5 GHz
510-96	Adapter 7/16 DIN (m) to 7/16 DIN (m), 7.5 GHz
510-97	Adapter 7/16 DIN(f) to 7/16 DIN(f), 7.5 GHz
61N50	RF SWR Bridge, 10-2500 MHz, 50 Ω, N(m)
61NF50	RF SWR Bridge, 10-2500 MHz, 50 Ω, N(f)

Model/Order No.	Name
1030-86	Band Pass Filter, 800 MHz band, 806-869 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-87	Band Pass Filter, 900 MHz band, 902-960 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-88	Band Pass Filter, 1900 MHz band, 1.85-1.99 GHz, Loss = 1.8 dB, N(m)-SMA(f)
1030-89	Band Pass Filter, 2400 MHz band, 2.4-2.5 GHz, Loss = 1.9 dB, N(m)-SMA(f)
48258	Spare soft carrying case
40-115	Spare AC/DC adapter
806-62	Spare automotive cigarette lighter/12 Volt DC adapter
800-441	Spare serial interface cable
760-229	Transit case for Anritsu Handheld Spectrum Analyzer
2300-347	Anritsu Handheld Software Tools
10580-00074	Anritsu HHSA User's Guide, Model MS2711B (spare)
10580-00071	Anritsu HHSA Programming Manual, Model MS2711B
10580-00072	Anritsu HHSA Maintenance Manual, Model MS2711B
10580-00097	Anritsu HHSA User's Guide, Model MS2711D
10580-00098	Anritsu HHSA Programming Manual, Model MS2711D
10580-00099	Anritsu HHSA Maintenance Manual, Model MS2711D
633-27	Rechargeable battery, NiMH
551-1691	USB to Serial adapter
70-28	Headset
2000-1029	Battery charger, NiMH with universal power supply
2000-1030	Portable antenna, 50 Ω, SMA (m) 1.71-1.88 GHz
2000-1031	Portable antenna, 50 Ω, SMA (m) 1.85-1.99 GHz
2000-1032	Portable antenna, 50 Ω, SMA (m) 12.4-2.5 GHz
2000-1035	Portable antenna, 50 Ω, SMA (m) 896-941 MHz
2000-1200	Portable antenna, 50 Ω, SMA (m) 806-869 MHz
	Printers
2000-1214	HP DeskJet printer Includes: interface cable, black print cartridge, and US power cable
2000-753	Spare serial-to-parallel converter cable
2000-663	Power cable (Europe) for DeskJet printer
2000-664	Power cable (Australia) for DeskJet printer
2000-1218	Power cable (UK) for DeskJet printer
2000-667	Power cable (So. Africa) for DeskJet printer
2000-1217	Rechargeable battery for DeskJet printer
2000-1216	Black print cartridge for DeskJet printer



NETWORK ANALYZERS

Selection guide

Group	Model	Frequency band	Measurement function											
			S parameter	Power sweep mode	Receiver mode	Multi-source control	Time domain	Harmonics measurement	IMD measurement	Mixer measurement	Balance circuit analysis	Spectrum analyzer	DTF	Crystal unit measurement
Vector	MS4630B	10 Hz to 300 MHz	√*1											√
	MS4622A	10 MHz to 3 GHz	√*1	√	√	√	√	√	√	√				
	MS4622B	10 MHz to 3 GHz	√	√	√	√	√	√	√	√				
	MS4622C	10 MHz to 3 GHz	√	√	√	√	√	√	√	√	√			
	MS4622D	10 MHz to 3 GHz	√	√	√	√	√	√	√	√	√			
	MS4623A	10 MHz to 6 GHz	√*1	√	√	√	√	√	√	√				
	MS4623B	10 MHz to 6 GHz	√	√	√	√	√	√	√	√				
	MS4623C	10 MHz to 6 GHz	√	√	√	√	√	√	√	√	√			
	MS4623D	10 MHz to 6 GHz	√	√	√	√	√	√	√	√	√			
	MS4624A	10 MHz to 9 GHz	√*1	√	√	√	√	√	√	√				
	MS4624B	10 MHz to 9 GHz	√	√	√	√	√	√	√	√				
	MS4624C	10 MHz to 9 GHz	√	√	√	√	√	√	√	√	√			
	MS4624D	10 MHz to 9 GHz	√	√	√	√	√	√	√	√	√			
	37147C	40 MHz to 20 GHz	√*2		√	√	√			√				
	37169C	40 MHz to 40 GHz	√*2		√	√	√			√				
	37225C	40 MHz to 13.5 GHz	√	√	√	√	√			√				
	37247C	40 MHz to 20 GHz	√	√	√	√	√			√				
	37269C	40 MHz to 40 GHz	√	√	√	√	√			√				
	37277C	40 MHz to 50 GHz	√	√	√	√	√			√				
	37297C	40 MHz to 65 GHz	√	√	√	√	√			√				
	37325C	40 MHz to 13.5 GHz	√	√	√	√	√			√				
	37347C	40 MHz to 20 GHz	√	√	√	√	√			√				
	37369C	40 MHz to 40 GHz	√	√	√	√	√			√				
	37377C	40 MHz to 50 GHz	√	√	√	√	√			√				
	37397C	40 MHz to 65 GHz	√	√	√	√	√			√				
	ME7808A	40 MHz to 110 GHz	√	√			√							
Scalar	56100A	10 MHz to 50 GHz			√*3									
	54107A/54111A	1 MHz to 3 GHz			√*3								√	
	54147A/54137A	10 MHz to 20 GHz			√*3								√	
	54161A	10 MHz to 32 GHz			√*3								√	
	54169A	10 MHz to 40 GHz			√*3								√	
	54177A	10 MHz to 50 GHz			√*3								√	
Site master	S251C	625 to 2500 MHz	√*1										√	
	S113C	2 to 100 MHz	√*4										√	
	S114C	2 to 100 MHz	√*4									√	√	
	S331D	25 to 4000 MHz	√*4										√	
	S332D	25 to 4000 MHz	√*4									√	√	
	S810C	3.3 to 10.5 GHz	√*4										√	
	S820C	3.3 to 20 GHz	√*4										√	

*1: S11-/S21 measurement by 1 path 2 port calibration can be performed.
*2: In order to carry out S-Parameter measurement, external component, such as coupler, is needed..
*3: A transmission characteristic and return loss measurement can be performed.
*4: S11 measurement by OSL calibration can be performed.

Selection guide (Frequency range)

Model	Frequency range																						Remarks
	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	50 MHz	100 MHz	200 MHz	500 MHz	1 GHz	2 GHz	5 GHz	10 GHz	20 GHz	50 GHz	100 GHz	200 GHz	
MS4630B	■	■	■	■	■	■	■	■	■	■	■	■	■										10 Hz to 300 MHz
MS4622A									■	■	■	■	■	■	■	■							10 MHz to 3 GHz
MS4622B									■	■	■	■	■	■	■	■							10 MHz to 3 GHz
MS4622C									■	■	■	■	■	■	■	■							10 MHz to 3 GHz
MS4622D									■	■	■	■	■	■	■	■							10 MHz to 3 GHz
MS4623A									■	■	■	■	■	■	■	■	■						10 MHz to 6 GHz
MS4623B									■	■	■	■	■	■	■	■	■						10 MHz to 6 GHz
MS4623C									■	■	■	■	■	■	■	■	■						10 MHz to 6 GHz
MS4623D									■	■	■	■	■	■	■	■	■						10 MHz to 6 GHz
MS4624A									■	■	■	■	■	■	■	■	■						10 MHz to 9 GHz
MS4624B									■	■	■	■	■	■	■	■	■						10 MHz to 9 GHz
MS4624C									■	■	■	■	■	■	■	■	■						10 MHz to 9 GHz
MS4624D									■	■	■	■	■	■	■	■	■						10 MHz to 9 GHz
37147C										■	■	■	■	■	■	■	■	■					40 MHz to 20 GHz
37169C										■	■	■	■	■	■	■	■	■	■				40 MHz to 40 GHz
37225C										■	■	■	■	■	■	■	■	■					40 MHz to 13.5 GHz
37247C										■	■	■	■	■	■	■	■	■					40 MHz to 20 GHz
37269C										■	■	■	■	■	■	■	■	■	■				40 MHz to 40 GHz
37277C										■	■	■	■	■	■	■	■	■	■				40 MHz to 50 GHz
37297C										■	■	■	■	■	■	■	■	■	■	■			40 MHz to 65 GHz
37325C										■	■	■	■	■	■	■	■	■					40 MHz to 13.5 GHz
37347C										■	■	■	■	■	■	■	■	■					40 MHz to 20 GHz
37369C										■	■	■	■	■	■	■	■	■	■				40 MHz to 40 GHz
37377C										■	■	■	■	■	■	■	■	■	■				40 MHz to 50 GHz
37397C										■	■	■	■	■	■	■	■	■	■	■			40 MHz to 65 GHz
ME7808A										■	■	■	■	■	■	■	■	■	■	■	■		40 MHz to 110 GHz
56100A									■	■	■	■	■	■	■	■	■	■	■				10 MHz to 50 GHz
54107A/54111A						■	■	■	■	■	■	■	■	■	■	■							1 MHz to 3 GHz
54147A/54137A									■	■	■	■	■	■	■	■	■	■					10 MHz to 20 GHz
54161A									■	■	■	■	■	■	■	■	■	■	■				10 MHz to 32 GHz
54169A									■	■	■	■	■	■	■	■	■	■	■				10 MHz to 40 GHz
54177A									■	■	■	■	■	■	■	■	■	■	■				10 MHz to 50 GHz
S251C														■	■	■							625 to 2500 MHz
S113C							■	■	■	■	■	■	■	■	■								2 to 1200 MHz
S114C							■	■	■	■	■	■	■	■	■								2 to 1200 MHz
S331D										■	■	■	■	■	■	■							25 to 4000 MHz
S332D										■	■	■	■	■	■	■							25 to 4000 MHz
S810C																■	■						3.3 to 10.5 GHz
S820C																■	■	■					3.3 to 20 GHz

*1: In order to carry out S-Parameter measurement, external component, such as coupler, is needed.

VECTOR NETWORK ANALYZERS

37100C, 37200C, 37300C Series

22.5 MHz to 65 GHz

GPIB

For Fast and Accurate S-Parameter Measurements

The 37200C and 37300C series microwave vector network analyzers (VNAs) are high performance tools designed to make fast and accurate S-parameter measurements across the 40 MHz to 65 GHz range.

These network analyzers integrate a synthesized source, S-parameter test set, and tuned receiver into a single compact package that is ideal for benchtop testing.

Code named Lightning, the 37200C and 37300C offer new levels of measurement capabilities to speed manufacturing test and increase throughput. Choose the instrument model and options that best suit your application and budget.

The 37200C series is designed for passive device measurements, while the 37300C series adds active device measurement capabilities. Five microwave models are available from 40 MHz to 13.5, 20, 40, 50, or 65 GHz.

The 37100C series microwave vector network analyzers are configured as direct-access receivers for antenna, frequency conversion, and multiple output device measurements. The 37100C offers ultimate flexibility to meet most receiver measurement needs while maintaining the ability to measure all four S-parameters with the addition of a reflectometer setup at the front end of the receiver.

The 37100C series offers two wide-band microwave models covering the 22.5 MHz to 20 GHz or 40 GHz ranges.

Features

• High speed data transfer and control

For maximum efficiency, dual GPIB ports are standard on every 37100C/37200C/37300C series VNA. High-speed transfers across the analyzer's IEEE 488.2 GPIB bus minimize data collection times. The second GPIB port is dedicated to control of peripheral devices such as printers, plotters, power meters, and frequency synthesizers. The 37100C/37200C/37300C series maximizes throughput by combining fast, error-corrected sweeps with high-speed data transfers.

• Compact size

The 37200C/37300C series analyzers integrate a fast sweeping synthesized source, auto-reversing S-parameter test set, and four-channel receiver into a single compact package. The 37100C series analyzers integrate a fast sweeping synthesized source and four-channel receiver into a single compact package and provides direct access to all four receiver samplers via the front panel. Components within the analyzer have been integrated to reduce cost and weight and improve the instrument's long-term reliability.

• Built-in mass storage

Testing devices with multiple setups is now easier. A built-in hard disk drive rapidly stores and recalls frequently used front panel setups and calibrations. Store your complete test setup including limit lines and frequency markers. Create descriptive file names to assist multiple users or device types. The high storage capability of the internal hard disk means there is space for literally hundreds of calibrations, front panel setups, and data traces. In secure environments, the internal hard disk can be removed and either an external drive on the SCSI port or the internal 1.44 MB floppy drive can be used for uploading proprietary setups.

• Fast synthesized sweeps

Measurement update rates of less than 2 ms per point are possible with the 37100C/37200C/37300C series analyzers. Each data point is fully phase-locked and vector-error-corrected for optimum accuracy. Realize near real-time updates with the instrument's tune mode.

The internal source frequency resolution of 1 Hz facilitates narrow-band device measurements.

• Time domain analysis

Analyze impedance discontinuities as a function of time or distance with the 37100C/37200C/37300C's high-speed time domain (Option 2A). Isolate individual reflections in time and evaluate their effects in the frequency domain. Remove the effects of device packages and fixturing with time domain gating to see the actual performance of your designs. Use the independent display channels to view the response of your designs before, during, and after time domain processing. The software provides four different windowing functions to optimize dynamic range and resolution. The exclusive phasor impulse mode will show you the true impedance characteristics of mismatches in waveguide, microstrip, and other band-limited media.

• Multiple source control and set-on receiver mode

Separately control the frequency of two sources and a receiver without the need for an external controller. Independently specify the sweep ranges and output powers of the sources and the sweep range of the receiver to accommodate swept IMD, TOI, and harmonic measurements. The 37100C/37200C/37300C's set-on receiver mode allows it to operate as a tuned receiver by phase locking all of its local oscillators to its internal crystal reference oscillator.

LabVIEW® compatibility
Standard with every 37100C/37200C/37300C series analyzer is National Instruments LabVIEW® instrument driver. Create custom test programs (virtual instruments) in less time with LabVIEW's graphical programming environment. Take advantage of the network analyzer's high data throughput for tuning operations. Fast data transfers over GPIB permit near realtime updates on your PC's display. Customize programs to automatically display, test, and document measurement results. Reuse virtual instruments in other test routines to minimize program development time. LabVIEW gives you full access to more than 900 mnemonics in the 37100C/37200C/37300C analyzer's command set for complete automated data collection and analysis.

Internally controlled AutoCal®
One source of potential errors and inaccuracies in any network analyzer system is the calibration of that system. The Anritsu AutoCal automatic calibrator is designed to speed and simplify the calibration of your 37200C/37300C VNA. Using the built-in software support and an AutoCal module connected to the serial port on the rear panel of the instrument, you are ready to make fast, accurate, and repeatable calibrations.

Three-year factory warranty
All 37100C/37200C/37300C series VNAs are backed with a no-questions-asked three-year warranty.

Upgradeability
The 37100C/37200C/37300C series analyzers are designed to accommodate higher frequency ranges and more powerful features as your requirements grow. Any 37100C/37200C/37300C series VNA can be upgraded to any other model in the instrument family, or any other series, to fit your changing requirements. Contact Anritsu Customer Service to request an upgrade and an Anritsu service engineer will install the added capability and verify your system's total performance. Upgradeability is a cost-effective approach to satisfying today's production needs while providing the flexibility to meet tomorrow's demands. System software upgrades are as easy as inserting new discs into the instrument's floppy drive.

Applications

Filters
Let the analyzer's wide dynamic range show you filter rejection and input match on the same display. Overlay traces and tune for optimum transmission and group delay responses without reduction in sweep speed.
Further speed improvements are possible using the instrument's tune mode. This unique feature helps users optimize sweep times in one direction for better hand-to-eye tuning while maintaining a 12-term corrected S-parameter display. Anritsu's tune mode maximizes sweep speed and accuracy, simultaneously, by allowing you to choose when reverse parameters are updated.
Automatically locate filter center frequency, 3 dB bandwidth, max/min insertion loss, Q, and shape factor. Instantly measure passband phase distortions with Anritsu's automatic reference plane extension capability. A single key press quickly identifies filter non-linear phase responses.

Amplifiers (available on 37300C series only)
Easily measure amplifier gain compression vs. input power or frequency. Power meter assisted linearity and flat output power calibration combined with a receiver port calibration provides capability to measure output power in dBm. A 1 watt, 70 dB (60 dB on >40 GHz models) step attenuator in the port 1 path, and a 40 dB step attenuator in the port 2 path, coupled with 20 dB ALC range, give complete control to characterize virtually any amplifier. This range is reduced to 12 dB at frequencies >50 GHz. Internal bias tees simplify DC biasing of your active designs. A front panel loop allows external amplifier insertion, increasing port 1 power up to 1 watt maximum for high input power amplifiers.

Mixers
Perform absolute and accurate S-parameter measurements (magnitude and phase) of frequency translation devices. Make error corrected conversion loss, group delay, and port match measurements of mixers and up/downconverters. Anritsu's Mixer (NxN) Calibration Assistant software adjusts the VNA's 12-term calibration for the second mixer, BPF, and attenuators in the measurement path.
No reference mixer is required for VNA phase locking since the frequency range of the receiver is set to the same range as the source.

Multiport and Balanced/Differential
Measure single-ended and mixed-mode S-parameters with the 37200C/37300C series VNA, a 4-port test set, and an external PC running Anritsu's Multiport Navigator™ software. Characterize single-ended multiport components (diplexers, couplers, power dividers, etc.) or balanced/differential components. Anritsu's easy-to-use Navigator software provides full step-by-step direction, simplifying calibrations and measurements.

Microstrip devices
The 37200C/37300C series offers complete substrate measurement solutions for both microstrip and coplanar waveguide (CPW) designs. The 37200C/37300C series analyzers accommodate the model 3680 series Universal Test Fixtures (UTF), calibration kits, and verification kits. Guaranteed system specifications provide assurance that your test results are accurate and verifiable.
Completely characterize connectorless devices with the 37200C/37300C's Line-Reflect-Line (LRL) and Line-Reflect-Match (LRM) calibration capability. The four channel design provides true LRL/LRM error-correction giving you the highest performance available for in-fixture measurements. Highly reflective devices, along with well matched ones are measured with the same degree of ease. Automatic dispersion compensation improves measurement accuracy to help you determine phase distortions in all your microstrip designs. The result is quality measurements you can count on for your connectorless devices.

E/O and O/E devices
The 37200C/37300C series incorporates a de-embedding function that simplifies VNA calibration when measuring E/O and O/E devices. Characterize the transfer function, group delay, and return loss of optical modulators (E/O) and photoreceivers (O/E).
An MN4765A O/E calibration module and a laser source are required to complete the test set-up. The internal VNA application de-embeds the response of the O/E calibration module to allow direct measurement of the modulator. For O/E measurements, use the O/E calibration module to characterize a modulator first, then use the modulator as the characterized reference to measure another photoreceiver.

Antennas
Far field measurements are enhanced with the speed of taking data over GPIB, using the 37100C/37200C/37300C in fast CW mode. Rates of 0.8 ms/point can be achieved using internal triggering, 1.2 ms/point with external triggering, and 1.5 ms/point with GPIB triggering.
For near field measurements, internal buffer data collection is provided to allow saving active channel measurement data from multiple sweeps without having to synchronize and collect data at the end of each sweep. The 37100C/37200C/37300C can store up to 50,000 data point measurements, each consisting of two real and imaginary IEEE 754 4-byte floating point numbers.

Specifications

Measurement capabilities	Number of channels	Four measurement channels
	Parameters	S_{11}, S_{21}, S_{12}, S_{22}, or user defined; analog voltage input; complex input and output impedance; complex input and output admittance; complex forward and reverse transmission
	Domains	Frequency domain, CW draw, and optional high speed time domain (Option 2A)
	Formats	Log magnitude, phase, log magnitude and phase, Smith chart (impedance), Smith chart (admittance), linear polar, log polar, group delay, linear magnitude, linear magnitude and phase, real, imaginary, real and imaginary, and SWR
	Data points	1601 maximum. System also accepts an arbitrary set of N discrete data points where $2 \le N \le 1601$. CW mode permits selection of a single point.
	Reference delay	Can be entered in time or in distance. Automatic reference delay adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between the reference and test is accurate and stable since measurement frequencies are always synthesized.
	Reference offset	Magnitude and phase
	Markers	Six independent markers can be used to read out measurement data. In delta-reference mode, any one marker can be selected as the reference for the other five. Markers can automatically find critical filter parameters i.e. 3 dB bandwidth, loss, center frequency, shape factor and Q.
	Marker sweep	Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.
	Limits	Two limit lines per data trace to indicate test limits. Limits can be either single or segmented limits for testing devices pass-fail.
	Measurement dynamic range	Table 1 gives receiver dynamic range as the ratio of maximum signal level at Port 2 (or individual sampler input) to the noise floor.
	Data averaging	Averaging of 1 to 4096 averages per data point can be selected.
	IF bandwidth	Front panel switch selects four levels of IF bandwidth: 10 kHz, 1 kHz, 100 Hz and 10 Hz
Display capabilities	Display channels	1, 2, 3 or 4 channels can be displayed. Each channel can display any S-parameter or user defined parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously.
	Display type	Color LCD, 8.5" diagonally, VGA display. Color of graticule, trace data and text are user definable.
	Trace overlay	Overlays two traces with the same graticule type on the same display
	Trace memory	A separate memory for each channel can be used to store measurement data for later display or subtraction, addition, multiplication or division.
	Scale resolution	Log mag: 0.001 dB, linear mag: 1 pU Phase: 0.01°, group delay: 0.001 ps Time: 0.001 ms, distance: 0.1 mm SWR: 1 pU Power: 0.05 dB
	Autoscale	Automatically sets resolution and offset to display measurement data on the full display
	Reference position	Settable to any graticule line
	Annotation	Type of measurement, vertical and horizontal scale resolution, start and stop frequencies and reference position
Vector error correction	Error correction models	Full 12-term, one-path two-port, reflection only, transmission response
	LRL/LRM	Line-Reflect-Line and Line-Reflect-Match calibration models are available for coaxial, microstrip and waveguide transmission lines.
Signal source capabilities	Source power level	Source power may be set from the 37100C/37200C/37300C front panel menu. Check table 2 for levels.
	Flat power correction	The 37100C/37200C/37300C corrects for test port power variations using an external power meter. Once the port power has been flattened, the power meter is removed and the signal source power level may be changed within the remaining power adjustment range.
	Multiple source control	Allows a user to separately control the frequency of two sources and receiver without need for an external controller. Source #1: 37200C/37300C internal source, or any 68000C, 69000B, or MG3690A synthesizer Source #2: Any 68000C, 69000B, or MG3690A synthesizer Receiver: 37200C/37300C internal receiver
	Internal 10 MHz time base stability	Standard (1 Hz resolution) With aging: $<1 \times 10^{-9}$/day With temperature: $<5 \times 10^{-9}$ over 0° to 55°C
Hard copy	Printers	Select full screen, graphical, tabular data, and printer type. Compatible with most HP and Epson printers with a parallel (Centronics) interface
	GPIB plotters	Compatible with most HP and Tektronix plotters
	Disk file	Bitmap, S2P, text, tabular data, and HPGL
Storage	Internal memory	Ten front panel states (setup) can be stored and recalled from non-volatile memory locations.
	Internal hard disk drive	Store and recall instrument setups, calibration files and trace data files. All files are MS-DOS compatible.
	Internal floppy disk drive	Store and recall instrument setups, calibration files and trace data files from 3.5 inch 1.44 MB floppy disks. All files are MS-DOS compatible.
Remote programming	Interface	GPIB (IEEE 488.2)
	Addressing	Address can be set from the front panel and can range from 1 to 30.
	Transfer formats	ASCII, 32-bit floating point and 64-bit floating point
	Speed	150 kB/sec
	Interface function codes	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DT1, DC0, C0
General	Test ports	GPC-7, 3.5 mm, N-type, K, and V connectors supported
	Power requirements	85 to 240 V, 48 to 63 Hz, 540 VA maximum
	Dimensions	432 (W) x 267 (H) x 585 (D) mm (10.5 x 17 x 23 in)
	Mass	27 kg (60 lbs)
	Temperature	0° to 50°C (operate), –40° to 75°C (storage)

Table 1a Dynamic range (37100C)

Model	Frequency (GHz)	Max. signal into a_x, b_x (dBm)	Noise floor (dBm)	Receiver dynamic range (dB)	Source power (dBm, typical)
37147C	0.0225	–18	–122	104	10
	2	–12	–106	94	8
	20	–12	–103	91	5
37169C	0.0225	–18	–122	104	10
	2	–12	–106	94	8
	20	–12	–103	91	3
	40	–15	–100	85	–3

Table 1b Dynamic range (37200C/37300C)

Model	Frequency (GHz)	Max. signal into port 2 (dBm)	Noise floor (dBm)	Receiver dynamic range (dB)	Port 1 power (dBm, typical)	System dynamic range (dB)
37225C	0.04	+20	–70	90	0	70
	2	+3	–98	101	0	98
	13.5	+3	–98	101	0	98
37247C	0.04	+20	–70	90	0	70
	2	+3	–98	101	0	98
	20	+3	–96	99	0	96
37269C	0.04	+20	–70	90	0	70
	2	+3	–98	101	0	98
	20	+3	–95	98	–5	90
	40	+3	–93	96	–15	78
37277C	0.04	+20	–77	97	0	77
	2	+3	–105	108	+5	110
	20	+3	–97	100	–2	95
	40	+3	–95	98	–7	88
	50	+3	–87	90	–2	85
37297C	0.04	+20	–77	97	0	77
	2	+3	–105	108	+5	110
	20	+3	–97	100	–2	95
	40	+3	–95	98	–7	88
	50	+3	–87	90	–2	85
	65	+3	–77	80	–2	75
37325C	0.04	+30	–65	95	+5	70
	2	+30	–93	123	+5	98
	13.5	+30	–93	123	+5	98
37347C	0.04	+30	–65	95	+5	70
	2	+30	–93	123	+5	98
	20	+30	–91	121	+5	96
37369C	0.04	+30	–65	95	0	70
	2	+30	–93	123	+5	98
	20	+30	–90	120	0	90
	40	+30	–83	113	–7	76
37377C	0.04	+30	–77	107	0	77
	2	+30	–105	135	+5	110
	20	+30	–97	127	–2	95
	40	+30	–95	125	–7	88
	50	+30	–87	117	–2	85
37397C	0.04	+30	–77	107	0	77
	2	+30	–105	135	+5	110
	20	+30	–97	127	–2	95
	40	+30	–95	125	–7	88
	50	+30	–87	117	–2	85
	65	+30	–77	107	–2	75

Table 2 Power range

Model	Rated power (dBm)	Minimum power (dBm)	Resolution (dB)
37147C	+5	–15	0.05
37169C	–3	–23	
37225C	0	–20	
37247C			
37269C	–15	–27	
37277C	–7	–27	
37297C	–7	–19	
37325C	+5	–90	
37347C			
37369C	–7	–97	
37377C	–7	–87	
37397C	–7	–79	

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
37147C	Direct Access Receiver (22.5 MHz to 20 GHz)
37169C	Direct Access Receiver (22.5 MHz to 40 GHz)
37225C	Vector Network Analyzer (40 MHz to 13.5 GHz)
37247C	Vector Network Analyzer (40 MHz to 20 GHz)
37269C	Vector Network Analyzer (40 MHz to 40 GHz)
37277C	Vector Network Analyzer (40 MHz to 50 GHz)
37297C	Vector Network Analyzer (40 MHz to 65 GHz)
37325C	Vector Network Analyzer (40 MHz to 13.5 GHz)
37347C	Vector Network Analyzer (40 MHz to 20 GHz)
37369C	Vector Network Analyzer (40 MHz to 40 GHz)
37377C	Vector Network Analyzer (40 MHz to 50 GHz)
37397C	Vector Network Analyzer (40 MHz to 65 GHz)
	Options
Option 1	Rack mount kit with slides
Option 1A	Rack mount kit with handles
Option 2A	High-speed time (distance) domain capability
Option 4	External SCSI-2 hard disk drive compatibility (internal HDD removed)
Option 7A	Replaces universal K connector (standard) with universal GPC-7 (37200C/37300C only)
Option 7N	Replaces universal K connector (standard) with universal N-male (37200C/37300C only)
Option 7NF	Replaces universal K connector (standard) with universal N-female (37200C/37300C only)
Option 7S	Replaces universal K connector (standard) with universal 3.5 mm-male (37200C/37300C only)
Option 7K	Replaces universal V connector (standard) with universal K (m) (37277C/37297C/37377C/37397C models only)
Option 11	Reference loop extension cables (standard on 37300C series)
Option 12	Rear Panel IF Inputs (for 37x97C and 37x77C only). Required for upgrade to ME7808A Broadband VNA.
	Calibration kits
3650	SMA/3.5 mm Calibration Kit
Option 1	Adds sliding terminations
3651	GPC-7 Calibration Kit
Option 1	Adds sliding terminations
3652	K Connector Calibration Kit
Option 1	Adds sliding terminations
3653	Type N Calibration Kit
3654B	V Connector Calibration Kit with sliding terminations
36581NNF	AutoCal, N (m) to N (f), 40 MHz to 18 GHz
36581KKF	AutoCal, K (m) to K (f), 40 MHz to 20 GHz
36582KKF	AutoCal, K (m) to K (f), 40 MHz to 40 GHz

Model/Order No.	Name
	Verification kits
3663	Type N Verification Kit
3666	SMA/3.5 mm Verification Kit
3667	GPC-7 Verification Kit
3668	K Connector Verification Kit
3669B	V Connector Verification Kit
	Test port cables
3670A50-1	GPC-7 semi-rigid cable, 1 foot
3670A50-2	GPC-7 semi-rigid cable, 2 foot
3670K50-1	K connector semi-rigid cable, 1 foot
3670K50-2	K connector semi-rigid cable, 2 foot
3670V50-1	V connector semi-rigid cable, 1 foot
3670V50-2	V connector semi-rigid cable, 2 foot
3671A50-1	GPC-7 flexible cables, 25 in. (1 pair)
3671A50-2	GPC-7 flexible cables, 38 in.
3671S50-1	3.5 mm flexible cables, 25 in. (1 pair)
3671S50-2	3.5 mm flexible cables, 38 in.
3671K50-1	K connector flexible cables, 25 in. (1 pair)
3671K50-2	K connector flexible cables, 38 in.
3671V50-3	V connector flexible cable, 25 in. (1 pair)
3671V50-4	V connector flexible cable, 38 in.

MILLIMETER WAVE VECTOR NETWORK ANALYZER

37000 Family

33 to 110 GHz

CE GPIB

High Performance Millimeter Wave Vector Network Analysis

The 37000 family millimeter wave vector network analyzer (VNA) extends the exceptional performance of the Lightning VNA family to 110 GHz. This improvement to our original millimeter wave system, based on the 360B VNA, continues our commitment to providing the highest quality microwave and millimeter wave test equipment available while still maintaining an intuitive user interface. The minimum configuration for the millimeter wave VNA has a 37147C VNA, a 3735B Test Set, two synthesized sources, and a pair of millimeter heads.

Features

- **Measurement speed and accuracy**

The millimeter wave VNA, based on our popular Lightning 37000 platform, offers the fastest measurement speed available in a millimeter wave VNA. Measurement speed of approximately 20 ms per point for an 801 data point sweep means faster tuning and throughput for your millimeter wave devices. The millimeter wave system also offers full auto-reversing, 12-term, error-corrected S-parameter measurements that enable advanced calibration techniques such as Line-Reflect-Line (LRL), Line-Reflect-Match (LRM), and Thru-Reflect-Match (TRM) to be used for maximum accuracy in your on-wafer measurements. For waveguide measurements, the millimeter wave system supports all of the above methods as well as the offset short calibration technique. The 8.5 inch, color liquid crystal display (LCD) allows users to easily view the data traces for all four S-parameters while simultaneously displaying limit lines and trace memory functions. The built-in 3.5 inch MS-DOS® compatible floppy disk drive and internal hard disk drive simplify the procedure to both store and recall calibrations, front panel setups, and measurement data. The versatility of the Lightning platform allows data to be gathered using the *.s2p, *.txt, *.dat, *.bmp, and *.hgl file formats so data can be easily loaded into both circuit simulation and graphics programs.

- **The most dynamic range in a millimeter VNA**

Increased dynamic range relates directly to increased measurement accuracy and confidence when measuring millimeter wave components and subsystems. To achieve optimum measurement speed and dynamic range for your measurements, the Lightning millimeter wave VNA allows the number of measurement averages and video IF bandwidth to be varied. The Lightning millimeter wave VNA system dynamic range is typically 15 dB better than comparable VNAs, and noise floor specifications are measured with 512 averages not 1024 averages — an important point to consider when making comparisons. Simply stated, the Lightning millimeter wave system provides the best dynamic range with sweep speeds twice as fast as comparable instruments.

- **Flexible configuration in waveguide and coax**

Our flexible module configurations let you specify the capability of your millimeter wave VNA. We offer two versions of millimeter wave heads that allow you to tailor the Lightning based millimeter system to your exact measurement needs. The 3740A series transmission/reflection modules have simultaneous transmission and reflection capability, while the 3741A series transmission only module is used when reflection measurements are not required. A pair of 3740A modules allow measurement of all four S-parameters. A 3740A transmission/reflection module combined with a 3741A Transmission Only module allows measurement of one-path/two port S-parameters (S_{11} and S_{21}).
A single 3740A transmission/reflection module can be used for S_{11} reflection measurements. The 3740A series also provides the smallest footprint and lightest weight of any millimeter wave test head on the market today. This greatly simplifies your test setup; regardless of whether you are manually adjusting the head position for waveguide measurements or have attached them to a wafer probe station. In order to maximize the flexibility of your VNA, the system architecture provides for a smooth transition between your waveguide and coaxial device measurements. Simply add a coaxial test set to your system and now you have the capabilities to fully characterize your active and passive coaxial devices up to 40 GHz.

- **Complete measurement solutions**

In addition to the millimeter wave VNA measurement system, Anritsu offers a full line of synthesized signal generators up to 110 GHz. To complete your millimeter wave measurement setup, Anritsu also offers solutions for waveguide, on-wafer, and even coaxial applications. With our custom design and manufacturing capabilities, we have developed 110 GHz coaxial connectors, couplers, adapters, and even test fixtures for use in your millimeter wave test set-ups.

Specifications

System performance

Waveguide designation	Q-Band (WR-22)	V-Band (WR-15)	E-Band (WR-12)	Extended E-Band	W-Band (WR-10)	Extended W-Band
Frequency range (GHz)	33 to 50	50 to 75	60 to 90	56 to 60 60 to 85 85 to 94	75 to 100 100 to 110	65 to 75 75 to 100 100 to 110
Maximum signal into port 2 (dBm)	+10	+8	+8	+8	+6	+6
Noise floor (dBm)	–93	–90	–90	–85 –90 –76	–90 –90	–90 –89 –87
Receiver dynamic range (dB)*1	103	98	98	93 98 84	96 96	96 95 93
High level noise (dB, typical)	.02	.05	.06	.08	.06	.08
Power @ DUT (dBm, typical)	+7	+7	+6	+5 +6 +4	+5 +2	–5 +5 +2
System dynamic range (dB)*2	100	97	96	90 96 80	95 92	85 94 89

*1: "Receiver dynamic range" is defined as the ratio of the maximum signal level at Port 2 for 0.1 dB compression to the system noise floor.
*2: "System dynamic range" is defined as the ratio of the power at Port 1 and the system noise floor (forward measurements only).

Test port characteristics

	Offset short calibration*1					
Waveguide designation	Q-Band (WR-22)	V-Band (WR-15)	E-Band (WR-12)	Extended E-Band	W-Band (WR-10)	Extended W-Band
Frequency (GHz)	33 to 50	50 to 75	60 to 90	56 to 94	75 to 110	65 to 110
Directivity (dB)	>50	>50	>46	>44	>46	>40
Source match (dB)	>45	>37	>36	>33	>36	>30
Load match (dB)	>50	>50	>46	>44	>46	>40
Reflection frequency tracking (dB)	±0.010	±0.030	±0.040	±0.080	±0.040	±0.080
Transmission frequency tracking (dB)	±0.010	±0.060	±0.060	±0.1	±0.070	±0.1
Isolation (dB)	>100	>90	>90	>80	>90	>80

	LRL calibration*1					
Waveguide designation	Q-Band (WR-22)	V-Band (WR-15)	E-Band (WR-12)	Extended E-Band	W-Band (WR-10)	Extended W-Band
Frequency (GHz)	33 to 50	50 to 75	60 to 90	56 to 94	75 to 110	65 to 110
Directivity (dB)	>50	>50	>46	>44	>46	>40
Source match (dB)	>50	>50	>46	>43	>46	>40
Load match (dB)	>50	>50	>46	>44	>46	>40
Reflection frequency tracking (dB)	±0.002	±0.002	±0.002	±0.006	±0.002	±0.006
Transmission frequency tracking (dB)	±0.002	±0.002	±0.002	±0.006	±0.002	±0.006
Isolation (dB)	>100	>90	>90	>80	>90	>80

*1: At 23 ±3˚C using the offset short calibration method with a sliding load or LRL calibration method (as noted) to achieve 12-term error correction.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
37147C	Vector Network Analyzer (22.5 MHz to 20 GHz)
37169C	Vector Network Analyzer (22.5 MHz to 40 GHz)
	Options (for VNA)
Option 1	Rack mount with track slides
Option 1A	Rack mount kit with handles
Option 2A	High-speed time (distance) domain capability
Option 4	External SCSI-2 hard disk drive compatibility
Option 13	Delete internal source
	Millimeter wave test set
3735B	Millimeter wave test set
3700C3	System console
	Options (for test set)
Option 1	Rack mount kit with track slides
Option 1A	Rack mount kit with handles
	Millimeter wave modules*1
3740A-Q	Transmission/reflection module (33 to 50 GHz, WR-22)
3740A-V	Transmission/reflection module (50 to 75 GHz, WR-15)
3740A-E	Transmission/reflection module (60 to 90 GHz, WR-12)
3740A-EE	Transmission/reflection module (56 to 94 GHz, WR-12)
3740A-W	Transmission/reflection module (75 to 110 GHz, WR-10)
3740A-EW	Transmission/reflection module (65 to 110 GHz, WR-10)
3741A-Q	Transmission only modules (33 to 50 GHz, WR-22)
3741A-V	Transmission only modules (50 to 75 GHz, WR-15)
3741A-E	Transmission only modules (60 to 90 GHz, WR-12)
3741A-EE	Transmission only modules (56 to 94 GHz, WR-12)
3741A-W	Transmission only modules (75 to 110 GHz, WR-10)
3741A-EW	Transmission only modules (65 to 110 GHz, WR-10)
	Synthesizers*2
MG3692A	Synthesized CW generator, 2 to 20 GHz
MG3693A	Synthesized CW generator, 2 to 30 GHz
MG3694A	Synthesized CW generator, 2 to 40 GHz
	Options (for signal source)
Option 1A	Rack mount kit with track slides
Option 1B	Rack mount kit with handles
Option 3	Ultra Low Phase Noise, main band, >2 GHz
Option 11	0.1 Hz frequency resolution
Option 14	VNA console mounting
Option 15A*2	High power output
Option 17B	Delete front panel
	Calibration kits*3
3655Q	WR-22 Waveguide (33 to 50 GHz)
Option 1	Adds sliding termination
3655V	WR-15 Waveguide (50 to 75 GHz)
Option 1	Adds sliding termination
3655E	WR-12 Waveguide (60 to 90 GHz)
Option 1	Adds sliding termination
3655W	WR-10 Waveguide (75 to 110 GHz)
Option 1	Adds sliding termination

*1: The millimeter wave VNA requires that at least one of the two modules is a transmission/reflection type. Contact Factory for Millimeter-Wave bands above 110 GHz.

*2: One of the synthesizers must have Option 15A for millimeter wave operation.

*3: Consisting of: Short, fixed (2 each)
Shim, 1/4 wavelength and 3/8 wavelength
Termination, fixed (2 each)
Test port section (2 each)

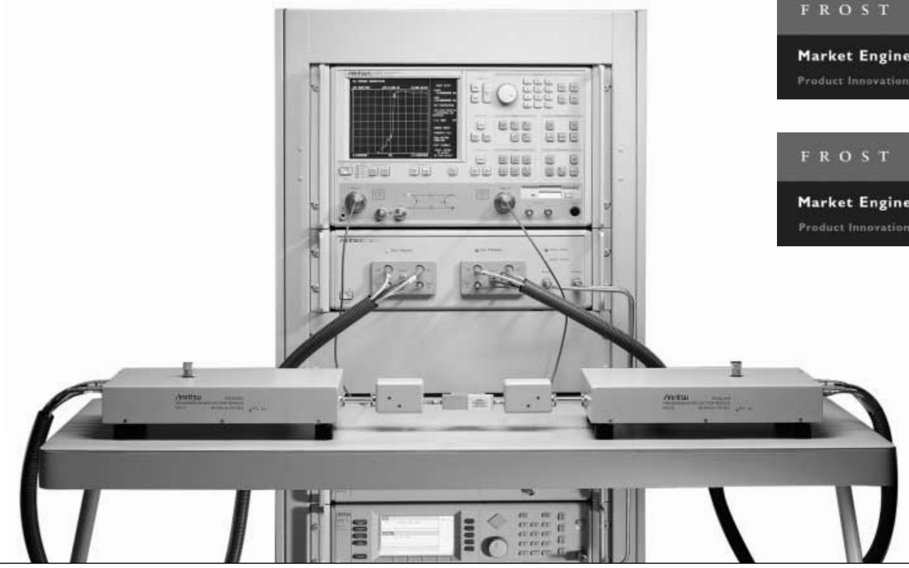
BROADBAND VECTOR NETWORK ANALYZER

ME7808A

40 MHz to 110 GHz

CE GPIB

Broadband S-Parameter Measurements to 110 GHz



FROST & SULLIVAN
Market Engineering Award Recipient
Product Innovation 2002

FROST & SULLIVAN
Market Engineering Award Recipient
Product Innovation & Introduction 2002

The ME7808A Broadband Vector Network Analyzer (VNA) is a high performance measurement solution that covers 40 MHz to 110 GHz in a single fast sweep. In contrast to the millimeter wave Vector Network Analyzer, the ME7808A is built on the advanced technology of the Lightning 65 GHz VNA, and extends its advanced features and intuitive user interface to 110 GHz.

The configuration for the Broadband VNA consists of:
- Lightning 65 GHz VNA
- Millimeter-Wave Modules (Extended W Band, 65 GHz to 110 GHz)
- Broadband Test Set
- Frequency Sources (20 GHz)
- Multiplexing Couplers
- Equipment Console with table

Features

- **Measurement Speed and Accuracy**

The Broadband VNA, based on our popular Lightning 37397C platform, offers the fastest measurement speed available. Measurement speeds of approximately 1.5 seconds for a 101 point sweep mean faster characterization of your millimeter wave and broad frequency devices. The ME7808A also offers full auto-reversing, 12-term, error-corrected S-parameter measurements with advanced calibration techniques – such as Short-Open-Load-Thru (SOLT), Line-Reflect-Line (LRL), and Line-Reflect-Match (LRM) – ensuring maximum accuracy in your on-wafer measurements. For waveguide measurements, the ME7808A system supports all of the above methods as well as the offset short calibration technique. For broadband measurements in W1 (1.0 mm) coax, the ME7808A system supports concatenated SOLT and offset short calibrations using the 3656 W1 calibration/verification kit. The 8.5 inch, color liquid crystal display (LCD) allows users to easily view the data traces for all four S-parameters while simultaneously displaying limit lines and trace memory functions. The built-in 3.5 inch MS-DOS® compatible floppy disk drive and internal hard disk drive simplify the procedure of storing and recalling calibrations, front panel setups, and measurement data. The versatility of the Lightning platform allows data to be gathered using the *.s2p, *.txt, *.dat, *.bmp, and *.hgl file formats so data can be easily loaded into both circuit simulation and graphics programs.

- **Single Pair of Coaxial Test Ports**

The ME7808A Broadband VNA combines the 40 MHz to 65 GHz output from the VNA and the 65 GHz to 110 GHz output from the mmW modules using a unique multiplexing coupler design. The effective system test ports for broadband frequency coverage are two W1 (1.0 mm) coax connectors. The Anritsu W1 connector is compatible with the IEEE standard 1.0 mm connector. This design provides a DC path that permits bias injection from the VNA front panel bias inputs directly to the W1 coax test ports.

- **Three Systems in One**

The Broadband VNA system provides maximum versatility and can be used in any of the following configurations:
1) as a broadband VNA (40 MHz to 110 GHz) with W1 (1.0 mm) connector coaxial interface
2) as a stand-alone 65 GHz VNA with V-connector coaxial interface
3) as a millimeter-wave VNA (65 GHz to 110 GHz) with a WR-10 waveguide connector interface. Additional discrete mmW bands (to 325 GHz) are easily supported by substituting other available mmW modules into the system.

This flexibility in measurement interface allows you to tailor the Broadband VNA to your exact measurement needs. When operating either the 65 GHz or mmW systems independently, higher output power and increased dynamic range are achievable. Wafer probe tips can be connected to any of the three interfaces to make on-wafer measurements.

- **Complete Measurement Solutions**

The Anritsu Broadband VNA is compatible with leading probe stations and probe tips for making on-wafer measurements. On-wafer calibration software such as SussCal from Suss MicroTec and WinCal from Cascade Microtech have built in drivers for the Anritsu VNA's and therefore can be used with the ME7808A. In addition, Anritsu also offers a complete list of accessories including coaxial calibration kits, waveguide calibration kits, W1 (1mm) coaxial and waveguide to coaxial adapters.

Specifications

Dynamic range (typical)

	Frequency (GHz)	0.04	2	20	40	50	<65	>65	75	85	100	110
W1 Coaxial Port	Max Signal into Port 2 (dBm)	30	30	30	30	30	30	16	14	13	12	12
	Port 1 Power, Typical (dBm)	–1	3	–7	–14	–10	–12	–14	–10	–11	–9	–11
	Noise Floor (dBm)	–76	–103	–92	–88	–79	–67	–65	–78	–81	–78	–73
	System Dynamic Range (dB)	75	106	85	74	69	55	51	68	70	69	62
	Receiver Dynamic Range (dB)	106	133	122	118	109	97	81	92	94	90	85

	Frequency (GHz)	0.04	2	20	40	50	<65	>65	75	85	100	110
On Wafer	Max Signal into Port 2 (dBm)	30	30	30	30	30	30	18	17	16	16	16
	Port 1 Power, Typical (dBm)	–1	3	–8	–16	–12	–14	–16	–13	–14	–13	–15
	Noise Floor (dBm)	–76	–103	–91	–86	–77	–65	–63	–75	–78	–74	–69
	System Dynamic Range (dB)	75	106	83	70	65	51	47	62	64	61	54
	Receiver Dynamic Range (dB)	106	133	121	116	107	95	81	92	94	90	85

	Frequency (GHz)	0.04	2	20	40	50	65
V Coaxial Port	Max Signal into Port 2 (dBm)	30	30	30	30	30	30
	Port 1 Power, Typical (dBm)	0	5	–2	–7	–2	–2
	Noise Floor (dBm)	–77	–105	–97	–95	–87	–77
	System Dynamic Range (dB)	77	110	95	88	85	75
	Receiver Dynamic Range (dB)	107	135	127	125	117	107

	Frequency (GHz)	65	75	85	100	110
WR-10 Waveguide	Max Signal into Port 2 (dBm)	8	8	8	8	8
	Port 1 Power, Typical (dBm)	–6	–4	–6	–5	–7
	Noise Floor (dBm)	–73	–84	–86	–82	–77
	System Dynamic Range (dB)	67	80	80	77	70
	Receiver Dynamic Range (dB)	81	92	94	90	85

System dynamic range is defined as the ratio of the typical power at Port 1 and the system noise floor.
The noise floor measurement is made using 512 averages in a 100 Hz IF bandwidth, including isolation calibration.

Measurement time for 101 data points (typical)

Frequency Span	40 MHz to 110 GHz
Time (s)	1.5

Measurement time is based on a single 40 MHz to 110 GHz sweep with 10 kHz IF bandwidth (no averages) after full 12-term calibration. Sweep time includes retrace and band switch times.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
ME7808A	Broadband Vector Network Analyzer (includes 37397C VNA, 3742A-EW[1] millimeter wave modules, broadband test set, frequency sources, multiplexing couplers, and an equipment console)
	Options
Option 14	Custom System Configuration: Configurable (Broadband or Split Band) VNA System. Includes: 37xxxC VNA (with Options), a 3738A Test Set, and two Synthesized Sources (MG369xA / 68xxxC / 69xxxB with Options). Additional configurable items may include 374x-x Millimeter-wave modules, and Multiplexing Couplers. Integrated into a 3700C3 Console.
Option 20	Broadband VNA Upgrade Package for 37397C (65 GHz) with Option 12. Includes: 3738A Test Set, two MG3692A Synthesized Sources, two 3742A-EW millimeter-wave modules, two multiplexing couplers, and 3700C3 Console.
	Optional Millimeter-wave modules[2]
3740A-V	Transmission/Reflection Module, 50 to 75 GHz
3740A-E	Transmission/Reflection Module, 60 to 90 GHz
3740A-EE	Transmission/Reflection Module, 56 to 94 GHz
3740A-EW	Transmission/Reflection Module, 65 to 110 GHz
3740A-W	Transmission/Reflection Module, 75 to 110 GHz

Model/Order No.	Name
	Test Port Cables
3670V50-2	Semi-rigid, V female to V male, 2 ft.
3671V50-3	Flexible, phase stable, V female to V male, 25 in. (1 pair)
57625	Semi-rigid, W1 male to W1 male, 13 cm
	Calibration Kits
3654B	V-connector calibration kit with sliding terminations
3655W	WR-10 waveguide calibration kit
3655W-1	WR-10 waveguide calibration kit with sliding terminations
3656	W1 calibration/verification kit
	Adapters (coaxial)
*3	W1 male to V male
*3	W1 male to V female
*3	W1 female to V male
*3	W1 female to V female
*3	W1 male to W1 male
*3	W1 male to W1 female
*3	W1 female to W1 female
	Adapters (waveguide to coaxial)
*3	WR-10 to W1 male
*3	WR-10 to W1 female

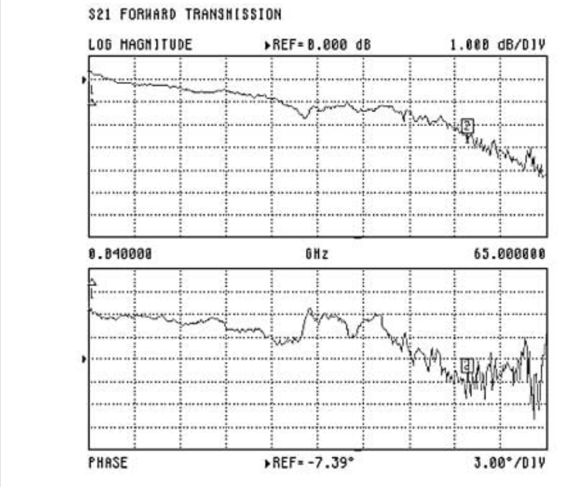
*1: 3742A-EW modules are equipped with an adjustable attenuator that is not available in the 3740A.
*2: Contact Factory for Millimeter-Wave bands above 110 GHz.
*3: Contact factory for model numbers.

O/E CALIBRATION MODULE
MN4765A
40 MHz to 65 GHz

For Highly Accurate and Stable Optoelectronic Measurements

NEW

The MN4765A is a characterized, unamplified photodiode module. It is used as an optical receiver with the 37200C/37300C series VNAs to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E) to 65 GHz.
The MN4765A consists of an InGaAs photodiode that converts modulated optical signals to electrical signals, and includes additional circuitry for temperature and bias stability. The photodiode has exceptional bandwidth response to 65 GHz and a typical responsivity of 0.7A/W. The MN4765A is characterized for 1550 nm in both magnitude and phase using a NIST derived calibration standard.



Frequency response of the MN4765A

Features

- **Fast and accurate optoelectronic measurements**
  The 37200C/37300C series VNAs, when calibrated using the MN4765A module, enable error-corrected Transfer Function, Group Delay and Return Loss measurements of E/O and O/E components and subsystems.
- **NIST derived characterization to 65 GHz**
  Magnitude and phase characterization is obtained using a primary standard characterized by NIST and held in the Anritsu Calibration Lab. The magnitude and phase data is provided on a diskette with the module.
- **Temperature Stable**
  The MN4765A is thermally stabilized to eliminate drift in photodiode performance over temperature.
- **Internal Biasing**
  Accurate bias voltage to the photodiode is maintained internally. An external, multi-country, AC adapter is included for easy operation.
- **High Linearity**
  Linear operating range to +6 dBm for transfer function measurement uncertainties of < 0.5 dB at 50 GHz and < 1 dB at 65 GHz.[+]
- **High Responsivity**
  0.7 A/W (typical)

Specifications

	Value	Unit
Frequency Range[*1]	0.04 to 65	GHz
Characterized Wavelength	1550 ±20	nm
Linear Optical Input Power[*2]	< 6	dBm
Max Optical Input Power	10	dBm
Operating Temperature[*3]	18 to 28	°C
Storage Temperature	–20 to 70	°C
Electrical Return Loss < 50 GHz < 65 GHz	< –8 < –5	dB
Operating Wavelength Range	1480 to 1620	nm
DC Responsivity	> 0.55	A/W
Optical Return Loss	< –24	dB

[*1] Frequency range over which the MN4765A is calibrated by Anritsu Calibration Lab.
[*2] Linear operating range over which |S21| uncertainty is < 0.25 dB.
[*3] Calibrated temperature is 23°C ± 3°C.

[+] Refer to "E/O and O/E Measurements with the 37300C Series VNA" Application Note (11410-00311).

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
MN4765A	O/E Calibration module (40 MHz - 65 GHz)

VECTOR NETWORK MEASUREMENT SYSTEMS (VNMS)

Ethernet / GPIB

MS4622A/B/D, MS4623A/B/D, MS4624A/B/D

10 MHz to 3 GHz **10 MHz to 6 GHz** **10 MHz to 9 GHz**

Innovative Manufacturing Solutions for Measuring S-Parameters, NF, P_{1dB}, IMD, and 3 and 4-Port Devices

Anritsu's family of RF Vector Network Measurement Systems include the MS462XA, MS462XB, and the new MS462xD. Code named Scorpion®, the MS462XX line is much more capable than traditional VNAs. With Scorpion's all new measurement options of vector error-corrected Noise Figure, Intermodulation Distortion, Fourth Measurement Port, and Harmonics, they create a total test solution. And, when you add the standard benefits of outstanding dynamic range and blazing fast measurement speed, you have a truly innovative solution for a manufacturing test environment!

Key Benefits

- See the true performance of all your passive and active components including antennas, isolators, filters, duplexers, couplers, SAW filters, baluns, amplifiers, mixers, and multi-port components
- With a single connection perform S-parameter, Harmonics, Time Domain, Compression, Intermodulation Distortion (IMD), Noise Figure (NF), and Frequency Translated Group Delay for accurate and thorough device characterization
- Optimized for your manufacturing process with features like 2 & 4 port AutoCal® modules which simplify calibrations, sequences for automating repetitive keystrokes, enhanced markers simplify data collection, and external SCSI interface for massive storage
- Measurement speeds of 150 µsec/point and dynamic range of 125 dB

Scorpion's AutoCal® feature also provides a capability for achieving fast, accurate, and highly repeatable calibrations without the need for an external controller. By using AutoCal® standard connector types or test port cable converters, you can calibrate directly using Type N, K, 3.5 mm, or SMA connectors. Planned upgrades include adapter characterization with the ability to calibrate using 7/16 or TNC type connectors.

- **4-Port Balance/Differential Measurements**

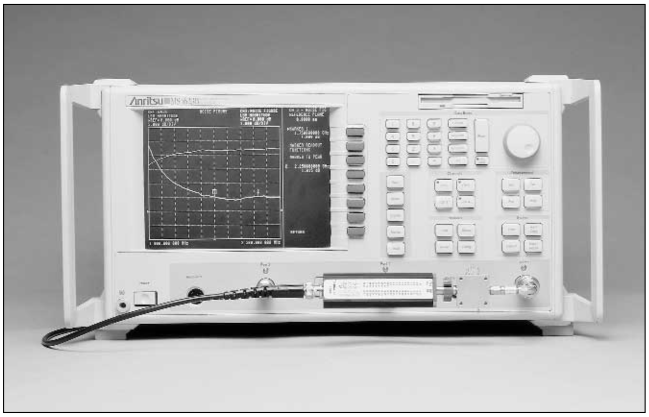
The MS462xD series of Vector Network Measurement Systems (VNMS) allow you to characterize devices like SAW filters and integrated circuits using powerful features like mixed-mode S-Parameters, embedding/de-embedding, and arbitrary impedance. De-embedding utilities provide compensation techniques for typical test fixture environments to further enhance the measurement accuracy, while integrated embedding utilities, consisting of an extensive library of circuit primitives, increases time-to-market and yield when simulating the final matched behavior of components. The Scorpion's arbitrary impedance transformations also accurately handle non-50 Ω measurement scenarios typically associated with balanced devices, making the VNMS well suited for applications requiring ripple, insertion loss and amplitude imbalance measurements on the order of 0.1 dB.

- **Amplifier Measurements**

Some of today's most demanding VNA measurements involve the characterization and tuning of multiple port devices such as duplexers, combiners, couplers, etc. In a traditional 2-port VNA, the full characterization and tuning of such devices presents significant challenges in terms of measurement speed, calibration, and the switching of input signals and measurement ports. With the addition of the third measurement port, the simplicity and speed with which these devices can be tested is greatly enhanced. The MS4622B, MS4623, and MS4624B network analyzers not only offer the option of adding a third measurement port, they also offer the industry's first ever second internal source. This second source is completely independent from the main source that switches between ports 1 and 2. By the addition of this second source, the potential now exists for replacing the signal generators and spectrum analyzers currently needed to characterize the non-linear effects that occur when multiple tones are simultaneously present in the pass-band of an active device.

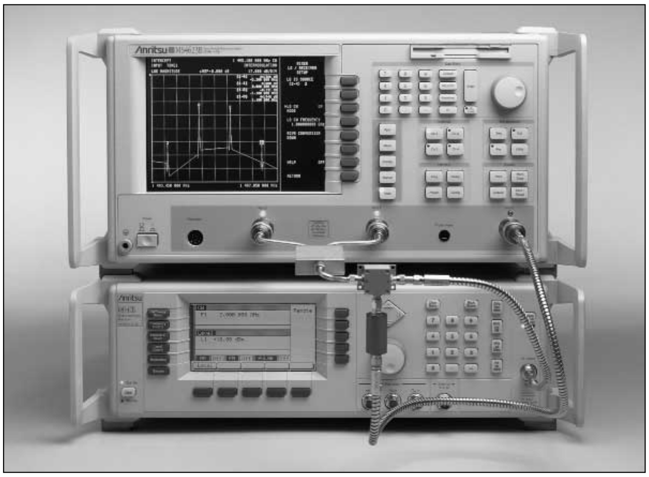
- **Vector error-corrected noise figure measurements**

The MS4622B, MS4623B, and MS4624B Vector Network Measurement Systems deliver the industry's first ever capability for making vector error-corrected noise figure measurements on active devices in today's hottest market – wireless communications. The Noise Figure options covering the frequency ranges of 50 MHz to 3 GHz and 50 MHz to 6 GHz, give you the functionality for making noise figure measurements much more accurately than has ever before been possible. This option allows for making S-parameter measurements and noise figure measurements with a single test connection. The measurement setup can be configured to make measurements with the noise source set in either an internal or an external mode. In the external mode, the noise source is connected directly to the DUT similar to traditional scalar noise figure measurements. In the internal mode, the noise source is connected to the VNA rear panel and internally routed to port 1. Therefore, when a 12-term calibration is applied concurrently with the noise figure calibration, you can make vector error-corrected noise figure measurements.



- **Mixer measurements**

Scorpion can also accurately characterize your mixers and other frequency-translating devices (FTDs) for isolation, match, conversion loss, noise figure and frequency translated group delay (FTGD). Without changing cables or instruments, Scorpion can make all these measurements quickly, easily and accurately. Add an external synthesizer and Scorpion can easily orchestrate swept frequency and swept power mixer IMD measurements. You no longer have to buy and integrate five separate instruments to perform these everyday measurements. With the integrated measurement flexibility of Scorpion, you can design and manufacture all of your passive, active, and frequency translating devices using a single instrument.



- **AutoCal® Automatic Calibrators**

One source of potential errors and inaccuracies in any measurement system is its calibration. A great deal of time can be wasted in a busy manufacturing environment trying to verify calibration accuracy, especially when multiple shifts run on several different test stations for the same product line. For this situation, you need a calibration system in place that offers the highest possible degree of assurance that every station on every shift is calibrated for identical results. With the Anritsu AutoCal® automatic calibrator, you get just that. Simply connect a serial cable between the AutoCal® and the rear panel of the VNA and you're ready to go. If adapters become necessary, AutoCal® can handle them with its revolutionary approach to adapter removal. This approach avoids the necessity of multiple calibrations commonly used in adapter removal calibrations. By using the AutoCal® adapter characterization process, you can calibrate in a SMA, Type N, 3.5mm, TNC, or 7/16 environment with confidence.

Specifications

Test port characteristics	Standard connector type	N female					
	Optional connector types	3.5 mm female, 3.5 mm male, GPC-7, N male					
	Measurement port characteristics	Connector	Configuration	Frequency (MHz)	Directivity (dB)	Source match (dB)	Load match (dB)
		3.5 mm (MS4600/11S) (MS4600/11SF)	Ports 1 and 2 MS462xB MS462xD	10 to 1000	>46	>44	>46
				1000 to 3000	>44	>41	>44
				3000 to 6000	>38	>39	>38
				6000 to 9000	>37	>36	>37
			Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000	>44	>42	>44
				1000 to 3000	>42	>40	>42
				3000 to 6000	>37	>37	>37
				6000 to 9000	>36	>35	>36
		N-Type Standard N(F) (MS4600/11NM)	Ports 1 and 2 MS462xB MS462xD	10 to 1000	>46	>44	>46
				1000 to 3000	>44	>41	>44
				3000 to 6000	>38	>39	>38
				6000 to 9000	>37	>36	>37
			Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000	>44	>42	>44
				1000 to 3000	>42	>40	>42
				3000 to 6000	>37	>37	>37
				6000 to 9000	>36	>35	>36
		GPC-7 (MS4600/11A)	Ports 1 and 2 MS462xB MS462xD	10 to 1000	>46	>44	>46
				1000 to 3000	>44	>41	>44
				3000 to 6000	>38	>39	>38
				6000 to 9000	>37	>36	>37
			Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000	>44	>42	>44
				1000 to 3000	>42	>40	>42
				3000 to 6000	>37	>37	>37
				6000 to 9000	>36	>35	>36

Source specifications	Frequency range		MS4622A/B/D, 10 MHz to 3 GHz MS4623A/B/D, 10 MHz to 6 GHz MS4624A/B/D, 10 MHz to 9 GHz	
	Frequency resolution		1Hz	
	Frequency stability (with internal time base) – aging		$<5x10^{-6}$ / year	
	Temperature		$<5x10^{-6}$ over +15°C to +50°C	
	Power output range		MS4622A Transmission/Reflection Test Set	+10 to –85 dBm
			MS4622B Active Reversing Test Set	+10 to –85 dBm
			MS4622B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A.	+10 to –85 dBm
			MS4622B (Opt 4) w/ Noise Figure	+7 to –85 dBm
			MS4622B (Opt 6) w/ 3rd Test Port	+10 to –85 dBm
			MS4622D Balanced/Differential 4-Port	+10 to –85 dBm
			MS4623A Transmission/Reflection Test Set	+10 to –85 dBm
			MS4623B Active Reversing Test Set	+7 to –85 dBm
			MS4623B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A	+7 to –85 dBm
			MS4623B (Opt 4) w/ Noise Figure (3 GHz only)	+5 to –85 dBm
			MS4623B (Opt 6) w/ 3rd Test Port	+7 to –85 dBm
			MS4623D Balanced/Differential 4-Port	+7 to –85 dBm
			MS4624A Transmission/Reflection Test Set	+10 to –85 dBm
			MS4624B Active Reversing Test Set	+7 to –85 dBm
			MS4624B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A	+7 to –85 dBm
			MS4624B (Opt 6) w/ 3rd Test Port	+7 to –85 dBm
			MS4624D Balanced/Differential 4-Port	+7 to –85 dBm
	Power control range		≥ 20 dB. The minimum absolute level for power sweep is –15 dBm while the maximum power output for a unit is +10 dBm.	
	Source power level		The source power (dBm) may be set from the front panel menu or via GPIB. Port 1 power level is settable from +10 dBm (on the simpler test sets, ranging to +5 dBm on the most complex) to –15 dBm with 0.01 dB resolution. In addition, the Port 1 (& Port 3) power may be attenuated in 10 dB steps using the internal 70 dB step attenuator. Port 3 step attenuator is not available in D models. Port 1 step attenuator is optional in A models.	
	Power level accuracy		±1 dB to 6 GHz, ±1.5 dB to 9 GHz (no flat power calibration applied; full-band frequency sweep at –15 dBm, 0 dBm, and maximum rated power).	
	Level test port power		The power at all sweep frequencies is leveled to within ±1 dB. Only port 1 and port 3 (if installed) can be externally leveled.	
	Harmonics and spurious		<–30 dBc at maximum rated power (MS4622x and MS4623x) <–25 dBc at maximum rated power (MS4624x)	
	Sweep type		Linear, CW, Marker, or N-Discrete point sweep	
	Power sweep range		20 dB (minimum)	
	Source #2 (optional)	Frequency range	10 MHz to 3 GHz (6 GHz or 9 GHz)	
		Frequency resolution	1 Hz	
		Power level accuracy	±1 dB to 6 GHz, ±1.5 dB to 9 GHz (no flat power calibration applied; full-band frequency sweep at –15 dBm, 0 dBm, and maximum rated power).	
		Harmonics and spurious	<–30 dBc at maximum rated power (MS4622x and MS4623x) <–25 dBc at maximum rated power (MS4624x)	
		Sweep type	Linear, CW, Marker, or N-Discrete point sweep	
		Power sweep range	20 dB (minimum)	

Continued on next page

Receiver specs	Average noise level	–100 dBm in 10 Hz IF Bandwidth (< 3 GHz); Typically > –110 dBm in narrowband sweep –90 dBm in 10 Hz IF Bandwidth (> 3 GHz); Typically > –100 dBm in narrowband sweep
	Maximum input level	+27 dBm, +20 dBm noise figure mode
	Damage level	> +30 dBm, > +23 dBm noise figure mode
	Measurement speed summary	Measurement times are measured using a single trace (S_{21}) display and one average. The measurement speeds for the communications band are measured in a 25 MHz band from 824 – 849 MHz. The typical measurement times displayed are as follows:

Data points	IF bandwidth (Hz)	10 MHz to 3 GHz (ms)	10 MHz to 6 GHz (ms)	10 MHz to 9 GHz (ms)	Communications band (ms)
51	30 kHz	16	18	31	11
	10 kHz	21	23	3 5	16
	3 kHz	32	35	46	27
	1 kHz	66	69	76	61
	300 Hz	187	189	203	184
101	30 kHz	26	28	40	20
	10 kHz	35	38	48	28
	3 kHz	57	60	71	50
	1 kHz	126	129	138	120
	300 Hz	366	370	380	368
201	30 kHz	44	48	64	37
	10 kHz	61	65	81	52
	3 kHz	106	110	126	98
	1 kHz	242	246	262	234
	300 Hz	716	720	740	712
401	30 kHz	80	87	110	70
	10 kHz	114	121	146	104
	3 kHz	206	212	236	196
	1 kHz	480	484	508	468
	300 Hz	1424	1432	1448	1408
801	30 kHz	150	161	202	130
	10 kHz	218	230	270	198
	3 kHz	400	412	456	380
	1 kHz	952	960	1000	928
	300 Hz	2820	2840	2900	2800

Measurement capabilities	Parameters	S_{11}, S_{21}, S_{22}, S_{12}, S_{33}, S_{23}, S_{32}, S_{13}, S_{31}, S_{14}, S_{24}, S_{34}, S_{44}, S_{41}, S_{42}, S_{43}, Harmonics, Noise Figure, Intermodulation Distortion (IMD), and user-defined combinations of a_1, a_2, a_3, a_4, b_1, b_2, b_3, and b_4. Mixed-Mode terms, too.
	Measurement frequency range	Frequency range of measurement can be narrowed within the calibration range without recalibration. CW mode permits single frequency measurements, also without recalibration. In addition, the system accepts N discrete frequency points where 2 <N <1601.
	Domains	Frequency Domain, CW Draw, and optional High Speed Time (Distance) Domain
	Formats	Log Magnitude, Phase, Log Magnitude & Phase, Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, Log Polar, Group Delay, Linear Magnitude, Linear Magnitude and Phase, Real, Imaginary, Real & Imaginary, SWR, and Power
	Data points	1601 maximum. Number of data points can be switched to a value of 801, 401, 201, 101, 51, 15, or 3 points without recalibration (if 1601 points were used in the calibration). In addition, the system accepts an arbitrary set of N discrete data points where 2 ≤N ≤1601. CW mode permits selection of a single data point without recalibration.
	Reference delay	Can be entered in time or in distance (when the dielectric constant is entered). Automatic reference delay feature adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between reference and test is always accurate and stable since measurement frequencies are always synthesized. In addition, the system compensates reference phase delay for dispersive transmission media such as microstrip.
	Alternate sweep	Allows the ability to decouple channel 1 and 2 from channel 3 and 4 for the following parameters: correction type, start and stop frequencies, number of data points, markers, sweep time, averaging, smoothing, and IF bandwidth.
	Markers	Twelve independent markers can be used to read out simultaneous measurement data. In alternate sweep mode there are sets of markers for each frequency sweep. In delta reference marker mode, any one marker can be selected as the reference for the other eleven. Markers can be directed automatically to the minimum or maximum of a data trace.
	Enhanced markers	Marker search for a level or bandwidth, displaying an active marker for each channel, and discrete or continuous (interpolated) markers. Identifies the X dB bandwidth of amplifiers, filters, and other frequency sensitive devices.
	Marker sweep	Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.
	Limit lines	Either single or segmented limit lines can be displayed. Two limit lines are available for each trace.
	Single limit readouts	Interpolation algorithm determines the exact intersection frequencies of data traces and limit lines.
	Segmented limit lines	A total of 20 segments (10 upper and 10 lower) can be generated per data trace. Complete segmented traces can be offset in both frequency and amplitude.
	Test limits	Both single and segmented limits can be used for PASS/FAIL testing. PASS or FAIL status is indicated on the display after each sweep. In addition, PASS/FAIL status is output through the rear panel I/O connector as selectable TTL levels (PASS=0V, FAIL=+5V, or PASS=+5V, FAIL=0V).
	Tune mode	Tune Mode optimizes sweep speed in tuning applications by updating forward S-parameters more frequently than reverse ones. This mode lets users select the ratio of forward sweeps to reverse sweeps after a full 12-term calibration. The ratio of forward sweeps to reverse sweeps can be set anywhere between 1:1 to 10,000:1.
	Power sweep measurements	Both Swept Power Gain Compression and Swept Frequency Gain Compression modes are available.
	Sequencing	Seven measurement sequences can be created, stored, edited, and run from the front panel. Sequences can include front-panel functions as well as user-definable control statements. Sequences can be run from either the unit front panel, via GPIB, or from an AT-style keyboard plugged into the front panel.
	Harmonic measurement	Measurement/display of fundamental, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, & 9th harmonic

Continued on next page

Display capabilities	Display channels		Four, each of which can display any S-parameter or user-defined parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously. Each channel is also capable of displaying harmonics, noise figure, intermodulation distortion, or time domain trace. A single channel, two channels (1 and 3, or 2 and 4), or all four channels can be displayed simultaneously. Channels 1 and 3, or channels 2 and 4, can be overlaid for rectilinear graph types.
	Trace overlay		Displays two data traces on the active channel's graticule simultaneously. The overlaid trace is displayed in yellow and the primary trace is displayed in red.
	Trace memory		A separate memory for each channel can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data.
	Blank frequency information		Blanking function removes all references to displayed frequencies on the LCD. Frequency blanking can only be restored through a system reset or GPIB command.
Measurement enhancements	Data averaging		Averaging of 1 to 4096 averages can be selected. The data averaging function is performed at each data point during the frequency sweep. Averaging can be toggled on or off via the front panel; a front-panel LED indicates that the data averaging function is enabled.
	IF bandwidth		Soft Key selection of IF bandwidth (30 kHz, 10 kHz, 3 kHz, 1 kHz, 300 Hz, 100 Hz, 30 Hz, 10 Hz)
	Trace smoothing		Computes an average over a percentage range of the data trace. The percentage of trace to be smoothed can be selected from 0 to 20% of trace.
	Group delay characteristics	Group delay	Group delay is measured by computing the phase change in degrees across a frequency step by applying the formula: $Tg = \frac{-1/360\ d(\text{phase})}{d(\text{frequency})}$
		Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range without recalibration. The frequency width of the aperture and the percent of the frequency range are displayed automatically.
		Range	The maximum delay range is limited to measuring no more than ±180° of phase change within the aperture set by the number of frequency points. A frequency step size of 100 kHz corresponds to 10 microseconds.
		Measurement repeatability (sweep to sweep)	For continuous measurement of a through connection, RSS fluctuations due to phase and FM noise are: $\frac{1.41\ \{(\text{Phase Noise})\text{\^{}}2 + (\text{Tg x Residual FM Noise})\text{\^{}}2\}\text{\^{}}.5}{360\ (\text{Aperture in Hz})}$
		Accuracy	$\text{Error in Tg} = \frac{\frac{\text{Error in phase}}{360} + (\text{Tg x Aperature Freq. Error (Hz)})}{\text{Aperture}}$
		Frequency Translating Group Delay (FTGD)	Allows the measurement of group delay of mixers and other translating devices by analyzing the phase shift experienced by a modulated signal (generated internally). The above Group Delay equation applies, except that the phase change is measured across the modulating bandwidth of the test signal instead of across frequency points. The aperture is fixed at about 900 kHz and the range is limited to about 1 µs. The use of angle modulation keeps the measurement relatively immune from compression and other non-linearities.
	LRL/LRM calibration capability		The LRL calibration technique uses the characteristic impedance of a length of transmission line as the calibration standard. A full LRL calibration consists merely of two transmission line measurements, a high reflection measurement, and an isolation measurement. The LRM calibration technique is a variation of the LRL technique that utilizes a precision termination rather that a second length of transmission line. A third optional standard, either Line or Match may be measured in order to extend the frequency range of the calibration. This extended calibration is achieved by mathematically concatenating either two LRL, two LRM, or one LRL and one LRM calibration(s). Using these techniques, full 12-term error correction can be performed on the MS462XX VNA.
	Dispersion compensation		Selectable as Coaxial (non-dispersive), Waveguide, or Microstrip (dispersive)
	Reference plane		Selectable as Middle of line 1 or Ends of line 1
	Corrected impedance		Determined by Calibration Standards
	AutoCal®		The Scorpion™ family incorporates internal control of the 3658X-series AutoCal® modules.
	FlexibleCal™		Optimize throughput by performing only the sweeps required to characterize multi-port devices. Also enables convenient switching between 2, 3 and 4 port calibration without recalibration.
Hard copy	Printer		Scorpion™ supports the HP 2225C InkJet, HP QuietJet, HP DeskJet, HP LaserJet II, III, IV, & V Series, and Epson compatible printers with parallel (Centronics) interfaces. They are also compatible with the ANRITSU "VNA Capture" program (outputs bitmap file over GPIB) and provide bitmap output over front panel to disk.
	GPIB plotters		Scorpion™ supports the HP Models 7440A, 7470A, and 7475A and Tektronix Model HC100 plotters.
Storage	Internal memory		Ten front panel states (setup/calibration) can be stored and recalled from nonvolatile memory locations. The current front panel setup is automatically stored in nonvolatile memory at instrument powerdown. When power is applied, the instrument returns to its last front-panel setup. The system will be able to exchange two stored calibrations in <0.5 s.
	Internal nonvolatile memory		Used to store and recall measurement and calibration data and front panel setups. All files are MS-DOS compatible.
	Internal floppy disk drive		A 3.5 inch diskette drive with 1.44 Mb formatted capacity is used to load measurement programs and to store and recall measurement and calibration data and front panel setups.
	Measurement data		102.8 kb per 1601 point S-parameter data file
	Calibration data		187.3 kb per 1601 point S-parameter data file (12-term cal plus setup)
	Trace memory file		12.8 kb per 1601 point channel
GPIB	GPIB interfaces		2 ports
	System GPIB (IEEE-488.2)		Connects to an external controller for use in remote programming of the network analyzer. Address can be set from the front panel and can range from 1 to 30.
	Dedicated GPIB		Connects to external peripherals for network analyzer controlled operations (e.g., GPIB plotters, frequency counters, frequency synthesizers, and power meters).

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General	Power requirements	85-240V, 48-63 Hz, 540 VA maximum
	Dimensions	222H x 425W x 450D mm (8.75 x 16.75 x 17.75 in)
	Weight	< 23kg. (52 lb.)
Environmental	Storage temperature range	–40°C to +75°C.
	Operating temperature range	0°C to +50°C (specifications apply at 23°C ±3 °C).
	Relative humidity	5% to 95% at +40°C.
EMC	Meets the emissions and immunity requirements of	EMC Directive - 89/336/EEC
		EN50081-1:1992
		CISPR-11:1990/EN55011:1991 Group 1 Class A
		EMC Directive - 89/336/EEC per EN61326
		EMMISSIONS Standard EN55011:1991 IEC 61000-3-2 IEC 61000-3-3
		IMMUNITY Standard IEC 1000-4-2:1995/prEN50082-1:1995 - 4kV CD, 8kV AD IEC 1000-4-3:1995/ENV50140:1994 - 3V/m IEC 1000-4-4:1995/prEN50082-1:1995 -500V SL; 1000V PL IEC 1000-4-5:1995/prEN50082-1:1995 - 2kV L-E, 1kV L-L IEC 1000-4-6:1995/ENV50141:1994 IEC 1000-4-8:1995/prEN50082-1:1995 IEC 1000-4-11:1995/prEN50082-1:1995
	Safety	Meets safety requirements of Low Voltage/Safety Standard 72/23/EEC - EN61010-1:1993

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MS4622A	10MHz – 3GHz transmission/reflection
MS4622B	10MHz – 3GHz active reversing
MS4622D	10MHz – 3GHz Balanced / Differential 4-Port
MS4623A	10MHz – 6GHz transmission/reflection
MS4623B	10MHz – 6GHz active reversing
MS4623D	10MHz – 6GHz Balanced / Differential 4-Port
MS4624A	10MHz – 9GHz transmission/reflection
MS4624B	10MHz – 9GHz active reversing
MS4624D	10MHz – 9GHz Balanced / Differential 4-Port
	Options
Option 1	Rack mount kit with slides
Option 2	Time domain
Option 3A	Adds to MS4622B a 2nd internal source (3 GHz source) + 3rd port
Option 3B	Adds to MS4623B a 2nd internal source (6 GHz source) + 3rd port
Option 3E	Adds to MS4624B a 2nd internal source (9 GHz source) + 3rd port
Option 4[*1]	Noise figure 50 MHz to 3 GHz (only for B models)
Option 4B[*1]	Noise figure 50 MHz to 6 GHz (only for B models)
Option 4F[*1]	Noise figure 50 MHz to 3 GHz (only for D models)
Option 4G[*1]	Noise figure 50 MHz to 6 GHz (only for D models)
Option 5	Frequency translation group delay
Option 6[*2]	3rd test port (B models; for use with external synthesizer)
Option 7	T/R step attenuator (only for A models, standard on B)
Option 8	Harmonic measurement
Option 11[*3]	Test Port connector
Option 13	Intermodulation distortion
Option 24	Processing Upgrade for MS462xB and MS462xC (standard in MS462xD)
	AutoCal®
36581NNF/2	AutoCal®, Type N, 10 MHz to 9 GHz
36581KKF/2	AutoCal®, Type K, 10 MHz to 9 GHz
36584KF	AutoCal®, 4-Port Type K, 10 MHz to 9 GHz
36584NF	AutoCal®, 4-Port Type N, 10 MHz to 9 GHz

Model/Order No.	Name
	Noise sources
NC346A	5 dB ENR noise source (3.5 mm)
NC346B	15 dB ENR noise source (3.5 mm)
	Calibration kits
3750R	SMA/3.5 mm RF Cal Kit ≤9 GHz
3750R/1	Adds a set of five Phase Equal Insertables (PEIs)
3750R/3	Adds additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations.
3751R	GPC-7 RF Cal Kit ≤9 GHz
3751R/2	Adds a third GPC-7 termination required for three port calibrations.
3751R/3	Adds two additional GPC-7 terminations required for four port calibrations.
3753R	50 Ω, Type N, RF Cal Kit ≤9 GHz
3753R/1	Adds a set of five Phase Equal Insertables (PEIs)
3753R/3	Adds additional N (female) and N (male) terminations required for four port calibrations.
3753-75R	75 Ω, Type N, RF Cal Kit ≤9 GHz
3753-75R/3	Adds additional N (75 Ω female) and N (75 Ω male) terminations required for four port calibrations.
	Verification kits
3663R	Type N verification kit
3666R	SMA/3.5 mm verification kit
3667R	GPC-7 verification kit
	Accessories
15LL50-0.3A	3.5 mm Male-Male Cable, 30 cm
15LL50-0.6A	3.5 mm Male-Male Cable, 60 cm
15LLF50-0.3A	3.5 mm Male-Female Cable, 30 cm
15LLF50-0.6A	3.5 mm Male-Female Cable, 60 cm
15NN50-0.3B	Type N Male-Male Cable, 30 cm
15NN50-0.6B	Type N Male-Male Cable, 60 cm
15NNF50-0.3B	Type N Male-Female Cable, 30 cm
15NNF50-0.6B	Type N Male-Female Cable, 60 cm

[*1] Does not include noise source.
[*2] Port 3 is a receiving port only, unless using an external synthesizer.
[*3] Standard connector is N-female, no cost option for 3.5 mm (male), 3.5 mm (female), N-male, or GPC-7.

VECTOR NETWORK MEASUREMENT SYSTEM / DIRECT-ACCESS RECEIVER

Ethernet / GPIB

MS4622C, MS4623C, MS4624C

10 MHZ to 3 GHz **10 MHz to 6 GHz** **10 MHz to 9 GHz**

For Measuring Antennas, Frequency Conversion, and Multiple-Output Devices

The MS462XC series of RF vector network analyzers are configured as direct-access receivers for antenna, frequency conversion, and multiple output device measurements. The MS462XC offers ultimate flexibility to meet most receiver measurement needs while maintaining the ability to measure all four S parameters with the addition of a reflectometer setup at the front end of the receiver.

The MS462XC series offers three wide-band RF models covering the 10 MHz to 3 GHz, 6 GHz or 9 GHz ranges, MS4622C, MS4623C, and MS4624C, respectively.

Applications

- **Mixers**

Mixers are integral components of most measurement systems. Mixer measurements are complicated by the fact that an LO is required and multiple frequencies are involved in the complete measurement of a mixer. In addition, the mixer is non-linear so power levels must be carefully considered, and in many instances non-linear effects such as compression and intermodulation distortion must be measured. The MS462XC has many features that simplify mixer measurements. The MS462XC can include two built in sources, to provide both the LO and RF signal required by the mixer – the system automatically tunes the receiver to the appropriate IF frequency. The unit can control additional external sources as required for intermodulation measurements.

The setup of the sources is obviously quite important in a mixer measurement. The Mixer device type simplifies this task somewhat. It allows the quick selection of which source is to be the DUT LO. It allows simple selection of a fixed LO or fixed IF measurement scenario (and specifying that LO or IF frequency). And, it informs the receiver of what kind of DUT conversion to expect (up conversion |RF+LO|, down conversion |RF –LO|, or no conversions might be used for a quick leakage measurement). Activating the mixer device type also performs the important function of turning on both internal sources for front panel access (usually using ports 1 and 3 driving, port 2 being the receive port). Two ports are not allowed to drive simultaneously during normal S-parameter measurements.

- **Antennas**

Far-field measurements are enhanced with the speed of taking data over GPIB, using fast CW mode. Rates of 8,900 points per second can be achieved.

Specifications

General measurement and enhancement display capabilities are the same as those for the MS4622A/B/D, MS4623A/B/D, MS4624A/B/D.

Number of channels	Four measurement channels
Operating port power (A1, A2, B1 and B2)	–5 dBm for 0.1 dB compression
Maximum port power for no damage	+20 dBm
Noise floor	–110 dBm@10 Hz IF bandwidth (<3 GHz), typically >–120 dBm in narrowband sweep; –100 dBm@10 Hz IF bandwidth (>3 GHz), typically >–110 dBm in narrowband sweep
System dynamic range	97 dB
Power output range (ports 1, 2 and 3)	MS4622C: +10 to –85 dBm MS4623C: +7 to –85 dBm MS4624C: +7 to –85 dBm
Source match (RF1, RF2 and RF3)	–9 dB (uncorrected)
Port match (A1, A2, B1 and B2)	–12 dB (uncorrected)
Frequency range	MS4622C: 10 MHz to 3 GHz MS4623C: 10 MHz to 6 GHz MS4624C: 10 MHz to 9 GHz
2nd internal source	Optional
Intermodulation Distortion	Optional
IMD (3rd order) dynamic range	70 dB with 10 Hz IF bandwidth @ 300 kHz tone separation and @ –20 dBm tone levels
IMD accuracy	±1 dB @ > –60 dBm levels
Power measurement accuracy	±1 dB without flat power calibration ±0.1 dB with flat power calibration
Full reversing transfer switch	Provided

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Mainframe
MS4622C	10 MHz to 3 GHz direct receiver access
MS4623C	10 MHz to 6 GHz direct receiver access
MS4624C	10 MHz to 9 GHz direct receiver access
	Options
Option 1	Rack mount kit with slides
Option 2	Time domain
Option 3C	Adds to MS4622C a 2nd internal source (3 GHz source) + 3rd port
Option 3D	Adds to MS4623C a 2nd internal source (6 GHz source) + 3rd port
Option 3F	Adds to MS4624C a 2nd internal source (9 GHz source) + 3rd port
Option 4D[*3]	Noise figure 50 MHz to 3 GHz (only for C models)
Option 4E[*3]	Noise figure 50 MHz to 6 GHz (only for C models)
Option 5	Frequency translated group delay
Option 6	3rd test port (only for B and C models)
Option 7	T/R step attenuator (only for A models, standard on B)
Option 8[*1]	Harmonic measurement
Option 11[*2]	Test Port connector
Option 13	Intermodulation distortion
Option 24	Processing Upgrade for MS462xB and MS462xC (standard in MS462xD)
	Noise sources
NC346A	5dB ENR noise source (3.5 mm)
NC346B	15dB ENR noise source (3.5 mm)

*1: Subject to frequency range limitations imposed by test set.

*2: Standard connector is N-female, no cost option for 3.5 mm (male), 3.5mm (female), N-male, or GPC-7.

*3: Does not include noise source.

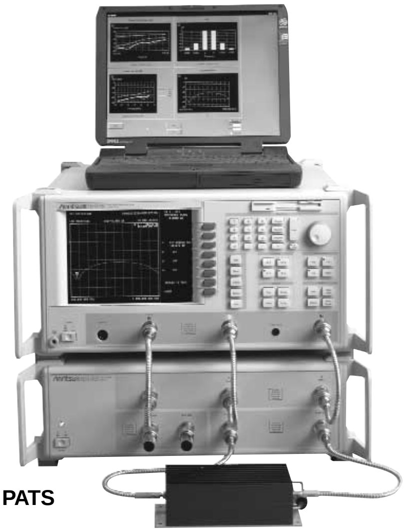
POWER AMPLIFIER TEST SYSTEM (PATS)

ME7840A

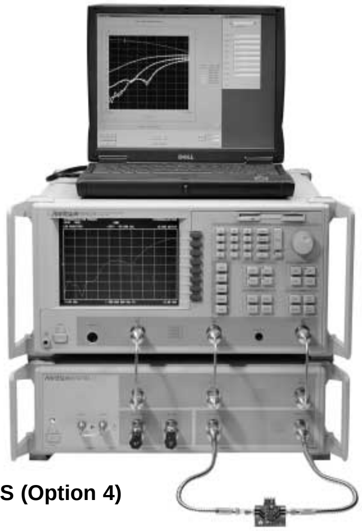
800 to 2400 MHz, 100 Watts / 10 to 6000 MHz, 5 Watts

GPIB

Easy-to-Use System for Power Amplifier Design and Manufacturing



PATS



HATS (Option 4)

The ME7840A Power Amplifier Test System (PATS) is a flexible, easy-to-use system for base station power amplifier testing and with the introduction of the new option 4 Handset Amplifier Test Set (HATS) it now provides full coverage to handle all of your power amplifier testing needs.

Key Benefits

- Versatility to characterize most power and handset amplifiers
- Consolidate multiple test stations and connections to increase productivity
- Improve accuracy and repeatability of S-parameter, Harmonics, Gain Compression, Intermodulation Distortion (IMD), and Adjacent Channel Power Ratio (ACPR) measurements
- Flexibility to accommodate future requirements with auxiliary paths
- Scorpion Navigator™ enables test executive integration in about a week

PATS consists of three distinct parts: The Scorpion Navigator Software, the MS462xC Vector Network Measurement System, and the MS4782D Test Set.

- **Scorpion Navigator Software**

The Scorpion Navigator software is installed on your computer to orchestrate the PATS and HATS measurements. The computer should be a Pentium II at 200 MHz or equivalent system with a GPIB Card (computer not included).

- **MS462xC Vector Network Measurement System (VNMS)**

The MS462xC is the Direct Receiver Access (DRA) configuration for the MS462xx family of Vector Network Measurement Systems (VNMS). The MS462xC series is available in two wide-band RF models covering the 10 MHz to 3 GHz or 6 GHz range (MS4622C and MS4623C respectively).

- **MS4782D Test Set (Option 4, MN4783A)**

The MS4782D or MN4783A (option 4) Test Set provides the necessary hardware to interface between your power amplifier and the VNMS.

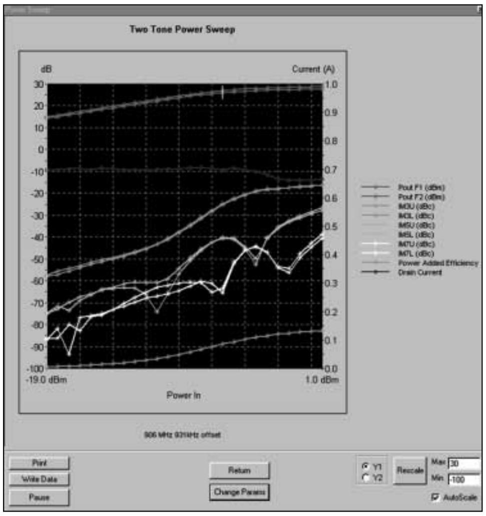
Scorpion Navigator Software Results

With frequency sweeps as fast as 150 µs/point and power sweeps as fast as 150 µs/point, you can quickly, thoroughly, and accurately characterize your power amplifiers in real-time.
Simultaneously overlay measurements in both frequency and power and see the results of over 250 data points updated twice per second.

Measurement capabilities:

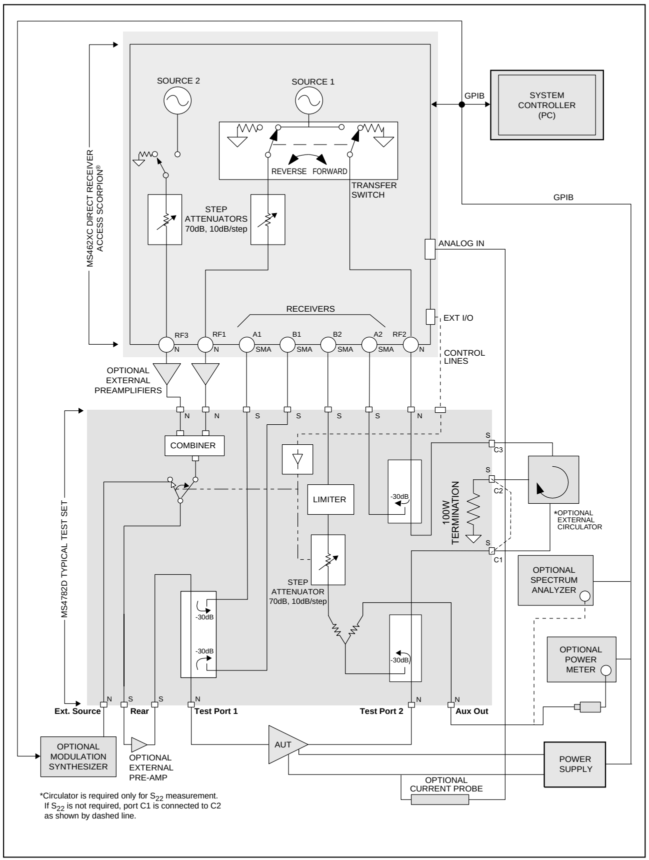
Measurements	CW	Swept Frequency (as fast as 150 µsecs/pt)	Swept Power (as fast as 150 µsecs/pt)
ACPR	√		√ *1
S-Parameters Hot S_{22}	√	√	√
IMD, TOI (two-tone): 3rd, 5th, 7th, & 9th	√	√	√
Gain Compression: P_1 dB AM/PM	 √ √	 √	 √ √
Harmonics: Magnitude Phase	√	√ √	√
Noise Figure*2	√	√	
Power Added Efficiency (PAE)	√	√	√
Drain Current	√	√	√

*1: Swept power speed is related to external source
*2: Noise Figure only available with option 4 (HATS test set)



Power Amplifier Test Set Block Diagram

The following block diagram depicts the standard MS4782D Test Set design. Anritsu can configure and optimize a custom test set for your specific requirements.



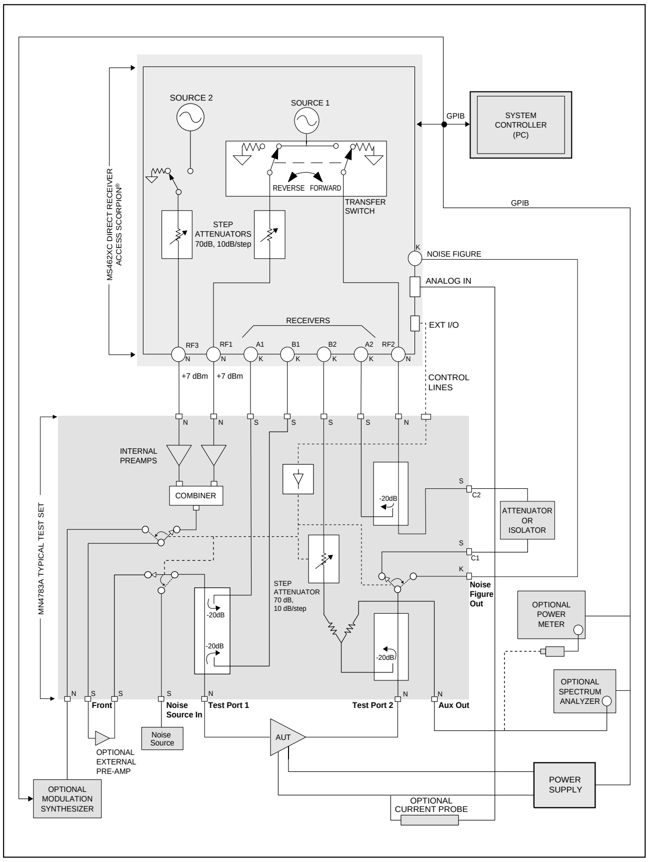
*Circulator is required only for S_{22} measurement. If S_{22} is not required, port C1 is connected to C2 as shown by dashed line.

Specifications

Characteristic	Value	Notes
Amplifier Under Test Power Output	100W max	Without Hot S_{22} provision (Contact Anritsu for custom designs for higher power)
Bandwidth through Test Set	800 MHz – 2.4 GHZ	Without S_{22} provision (Contact Anritsu for custom designs for different frequency ranges)
Amplifier Under Test Input Power range available from PATS	–85 dBm to +10 dBm	This value is for each tone, at combiner input. Provision for preamplifiers provided for greater levels
IMD (3^{rd} order) Dynamic Range	70 dB min	With 10 Hz IF bandwidth @ 300 kHz tone separation and –20 dBm tone levels
IMD Accuracy	±1 dB max	@ >–60 dBc levels
Port Power Accuracy	±0.1 dB typical ±1 dB max	With flat power calibration Without flat power calibration
Dynamic Range	80 dB min	Over-all system including Test Set
Port Match (test ports 1 & 2)	40 dB min	Corrected value
Port Match (test ports 1 & 2)	13 dB min	Uncorrected value
Directivity	40 dB	800 MHz – 2.4 GHz, Corrected value

Handset Amplifier Test Set Block Diagram

The following block diagram depicts the standard MS4782D Test Set design. Anritsu can configure and optimize a custom test set for your specific requirements.



Specifications

Characteristic	Value	Notes
Amplifier Under Test Power Output	5W max	–
Bandwidth through Test Set	10 MHz – 6.0 GHZ	–
Amplifier Under Test Input Power range available from HATS	–65 dBm to +13 dBm	This value is for each tone, at combiner input. Provision for preamplifiers provided for greater levels
IMD (3^{rd} order) Dynamic Range	70 dB min	With 10 Hz IF bandwidth @ 300 kHz tone separation and –20 dBm tone levels
IMD Accuracy	±1 dB max	@ >–60 dBc levels
Port Power Accuracy	±0.1 dB typical ±1 dB max	With flat power calibration Without flat power calibration
Dynamic Range	80 dB typical 70 dB typical	10 MHz to 3 GHz 3 GHz to 6 GHz
Port Match 10 MHz to 3 GHz	40 dB (corrected) 13 dB (uncorrected)	Uncorrected match for Test Port 2 is typically 20 dB
Port Match 3 GHz to 6 GHz	37 dB (corrected) 13 dB (uncorrected)	Uncorrected match for Test Port 2 is typically 18 dB
Directivity	40 dB	50 MHz – 6 GHz, Corrected value
Noise Figure	50 MHz – 6 GHz	

Ordering information

Please specify model/order number, name, and quantity when ordering. Anritsu can configure and optimize a custom test set for your specific requirements. The following information represents the standard configuration and options.

Model/Order No.	Name
	Main frame
ME7840A	PATS, 800 to 2400 MHz, 100 Watts
MS4623C[*1,2]	Scorpion®, DRA configuration, 10 MHz to 6 GHz
MS4600/3D	Scorpion® optional 6 GHz internal source with 3rd test port
MS4600/8	Scorpion® optional harmonic measurement application
MS4600/13	Scorpion® optional intermodulation distortion application
MS4782D	PATS Test Set (100 Watts, 800 – 2400 MHz)[*3]
43425	Accessories and interconnect kit
	Scorpion Navigator™
	Options
ME7840/1	Replace MS4623C with MS4622C (3 GHz option)
ME7840/2	Replace MS4782D test set with MS4782A
ME7840/3	Delete Test Set
ME7840/4	Handset Amplifier Test Set (HATS) (5 Watts, 10 – 6000 MHz)
	Circulators
	Circulators may be required for measurements of Hot S_{22}:
1000-50	Circulator, 800 – 1000 MHz, 20 dB min, 50 Watts Max AUT Power
1000-52	Circulator, 1.8 – 2.5 GHz, 20 dB min, 50 Watts Max AUT Power, (connecting cable(s) not included)
1000-53	Circulator, 1.8 – 2.5 GHz, 22 dB min, 79 Watts Max AUT Power
	Note: All circulators have 3 SMA female connectors.
	Current Probes
	Current Probes are required for drain current and Power Added Efficiency (PAE) calculations:
2000-1067	Current Probe Max current: 100mV/A:10A, 10mV/A:100A Accuracy (at lesser current range setting): 3% of reading ±50mA
2000-1085	Current Probe Max current: 1mV/mA:1A, 10mV/A:80A Accuracy (at lesser current range setting): 2% of reading ±5mA
	Calibration kits
3750R	SMA/3.5 mm RF Cal Kit ≤9 GHz
3750R/1	Adds a set of five Phase Equal Insertables (PEIs)
3750R/3	Adds additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations.
3753R	50 Ω, Type N, RF Calkit ≤9 GHz
3753R/1	Adds a set of five Phase Equal Insertables (PEIs)
3753R/3	Adds additional N (female) and N (male) terminations required for four port calibrations.
	AutoCal®
36581NNF/2	AutoCal, Type N, 10 MHz to 9 GHz
36581KKF/2	AutoCal, Type K, 10 MHz to 9 GHz
	Economy cables
15LL50-0.3A	3.5 mm Male-Male Cable, 30 cm
15LL50-0.6A	3.5 mm Male-Male Cable, 60 cm
15LLF50-0.3A	3.5 mm Male-Female Cable, 30 cm
15LLF50-0.6A	3.5 mm Male-Female Cable, 60 cm
15NN50-0.3B	Type N Male-Male Cable, 30 cm
15NN50-0.6B	Type N Male-Male Cable, 60 cm
15NNF50-0.3B	Type N Male-Female Cable, 30 cm
15NNF50-0.6B	Type N Male-Female Cable, 60 cm

*1: ME7840A standard connector type is N-female.
*2: Scorpion® DRA rear panel Reference Channel Connectors a1, a2, b1, and b2 are SMA-female connectors.
*3: Special test sets can be configured for other power levels and frequency ranges.

TOWER MOUNTED AMPLIFIER TEST SYSTEM (TMATS)
ME7842B

10 to 6000 MHz

CE GPIB

Fully Characterize and Test Tower Mounted Amplifiers (TMAs) with a Single Connection

The result of working with a top infrastructure provider of Node B base station components, the ME7842B is a measurement system capable of simplifying the complexity of multi-port Tower Mounted Amplifier (TMA) test. With innovative instrumentation, flexible multi-port test set and easy-to-use software, TMATS has dramatically reduced TMA test times from hours to just minutes. The easy-to-use software, the Scorpion Navigator™, includes unprecedented features that enable integration into any manufacturing environment in about a week. The solution is now commercialized and ready to tackle your toughest TMA measurement requirements.

Key Benefits

- Versatility to characterize most TMA configurations (2 – 5 ports)
- Consolidate multiple test stations and connections to increase productivity
- Improve accuracy and repeatability of S-parameter, Harmonics, Gain Compression, Intermodulation Distortion (IMD), Noise Figure (NF), and Adjacent Channel Power Ratio (ACPR) measurements
- Flexibility to accommodate future requirements with auxiliary paths
- Scorpion Navigator enables test executive integration in about a week

TMATS consists of three distinct parts: The Scorpion Navigator software, MS462xB Vector Network Measurement System, and the MN4790A Test Set.

- **Scorpion Navigator Software**

The Scorpion Navigator software is installed on your computer to orchestrate the TMATS measurements. The computer should be a Pentium II at 200 MHz or equivalent system with a GPIB Card (computer not included).

- **MS462xB Vector Network Measurement System (VNMS)**

The MS462xB is a powerful full reversing S-parameter configuration offering performance, ease-of-use and the versatility that is required in TMA testing.

The MS462xB series is available in two wide-band RF models covering the 10 MHz to 3 GHz or 6 GHz range (MS4622B and MS4623B respectively).

- **MN4790A Test Set**

The MN4790A Test Set provides the necessary hardware to interface between your tower mounted amplifier (TMA) and the VNMS.

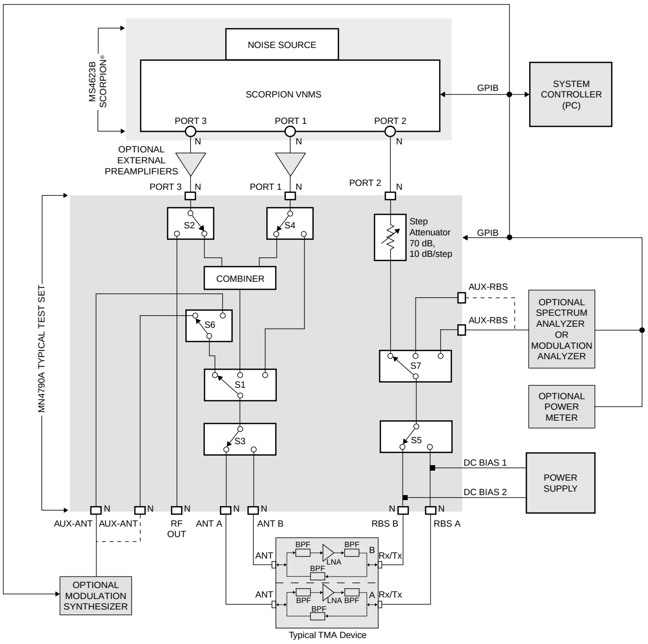
Measurement capabilities:

Measurements	CW	Swept Frequency (as fast as 150 µsecs/pt)	Swept Power (as fast as 150 µsecs/pt)
Noise Figure	√	√	
ACPR	√		√∗
S-Parameters	√	√	√
IMD, TOI (two-tone): 3rd, 5th, 7th, & 9th	√	√	√
Gain Compression: P_1 dB AM/PM	√ √	√	√ √
Harmonics: Magnitude	√	√	√
Power Added Efficiency (PAE)	√	√	√

∗ Swept power speed is related to external source

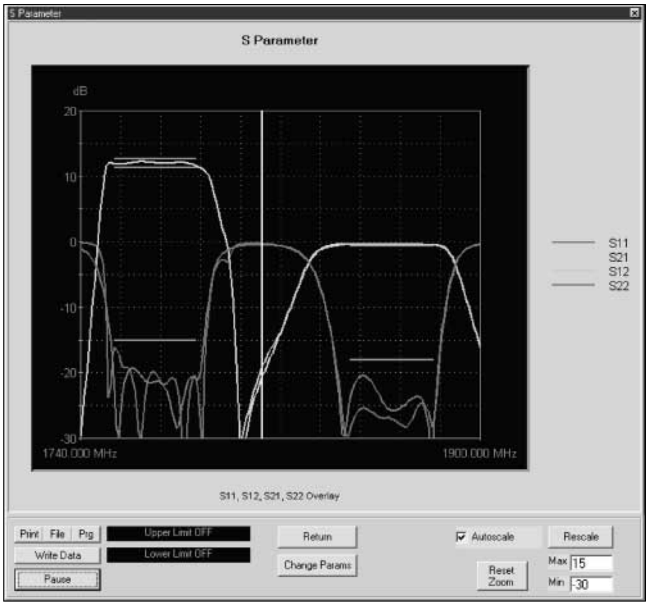
TMATS Block Diagram

The following block diagram depicts the standard MN4790A Test Set design. Anritsu can configure and optimize a custom test set for your specific requirements.



Scorpion Navigator Software Results

The Scorpion Navigator is optimized for testing both current and future TMA configurations. Once calibrated, simply choose the desired TMA path and the necessary measurement. That's all it takes to begin. Manual operation is simplified with a flexible and easy-to-use graphical user interface optimized for testing a TMA. The standard list of measurements includes: S-parameters with clear pass/fail limit lines, compression, intermodulation distortion, harmonics, noise figure and adjacent channel power ratio.



Upper Limit OFF

Lower Limit OFF

☑ Autoscale

Max 15

Min -30

Specifications

Characteristic	Specification
Frequency, Test Set	10 MHz to 6 GHz 500 MHz to 6 GHz for IMD
Maximum Power Level	+20 dBm
Input Power Range to DUT	0 dBm to –85 dBm
IMD (3rd Order) Dynamic Range	70 dBm
IMD Accuracy	±1 dB max (at >–60 dBc Levels)
Port Power Accuracy	±0.1 dB typical (with flat power Levels)
Dynamic Range	80 dB typical
Directivity	40 dB (10 MHz to 3 GHz, corrected) 35 dB (3 GHz to 6 GHz, corrected)
Source Match	35 dB (10 MHz to 6 GHz, corrected)
Isolation between DUT Ports ANTA ↔ ANTB RBSA ↔ RBSB ANTn ↔ RBSn	 60 dB 60 dB 100 dB
Damage Level (test set)	>+27 dBm

Ordering information

Please specify model/order number, name, and quantity when ordering. Anritsu can configure and optimize a custom test set for your specific requirements. The following information represents the standard configuration.

Model/Order No.	Name
	The ME7842B* System consists of the following:
MS4623B*	Scorpion®, 10 MHz to 6 GHz
MS4600/3B	Scorpion® optional 6 GHz internal source with 3rd test port
MS4600/4B	Scorpion® optional 6 GHz noise figure
MS4600/8	Scorpion® optional harmonic measurement application
MS4600/13	Scorpion® optional intermodulation distortion application
MN4790A*	TMATS test set
ND57610	Accessories and interconnect kit includes Scorpion® Navigator Software

* ME7842B standard connector type is N-female.

The following information represents the options.

Model/Order No.	Name
	Calibration kits
3753R	Type N RF Calibration Kit (9 GHz)
3753R/1	Adds a set of five Phase Equal Insertables (PEIs)
3753R/3	Adds additional N (female) and N (male) terminations
	AutoCal®
36581NNF/2	AutoCal, 2-Port N, 10 MHz to 9 GHz
36585NF	AutoCal, 4-Port N, 10 MHz to 9 GHz
	Economy cables
806-109	Type N Male to 7/16 Male Cable, 60 cm
15NN50-0.3B	Type N Male to Male Cable, 30 cm
15NN50-0.6B	Type N Male to Male Cable, 60 cm
15NNF50-0.3B	Type N Male to Female Cable, 30 cm
15NNF50-0.6B	Type N Male to Female Cable, 60 cm
	Noise Sources
NC346A	5 dB ENR Noise Source, 3.5 mm connector
NC346B	15 dB ENR Noise Source, 3.5 mm connector

4 PORT VECTOR NETWORK ANALYZER AUTOMATIC CALIBRATOR

36584 Series

10 MHz to 9 GHz

Automatic, High-Reliability, and High-Quality Calibrators for Multi-port Coaxial Device Measurements

The 36584 series AutoCal® modules are automatic calibrators that provide fast, repeatable, and high-quality coaxial calibrations for 2, 3, & 4-Port S-Parameter requirements up to 9 GHz. These modules contain precisely characterized calibration standards that aid in the removal of normal systematic errors when using the MS46XXA/B/C/D series Vector Network Measurement System (VNMS). The 4-Port AutoCal® is available in two models: 10 MHz to 9 GHz, with N (f) connectors and 10 MHz to 9 GHz, with K (f) connectors. 4-Port AutoCal® modules come with a data file characterizing each standard in the calibrator module. Each module is guaranteed to perform to its specifications for six months without re-characterization. Following this period, re-characterization can be performed by the customer, or by sending the module to the nearest service center. The 4-Port AutoCal® has a direct serial interface to the MS462x series of Anritsu Vector Network Measurement Systems. The control software is built-in to the VNMS.

Features

- **Calibration types**
1-port S_{11} and S_{22} calibration, and full 2-port, 12-term OSLT, 3-port, 24-term OSLT, and 4-port, 40-term OSLT calibrations can be performed with the 4-Port 36584 series AutoCal®.
- **Fast**
Significantly reduces calibration time making it ideal for the manufacturing environment.
- **Reliable**
Eliminates unreliable measurements due to inaccurate manual calibrations.
- **Accurate**
Accuracy that exceeds OSLT calibration, with broadband loads. Characterized modules are traceable to NIST.
- **True thru**
Inherently, the internal calibrator thru is not as accurate as an external direct thru connection. The true thru mode offers the choice of manually removing the AutoCal® module for a true thru calibration.
- **Isolation cal**
Isolation cal is offered as part of a full 2, 3, or 4-port calibration. The user is given the option of skipping isolation, using the default averaging factor during isolation, or entering a custom averaging factor.
- **Thru update**
Due to cable movements and aging, periodically updating the thru portion of a calibration is recommended. Thru update mode offers the choice of simply performing a direct manual thru step to update a current calibration. This is easily performed without having to invoke the AutoCal® module.
- **Manual control**
Manual control offers the ability to connect any of the internal standards to the test ports of the VNA. This feature could be used to manually verify a calibration.
- **Adapter removal**
VNA calibration for testing non-insertable devices requires phase equal insertables. If this is not possible, or is undesirable, adapter removal calibration is the solution. Adapter removal requires two full 12-term calibrations, moving an adapter from one test port cable to the other between calibrations (a job AutoCal® makes quick and easy). Internal software mathematically subtracts the effect of the adapter, yielding the desired adapter-less measurement.

Specifications

All specifications are guaranteed over the ambient temperature range of 23° ±3°C.

- **Directivity**

Frequency	AutoCal® Module
0.01 to 1 GHz	42 dB
1 to 3 GHz	40 dB
3 to 6 GHz	36 dB
6 to 9 GHz	34 dB

- **Source match**

Frequency	AutoCal® Module
0.01 to 1 GHz	42 dB
1 to 3 GHz	39 dB
3 to 6 GHz	35 dB
6 to 9 GHz	33 dB

General

- **Serial input connector**

9 pin D-sub allowing PC or direct VNA control (Serial cable supplied)

- **Power supply input connector**

+5V, ±15V for the electronic modules, and +5V, +24V for the electromechanical module. The modules are keyed against plugging the wrong supply. The appropriate DC supply is supplied with each AutoCal® module. These universal supplies will operate at either 110V or 220V input voltages.

- **Power LED**

On when the DC supply is plugged in.

- **Operate LED**

On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations.

- **Dimensions**

155 (W) x 65 (H) x 90 (D) mm (6 W x 2.5 H x 3.5 D in.)

Environment

- **Operating temperature**

18° to 28°C

- **Storage temperature**

–20° to 70°C

- **Relative humidity**

5% to 95% at 40°C

- **EMC**

Conforms to the EMC Directive, 89/336/EEC per EN61326
EN55011:1991
EN61000-3-2:1995
EN61000-3-3:1995
Immunity
EN61000-4-2:1995
EN61000-4-3:1995
EN61000-4-4:1995
EN61000-4-5:1995
EN61000-4-6:1995
EN61000-4-11:1995

Ordering information

Please specify model/order number, name, and quantity when ordering.

	AutoCal® Modules
36584KF	4-Port AutoCal®, K(f) type, 10 MHz to 9 GHz
36584NF	4-Port AutoCal®, N(f) type, 10 MHz to 9 GHz
	Test port converter sets
36583S	SMA type
36583L	3.5 mm type
36583K	K type

AutoCal® may be sent to the nearest service center for re-characterization, or a service engineer may perform the task at the customer's site. To minimize down-time, the customer can re-characterize his own AutoCal® module with a Lightning or Scorpion family VNA and a traditional cal kit.

VECTOR NETWORK ANALYZER AUTOMATIC CALIBRATOR

3658 Series

10 MHz to 40 GHz

Automatic, High-Reliability, and High-Quality Calibrators for Coaxial Device Measurements

The 3658 series AutoCal® modules are automatic calibrators that provide fast, repeatable, and high-quality coaxial calibrations up to 40 GHz. These modules contain precisely characterized calibration standards that aid in the removal of normal systematic errors when using vector network analyzers (VNAs). AutoCal® is available in four models: 0.04 to 18 GHz, with N (m) to N (f) connectors, 0.01 to 9 GHz and 0.04 to 20 GHz, with K (m) to K (f) connectors, and 0.04 to 40 GHz, with K (m) to K (f) connectors.

AutoCal® modules come with a data file characterizing each standard in the calibrator module. Each module is guaranteed to perform to its specifications for six months without re-characterization. Following this period, re-characterization can be performed by the customer, or by sending the module to the nearest service center.

Test port cable converter sets aid the user in calibrating a VNA for testing non-insertable devices and devices with SMA or 3.5 mm connectors. Test port converter sets are available for K Connector®, SMA, and 3.5 mm connectors. Adapter removal calibration is required for N type non-insertable device testing.

AutoCal® has a direct serial interface to the 37xxx and MS462x series of Anritsu vector network analyzers. The control software is built-in to the VNA. For operation with the 360B and/or older generation 37xxx models, an external PC running Microsoft Windows® with a National Instruments IEEE488.2 GPIB interface card is required.

Features

- **Calibration types**

1-port S_{11} and S_{22} calibration, and full 2-port, 12-term OSLT calibrations can be performed with AutoCal®.

- **True thru**

Inherently, the internal calibrator thru is not as accurate as an external direct thru connection. The true thru mode offers the choice of manually removing the AutoCal® module for a true thru calibration.

- **Isolation cal**

Isolation cal is offered as part of a full 2-port calibration. The user is given the option of skipping isolation, using the default averaging factor during isolation, or entering a custom averaging factor.

- **Switch averaging**

The mechanical module uses an electromechanical switch to select the calibration standards. Switch averaging is offered to reduce the effects of the electromechanical switch's non-repeatability. A 6 dB reduction of non-repeatability can be achieved by increasing switch averaging by a factor of four, at the expense of the overall calibration time.

- **Thru update**

Due to cable movements and aging, periodically updating the thru portion of a full 12-term calibration is recommended. Thru update mode offers the choice of simply performing a direct manual thru step to update a current calibration. This is easily performed without having to invoke the AutoCal® module.

- **Manual control**

Manual control offers the ability to connect any of the internal standards to the test ports of the VNA. This feature could be used to manually verify a calibration.

- **Adapter removal**

VNA calibration for testing non-insertable devices, requires phase equal insertables. If this is not possible or is undesirable, adapter removal calibration is the solution. Adapter removal requires two full 12-term calibrations, moving an adapter from one test port cable to the other between calibrations (a job AutoCal® makes quick and easy). Internal software mathematically subtracts the effect of the adapter, yielding the desired adapterless measurement.

Specifications

All specifications are guaranteed over the ambient temperature range of 23˚ ±3˚C.

- **Directivity**

Frequency	AutoCal® module	AutoCal® with 36583X
0.01 to 2 GHz	38 dB	36 dB
2 to 20 GHz	36 dB	34 dB
20 to 40 GHz	34 dB	32 dB

- **Source match**

Frequency	AutoCal® module	AutoCal® with 36583X
0.01 to 2 GHz	34 dB	32 dB
2 to 18 GHz (N)	31 dB	29 dB
2 to 20 GHz (K)	34 dB	32 dB
20 to 40 GHz	26 dB	24 dB

- **Reflection tracking**

Frequency	AutoCal® module	AutoCal® with 36583X
0.01 to 2 GHz	±0.15 dB	±0.20 dB
2 to 20 GHz	±0.20 dB	±0.25 dB
20 to 40 GHz	±0.25 dB	±0.30 dB

- **Transmission tracking (Internal thru mode)**

Frequency	AutoCal® module	AutoCal® with 36583X
0.01 to 2 GHz	±0.15 dB	±0.20 dB
2 to 20 GHz	±0.20 dB	±0.25 dB
20 to 40 GHz	±0.25 dB	±0.30 dB

- **Transmission tracking (True thru mode)**

Frequency	AutoCal® module	AutoCal® with 36583X
0.01 to 2 GHz	±0.10 dB	±0.15 dB
2 to 20 GHz	±0.10 dB	±0.15 dB
20 to 40 GHz	±0.20 dB	±0.25 dB

General

- **Serial input connector**

9 pin D-sub allowing PC or direct VNA control. (Serial cable supplied)

- **Power supply input connector**

+5V, ±15V for the electronic modules, and +5V, +24V for the electromechanical module. The modules are keyed against plugging the wrong supply. The appropriate DC supply is supplied with each AutoCal® module. These universal supplies will operate at either 110V or 220V input voltages.

- **Power LED**

On when the DC supply is plugged in.

- **Operate LED**

On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations.

- **Dimensions**

155 (W) x 65 (H) x 90 (D) mm (6 W x 2.5 H x 3.5 D in.)

Environment

- **Operating temperature**

18˚ to 28˚C

- **Storage temperature**

–20˚ to 70˚C

- **Relative humidity**

5% to 95% at 40˚C

- **EMC**

Conforms to the EMC Directive, 89/336/EEC per EN61326
EN55011:1991
EN61000-3-2:1995
EN61000-3-3:1995
Immunity
EN61000-4-2:1995
EN61000-4-3:1995
EN61000-4-4:1995
EN61000-4-5:1995
EN61000-4-6:1995
EN61000-4-11:1995

Ordering information

Please specify model/order number, name, and quantity when ordering.

	AutoCal® modules
36581NNF	N type, 40 MHz to 18 GHz
36581NNF/2	N type, 10 MHz to 9 GHz
36581KKF	K type, 40 MHz to 20 GHz
36581KKF/2	K type, 10 MHz to 9 GHz
36582KKF	K type, 40 MHz to 40 GHz
	Test port converter sets
36583S	SMA type
36583L	3.5 mm type
36583K	K type
	Service
2300-228	Re-characterization Software (for 360B's and 37000's prior to serial number 992001)

AutoCal® may be sent to the nearest service center for re-characterization, or a service engineer may perform the task at the customer's site. To minimize down-time, the customer can re-characterize his own AutoCal® module with a Lightning or Scorpion family VNA and a traditional cal kit.

VNA AND VNMS

Calibration Kits

For Performing Precise Calibrations of Vector Network Analyzers

3753R

3656

The Anritsu Calibration Kits contain all the precision components and tools required to calibrate your VNA or VNMS for error-corrected measurements in the connector style of your choice. Components are included for calibrating male and female test ports as required. The kits support calibration with opens, shorts, and broadband loads. Option 1 adds sliding terminations and a pin depth gauge where required.

Each calibration kit is individually serialized and characterized to ensure precise calibrations. A calibration coefficients diskette is included in the kit that is directly readable into the instrument.

The following kits are for use with 37XXX Lightning VNAs.

3650 SMA/3.5 mm Calibration Kit consisting of:

- 34ASF50-2 Female Adapter (2)
- 33FSF50 Female-Female Adapter (2)*
- 33SS50 Male-Male Adapter*
- 28S50-2 B Male Termination (2)
- 28SF50-2 Broadband Female Termination (2)
- 33SSF50-Male-Female Adapter (2)*
- 24S50 Male Open
- 23SF50 Female Open
- 23S50 Male Short
- 23SF50 Female Short
- 34AS50-2 Male Adapter (2)
- Connector Thumb Wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge
- Calibration coefficients diskette

Option 1

Adds the following:

- 01-212 Female Flush Short
- 01-211 Male Flush Short
- 17SF50 Female Sliding Termination
- 17S50 Male Sliding Termination

3651 GPC-7 Calibration Kit consisting of:

- 28A50-2 Broadband Termination (2)
- 24A50 Open
- 23A50 Short
- 01-200 Torque Wrench
- 01-221 Collet Extractor Tool and 4 Collets
- Calibration coefficients diskette

Option 1

Adds the following:

- 17A50 Sliding Termination
- 01-210 Reference Flat
- 01-220 Pin Depth Gauge

3652 K Connector® Calibration Kit consisting of:

- 34AKF50-2 Female Adapter (2)
- 33FKF50 Female-Female Adapter (2)*
- 33KK50 Male-Male Adapter*
- 28K50-2 Male Termination (2)
- 28KF50-2 broadband Female termination (2)
- 33KKF50-Male-Female Adapter (2)*
- 24K50 Male Open
- 23KF50 Female Open
- 23K50 Male Short
- 23KF50 Female Short
- 34AK50-2 Male Adapter (2)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge
- Calibration coefficients diskette
- Connector thumb wheel (4)

Option 1

Adds the following:

- 17KF50 Female Sliding Termination
- 17K50 Male Sliding Termination
- 01-212 Female Flush Short
- 01-211 Male Flush Short

---

* Phase Equal Adapters

3653 Type N Calibration Kit consisting of:
- 23NF50 Female Short
- 23N50 Male Short
- 24NF50 Female Open
- 24N50 Male Open
- 28N50-2 Broadband Male Termination (2)
- 28NF50-2B Broadband Female Termination (2)
- 34AN50-2 Male Adapter (2)
- 34ANF50-2 Female Adapter (2)
- 01-213 Reference Gauge
- 01-224 Pin Depth Gauge
- Calibration coefficients diskette

3654B V Connector® Calibration Kit consisting of:
- 23V50B-5.1 Male Short 5.1mm
- 23VF50B-5.1 Female Short 5.1mm
- 24V50B Male Open
- 24VF50B Female Open
- 28V50B Male Broadband Termination (2)
- 28VF50B Female Broadband Termination (2)
- 17VF50B Female Sliding Termination
- 17V50B Male Sliding Termination
- 33VV50 Male-Male Adapter[*]
- 33VFVF50 Female-Female Adapter (2)[*1]
- 33VVF50 Male-Female Adapter (2)[*1]
- Calibration coefficients diskette
- Connector thumb wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-322 Pin Depth Gauge
- 01-323 Female Adapter for pin gauge
- 01-204 Adapter Wrench
- 01-312 Male Flush Short
- 01-311 Female Flush Short

3655 Waveguide Calibration Kit
The 3655 Calibration Kit contains all of the precision components and tools required to calibrate your VNA for 12-term error-corrected measurements of test devices with the appropriate waveguide designation. Components are included for calibrating both module ports. The kit supports calibration with offset shorts and broadband loads. Option 1 adds a sliding termination.

Consisting of:
- Short, Flush (2)
- Offsets, 1/8 and 3/8 Wavelength
- Terminations, Fixed (2)
- Test Port Sections (2)

Option 1

Adds the following:
- Sliding Termination

3656 W1 (1.0 mm) Connector Calibration Kit and Verification Kit
The W1 calibration kit consists of precision components to calibrate the VNA to 110 GHz. The kit supports SOLT calibrations with opens, shorts and loads to 65 GHz, and Triple Offset short calibrations from 65 to 110 GHz. The kit also includes verification devices for determining system accuracy of the VNA. A diskette containing factory measured test data is supplied for comparison with customer measured data.

Consisting of:
- 23W50-1, Male Offset Short 2.02 mm
- 23WF50-1, Female Offset Short 2.02 mm
- 23W50-2, Male Offset Short 2.65 mm
- 23WF50-2, Female Offset Short 2.65 mm
- 23W50-3, Male Offset Short 3.180 mm
- 23WF50-3, Female Offset Short 3.180 mm
- 24W50, Male Open 1.510 mm
- 24WF50, Female Open 1.930 mm
- 28W50, Male Broadband Termination
- 28WF50, Female Broadband Termination
- 33WW50, Male-Male Adapter (1)
- 33WWF50, Male-Female Adapter (1)
- 33WFWF50, Female-Female Adapter (1)
- 01-401, Interchangeable Adapter Fixed Female[*2]
- 01-402, Interchangeable Adapter Fixed Male[*2]
- 18WWF50-1, 50 Ω Matched Thruline (Verification Device)
- 18WWF50-1B, Stepped Impedance Thruline (Verification Device)
- 01-504, Torque Wrench
- 01-505, End Wrench
- Calibration coefficients diskette
- Verification kit diskette

[*1] Phase Equal Adapters

[*2] Interchangeable adapters have one fixed end and one interchangeable end. The interchangeable end can be switched between a male and female. This preserves the calibration reference plane for non-insertable device measurements.

The following kits are for use with MS462XX Scorpion® VNMS.

3750R SMA/3.5 mm 9 GHz Calibration Kit consisting of:

- 23LF50 Female Short
- 23L50 Male Short
- 24LF50 Female Open
- 24L50 Male Open
- 28L50LF Male Termination (2)
- 28LF50LF Female Termination (2)
- Calibration coefficients diskette

Option 1
Adds the following:

- Set of five Phase Equal Insertables (PEIs)

Option 3
Adds the following:

- Additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations

3751R GPC-7 9 GHz Calibration Kit consisting of:

- 23A50 Short
- 24A50 Open
- 28A50LF Termination (2)
- Calibration coefficients diskette

Option 2
Adds the following:

- Third GPC-7 termination required for three port calibrations

Option 3
Adds the following:

- Two additional GPC-7 terminations required for four port calibrations

3753R Type N 9 GHz Calibration Kit consisting of:

- 23NF50 Female Short
- 24NF50 Female Open
- 24N50 Male Open
- 28NF50LF Female Termination (2)
- 28N50LF Male Termination (2)
- 23N50 Male Short
- Calibration coefficients diskette

Option 1
Adds the following:

- Set of five Phase Equal Insertables (PEIs)

Option 3
Adds the following:

- Additional N (female) and N (male) terminations required for four port calibrations

3753-75R Type N (75 Ω) Calibration Kit:

- Specified to 3 GHz

Option 3
Adds the following:

- Additional N (75 Ω female) and N (75 Ω male) terminations required for four port calibrations

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	37XXX Lightning VNA Calibration Kits
3650	SMA/3.5 mm calibration kit
Option 1	Adds sliding terminations
3651	GPC-7 calibration kit
Option 1	Adds sliding terminations
3652	K Connector® calibration kit
Option 1	Adds sliding terminations
3653	Type N calibration kit
3654B	V Connector® calibration kit with sliding terminations
3655	Waveguide calibration kit
Option 1	Adds sliding terminations
3656	W1 (1.0 mm) calibration and verification kit
	MS462XX Scorpion VNMS Calibration Kits
3750R	SMA/3.5 mm 9 GHz calibration kit
Option 1	Adds a set of five Phase Equal Insertables (PEIs)
Option 3	Adds an additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations
3751R	GPC-7 9 GHz calibration kit
Option 2	Adds a third GPC-7 termination required for three port calibrations
Option 3	Adds two additional GPC-7 terminations required for four port calibrations
3753R	Type N 9 GHz calibration kit
Option 1	Adds a set of five Phase Equal Insertables (PEIs)
Option 3	Adds additional N (female) and N (male) terminations required for four port calibrations
3753-75	75 Ω Type N 3 GHz calibration kit
Option 3	Adds additional N (75 Ω female) and N (75 Ω male) terminations required for four port calibrations

VNA AND VNMS

Verification Kits

For Confirming Accuracy of Vector Network Analyzers

3669B

The Anritsu Verification Kits contain precision components with characteristics that are traceable to NIST. Used primarily by the metrology laboratory, these components provide the most dependable means of determining the system accuracy of your VNA. A disk containing factory measured test data for all components is supplied for comparison with customer-measured data.

The following kits are for use with 37XXX Lightning VNAs.

3663 Type N Verification Kit consisting of:
- 42N-50, 50 dB Attenuator
- 18N50-10, 10 cm Airline
- 42N20, 20 dB Attenuator
- 18N50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3665 Waveguide Verification Kit consisting of:
- Straight section
- Pin set
- Mismatch section
- Ball driver
- 50 dB Attenuator
- 20 dB Attenuator
- Verification kit disks

3666 SMA/3.5 mm Verification Kit consisting of:
- 19S50-7, 7.5 cm Airline
- 19SF50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- 42S-50, 50 dB Attenuator
- 42S-20, 20 dB Attenuator
- Verification kit disks

3667 GPC-7 Verification Kit consisting of:
- 42A-50, 50 dB Attenuator
- 18A50-10, 10 cm Air line
- 42A-20, 20 dB Attenuator
- 18A50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3668 K Connector® Verification Kit consisting of:
- 19K50-7, 7.5 cm Airline
- 42K-50, 50 dB Attenuator
- 42K-20, 20 dB Attenuator
- 18K50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3669B V Connector® Verification Kit consisting of:
- 42V-40, 40 dB Attenuator
- 42V-20, 20 dB Attenuator
- 19V50-5, 5 cm Airline
- 18V50-5B, 5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

W1 (1.0 mm) Verification Components are included in W1 Calibration kit and Verification Kit (3656). See previous section for details.

The following kits are for use with MS462XX Scorpion VNMS.

3663R Type N 9 GHz Verification Kit consisting of:
- 42N-50, 50 dB Attenuator
- 42N20, 20 dB Attenuator
- 42NOP-20 N Mismatch attenuator
- Verification kit disks

3666R SMA/3.5 mm 9 GHz Verification Kit consisting of:
- 42L-50, 50 dB Attenuator
- 42L-20, 20 dB Attenuator
- 42LOP-20 SMA/3.5 mm Mismatch Attenuator
- Verification kit disks

3667R GPC-7 9 GHz Verification Kit consisting of:
- 42A-50, 50 dB Attenuator
- 42A-20, 20 dB Attenuator
- 42AOP-20 GPC-7 Mismatch Attenuator
- Verification kit disks

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Verification kits
3663	Type N verification kit
3665	Waveguide verification kit
3666	SMA/3.5 mm verification kit
3667	GPC-7 verification kit
3668	K connector® verification kit
3669B	V connector® verification kit
3663R	Type N 9 GHz verification kit
3666R	SMA/3.5 mm 9 GHz verification kit
3667R	GPC-7 9 GHz verification kit

NETWORK ANALYZER

MS4630B

10 Hz to 300 MHz

CE GPIB

For Fast Evaluation of IF Filters and Resonators

The MS4630B is suitable for electronics production lines demanding fast and accurate device measurements. It is particularly well suited to accurate, high-speed evaluation of IF filter resonance and group delay characteristics, as well as evaluating the impedance characteristics of resonators in AV equipment and personal computers. A fast sweep speed of 150 µs/measurement point is achieved using a high-speed synthesizer and digital signal processing (DSP) technologies. The post-processing data analysis functions have been strengthened with improved data-processing macros that have greatly increased the total production throughput.

In comparison to the earlier MS3401A/B and MS3606B network analyzers, the sweep speed is three times faster and the group delay measurement accuracy and stability have been improved by more than 10 times. In addition, the dynamic range has been improved to 120 dB (RBW: 1 kHz) while the weight of the analyzer has been dramatically reduced. The GPIB and PTA processing speed are 30 to 50% faster than the MS4630A. In addition, the sweep conditions can be set more easily by the addition of the list sweep function.

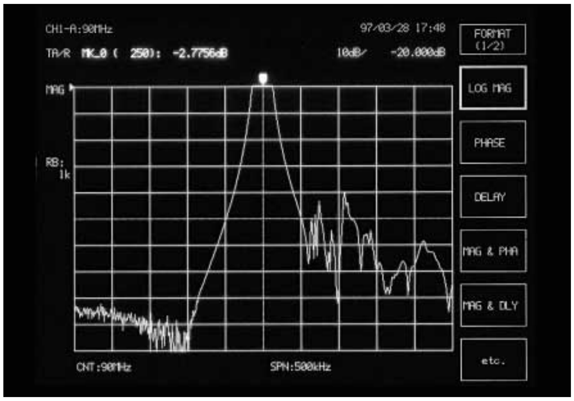
Features

- High-speed evaluation of IF filters, resonators, etc.
- Greatly increased production/inspection capacity

Performance and functions

- **High dynamic range**

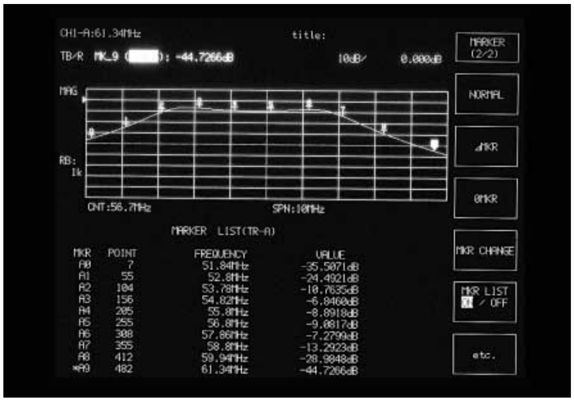
The high dynamic range of 120 dB (RBW: 1 kHz) permits fast and accurate out-of-band measurement of filter.



Filter out-of-band attenuation measurement

- **Multi-marker function**

Up to 10 markers can be set independently for each channel. The marker list function can be used to display all tabular data and waveform information simultaneously at each marker.



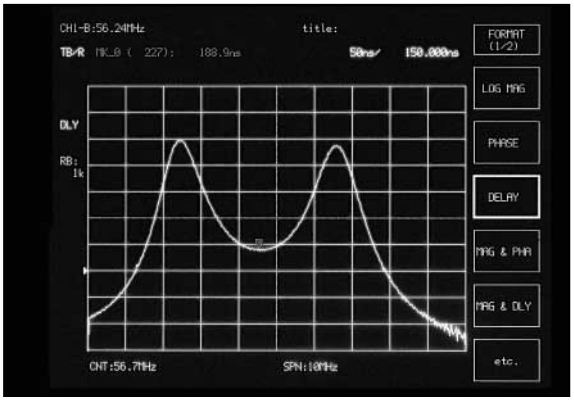
```
MARKER  LIST(TR-A)

MKR   POINT    FREQUENCY    VALUE
A0      7      51.84MHz    -35.5071dB
A1     55       52.8MHz    -24.4921dB
A2    104      53.78MHz    -10.7635dB
A3    156      54.82MHz     -6.8460dB
A4    205       55.8MHz     -8.8918dB
A5    255       56.8MHz     -9.0817dB
A6    308      57.86MHz     -7.2799dB
A7    355       58.8MHz    -13.2923dB
A8    412      59.94MHz    -28.9848dB
*A9   482      61.34MHz    -44.7266dB
```

Multi-markers

• High-accuracy group delay measurement

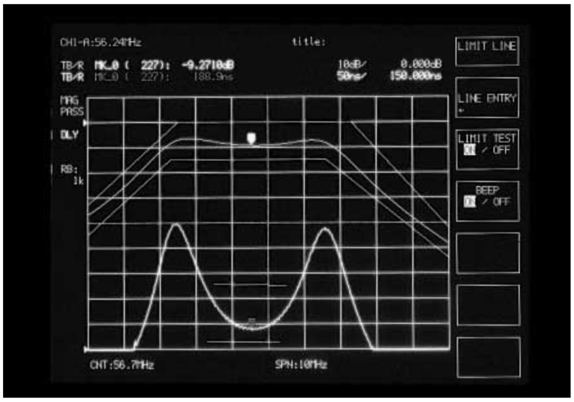
The group delay characteristics can be measured with a high degree of accuracy at a resolution of 1/10,000 of the measurement range.



Group delay characteristics

• Limit test function

Device pass/fail evaluation can be performed in real-time using the single and segmented limit test functions.

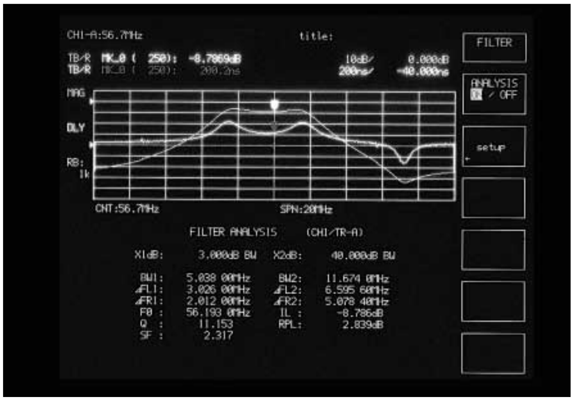


Filter pass/fail evaluation using limit test

• Filter measurement

Filter analysis functions

Filter characteristics such as 3 dB bandwidth, center frequency (fo), in-band ripple, out-of-band attenuation, etc., are digitally processed and analyzed at high speed. User can easily enter or change default values using filter set up menu.

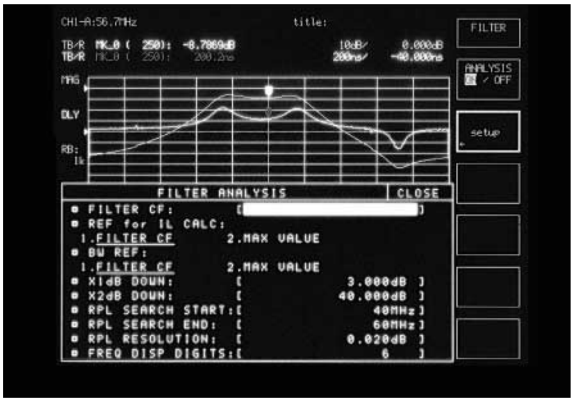


```
           FILTER ANALYSIS     (CH1/TR-A)

  X1dB:     3.000dB BW  X2dB:    40.000dB BW

   BW1:   5.038 00MHz    BW2:  11.674 0MHz
  ⊿FL1:   3.026 00MHz   ⊿FL2:  6.595 60MHz
  ⊿FR1:   2.012 00MHz   ⊿FR2:  5.078 40MHz
   F0 :  56.193 0MHz     IL :   -8.786dB
   Q  :    11.153        RPL:    2.839dB
   SF :     2.317
```

Measurement using filter functions

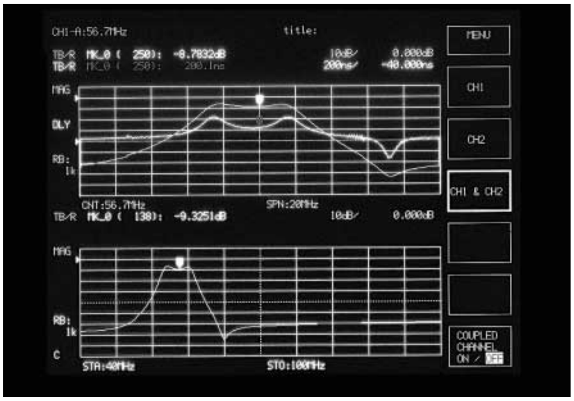


```
          FILTER ANALYSIS            CLOSE
 ▪ FILTER CF:          [                 ]
 ▪ REF for IL CALC:
   1.FILTER CF        2.MAX VALUE
 ▪ BW REF:
   1.FILTER CF        2.MAX VALUE
 ▪ X1dB DOWN:          [          3.000dB ]
 ▪ X2dB DOWN:          [         40.000dB ]
 ▪ RPL SEARCH START:[               40MHz]
 ▪ RPL SEARCH END:   [               60MHz]
 ▪ RPL RESOLUTION:   [           0.020dB ]
 ▪ FREQ DISP DIGITS:[               6    ]
```

Set up menu for filter functions

Simultaneous in-band and spurious response data display

Previously, spurious detection and passband measurement required switching of the measurement setup. The MS4630B alternate sweeping function permits simultaneous display of the measured passband and spurious band data. The very short switching time greatly improves the measurement efficiency.

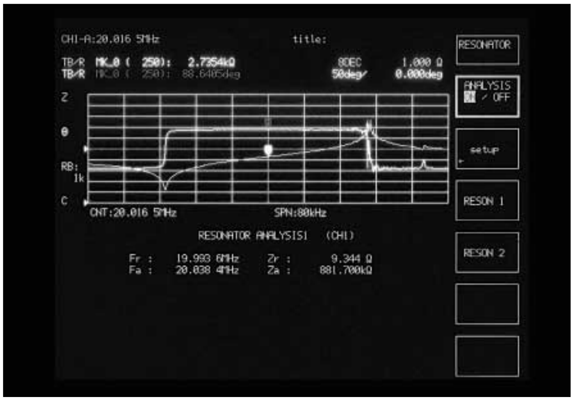


Spurious measurement using alternate sweeping

• Resonator measurement

High-speed measurement of resonator characteristics

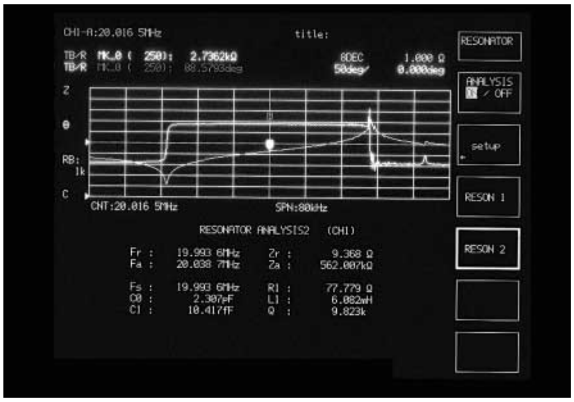
The MS4630B has a number of dedicated waveform analysis functions to improve the evaluation efficiency of resonators. Resonator 1 analyzes the resonance frequency (Fr) and the resonance impedance (Zr). Resonator 2 is able to measure resonator equivalence in addition to the parameters for Resonator 1.



```
        RESONATOR ANALYSIS1   (CH1)

  Fr :   19.993 6MHz    Zr :      9.344 Ω
  Fa :   20.038 4MHz    Za :   881.700kΩ
```

Resonator 1 measurement



```
CH1-A:20.016 5MHz
TB/R  MK.0 (  250):   2.7362kΩ          8DEC      1.000 Ω
TB/R  MK.0 (  250):  88.5793deg        50deg/     0.000deg
CNT:20.016 5MHz                 SPN:80kHz

             RESONATOR ANALYSIS2    (CH1)

      Fr :    19.993 6MHz     Zr :      9.368 Ω
      Fa :    20.038 7MHz     Za :    562.007kΩ

      Fs :    19.993 6MHz     R1 :     77.779 Ω
      C0 :      2.307pF       L1 :      6.082mH
      C1 :     10.417fF       Q  :      9.823k
```

Resonator 2 measurement

Specifications

<table>
<tr><td>Measurement items</td><td>Transmission characteristics (ratio measurement): Amplitude, phase, group delay
Reflection/impedance characteristics: Amplitude, phase (with external transducer)
Level characteristics: Absolute amplitude</td></tr>
<tr><td>Frequency</td><td>Range: 10 Hz to 300 MHz
Resolution: 0.01 Hz
Accuracy (standard)
Aging rate: ≤1 x 10^{-6}/day (15 minutes after power-on)
Temperature characteristics: ≤±5 x 10^{-6} (0˚ to +50˚C)
Accuracy (Option 13: High-stability reference oscillator)
Aging rate: ≤±2 x 10^{-8}/day (24 h after power-on)
Temperature characteristics: ≤±5 x 10^{-8} (0˚ to +50˚C)</td></tr>
<tr><td>Input</td><td>Channel No.
Standard: 2 (R, TA); Option 12: 3 (R, TA, TB)
Impedance: 50 Ω, 1 MΩ switchable (when combined with MA4605A: 75 Ω, 1 MΩ)
Input range (IRG): 0/+20 dBm
Max. input power
AC: +20 dBm; DC ±2.2 V (50 Ω)
AC: 0 dBm; DC: ±20 V (1 MΩ)
Connector: BNC-J
Probe source: +12 ±1 V, 100 mA (with protective circuit for shorts)</td></tr>
<tr><td>Average noise level</td><td>≤–120 dBm (RBW: 1 kHz, 1 to 300 MHz), ≤–110 dBm (RBW: 1 kHz, 80 kHz to 1 MHz)</td></tr>
<tr><td>Crosstalk</td><td>Between channels: ≥120 dB (80 kHz to 300 MHz), ≥110 dB (up to 80 kHz)
Between transmitter and receiver: ≥125 dB</td></tr>
<tr><td>Resolution bandwidth</td><td>3, 10, 30, 100, 500 Hz, 1, 2, 3, 4, 5, 10, 20 kHz and automatic setting</td></tr>
<tr><td>Output</td><td>Output level range
Output A: 0 to +21 dBm; Option 10: –70 to +21 dBm
Output B: –6 to +15 dBm (–9.5 to +11.5 dB when Option 14 added);
Option 10: –76 to +15 dBm (–79.5 to +11.5 dB when Option 14 added)
Output resolution: 0.01 dB
Output level accuracy: ≤±1.0 dB (frequency: 100 MHz, Output A: +10 dBm)
Output level linearity: ≤±0.5 dB (0 dBm reference, frequency: 100 MHz, Output A: 0 to +21 dBm)
Output level deviation: ≤±1.5 dB (output A: +10 dBm, 100 MHz reference)
Step error: ±0.5 dB (Option 10)
Output impedance: 50 Ω (when combined with MA4605A: 75 Ω)
Connector: BNC-J</td></tr>
<tr><td>Amplitude measurement</td><td>Measurement range: ≥120 dB
Measurement resolution: 0.001 dB
Display scale: 0.01 dB/div to 50 dB/div (1-2-5 sequence)
Dynamic accuracy
<table>
<tr><th>Level relative to IRG</th><th>80 kHz to 100 MHz</th><th>10 kHz to 300 MHz</th></tr>
<tr><td>0 to –10 dB</td><td>±0.30 dB</td><td>±0.30 dB</td></tr>
<tr><td>–10 to –60 dB</td><td>±0.05 dB</td><td>±0.05 dB</td></tr>
<tr><td>–60 to –70 dB</td><td>±0.10 dB</td><td>±0.30 dB</td></tr>
<tr><td>–70 to –80 dB</td><td>±0.30 dB</td><td>±1.00 dB</td></tr>
<tr><td>–80 to –90 dB</td><td>±1.20 dB</td><td>±4.00 dB</td></tr>
<tr><td>–90 to –100 dB</td><td>±4.00 dB</td><td>–</td></tr>
</table></td></tr>
</table>

Continued on next page

<table>
<tr><td>Phase measurement</td><td>Measurement range: ±180˚
Measurement resolution: 0.001˚
Display scale: 0.01˚ to 50˚ /div (1-2-5 sequence)
Dynamic accuracy
<table>
<tr><th>Level relative to IRG</th><th>80 kHz to 100 MHz</th><th>10 kHz to 300 MHz</th></tr>
<tr><td>0 to –10 dB</td><td>±6.0˚</td><td>±6.0˚</td></tr>
<tr><td>–10 to –60 dB</td><td>±0.3˚</td><td>±0.3˚</td></tr>
<tr><td>–60 to –70 dB</td><td>±0.8˚</td><td>±2.0˚</td></tr>
<tr><td>–70 to –80 dB</td><td>±2.0˚</td><td>±6.0˚</td></tr>
<tr><td>–80 to –90 dB</td><td>±6.0˚</td><td>±20.0˚</td></tr>
<tr><td>–90 to –100 dB</td><td>±20.0˚</td><td>–</td></tr>
</table></td></tr>
<tr><td>Group delay measurement</td><td>DRG: Δθ/(360 x ΔF) *Δθ: phase measurement range; ΔF: frequency span x smoothing aperture (%);
smoothing aperture: 20% to $\left(\dfrac{2}{\text{number measurement points}}\right)$ x 100%
Measurement resolution: 2.78 x 10^{-5}/ΔF
Display scale: 1 ps/div to 50 ms/div
Dynamic accuracy: Phase measurement accuracy/(360 x aperture frequency)</td></tr>
<tr><td>Calibration, correction</td><td>Calibration types: Frequency response, 1 port, 1 path-2 port, frequency response/isolation calibration, π-NET calibration
Calibration data interpolation:
Measurement frequency, when number of measurement points changed, based on calibration data before change, new calibration data interpolation calculation possible (except at log frequency measurement and 1001 measurement points)
Normalize: X–S
Electrical length calibration
Range: 0 to ±999999.9999999 m, Resolution: 100 nm
Phase offset range: ±180˚</td></tr>
<tr><td>Sweeping</td><td>Frequency sweep: LIN (CENTER/SPAN, START/STOP), LOG (START/STOP)
Level sweep: LIN (START/STOP/STEP)
List sweep: Frequency, level, RBW, the individual setting in the waiting time
Number of measurement points: 11, 21, 51, 101, 251, 501, 1001
Break point: Anywhere between 1 and 1001
Sweep time: 150 µs/point, 38 ms/250 points full sweep (RBW: 20 kHz, normalize calibration, 1 trace)
Setting range: 1 ms to 27.5 h
Sweep functions
Sweep range: Full sweep, part sweep (between markers)
Sweep control: REPEAT/SINGLE, STOP/CONT
Sweep trigger: INT/EXT (RISE, FALL, LEVEL)</td></tr>
<tr><td>Display</td><td>Max. display screens: 2 channels, 4 traces
Display format: LOG MAG (M), PHASE (P), DELAY (D), M/P, M/D, LIN MAG (LIN), LIN/P, LIN/D, REAL (R), IMAG (I), R/I, Z, Z/θ, Q, Z/Q, POLAR, VSWR, IMPD (Z∠θ, Rs + Ls/Cs, Q/D, R + jx), ADMT (Y∠θ, Rp + Lp/Cp, Q/D, G + jB)
Display: 640 x 480 dots, 16.5 cm color LCD</td></tr>
<tr><td>Markers</td><td>Marker functions: NORMAL MKR, Δ MKR, 0 MKR, MKR → MAX, MKR → MIN, MKR → CF, Δ → SPAN, MKR → +PEAK, MKR → –PEAK, MKR TRACK + PEAK, MKR TRACK–PEAK, MKR CHANGE, MKR OFFSET
Setting: Set marker position to frequency or point
Multi-marker: Max. 10 markers for each trace
Filter function: F0, IL, passband (L, R), attenuation band (L, R), Ripple, Q, SF
Resonator function
RESON 1: Fr, Fa, Zr, Za (0 PHASE), Fm, Fn, Zm, Zn (MAX/MIN)
RESON 2: Fs, Fr, Fa, Zr, Za, Q, equivalence constant (R1, L1, C1, C0)</td></tr>
<tr><td>Trace data calculation</td><td>Averaging functions
Method: SUM, MAX, MIN, Count: 1 to 1000
Measurement data memory (max. 1001 points each memory in same format as display format)
Main trace (MT) memory: 2 each (XMEM) for Channel 1 and Channel 2
Calibration S memory: 2 each (SMEM) for Channel 1 and Channel 2
Image memory: 2 each (IMEM) for Channel 1 and Channel 2
Sub-trace (ST): Following calculation between MT and ST (traces calculation of same data as display format)
MT → ST, MT = MT–ST, MT = ST
Limit line: Single or segment (10) limit line, pass/fail evaluation against limit line</td></tr>
<tr><td>Measurement parameters auto-setting</td><td>Receive bandwidth and sweep time: Receive bandwidth set automatically for set sweep time
Automatically set to give minimum sweep time at set receive bandwidth</td></tr>
<tr><td>Auxiliary media</td><td>Saving/recalling data:
Measurement parameters, measured data, calibration data, PTA application programs saved/recalled to/from FD and PMC
Function memory
FD: 100 functions max.
PMC: 100 functions max. (depends on PMC capacity)
Drive and capacity
3.5 inch FDD: 1
Capacity: 720 KB (2DD), 1.44 MB (2HD), MS-DOS format (bmt, text file)
Option 01: PMC (32 to 512 KB)</td></tr>
<tr><td>Printing</td><td>Printing is available using video plotter, printer and FD (bitmap format).</td></tr>
</table>

Continued on next page

Back-panel I/O	Frequency: 5/10 MHz ±10 ppm Level: ≥0.7 Vp-p (AC coupling) Input impedance: 50 Ω (connector: BNC-J) Reference oscillator output Frequency: 10 MHz Level: TTL (DC coupling, connector: BNC-J) External trigger input: TTL Level (connector: BNC-J) GPIB: IEEE488.2 (24-pin Amphenol connector) I/O Port: Parallel interface for PTA (36-pin Amphenol connector) RGB output: For external monitor (15-pin D-SUB connector) Video output: Separate (8-pin DIN) Centronics (Option 02): Parallel interface for printer (25-pin D-SUB connector) RS-232C (Option 02): Serial interface (9-pin D-SUB connector)
External control	Standard: GPIB and PTA; Option 02: RS-232C
Power	100 to 120/200 to 240 Vac (–15%/+10%, 250 Vac max, 100/200 V system auto-switching), 47.5 to 63 Hz, ≤180 VA (max.)
Dimensions and mass	426 (W) x 177 (H) x 451 (D) mm, ≤15 kg
Environmental conditions	Temperature range: 0˚ to +50˚C (operating; FDD: +4˚ to +50˚C), –20˚ to +60˚C (storage)
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS4630B	Network Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0013	Fuse, 5 A:	2 pcs
W1534AE	MS4630B operation manual (main frame):	1 copy
W1535AE	MS4630B operation manual (remote control):	1 copy
	Options	
MS4630B-01	PMC interface	
MS4630B-02	RS-232C, Centronics interface (printer output, external control)	
MS4630B-10	Output attenuator (70 dB, mechanical type)	
MS4630B-12	3 channel receiver	
MS4630B-13	High stability reference oscillator (aging rate: ≤±2 x 10^{-8}/day)	
MS4630B-14	3 branch output (for 3 channel receiver)	
	Optional accessories	
62BF50	Reflection Bridge	
62B50	Reflection Bridge	
62BF75	Reflection Bridge	
62B75	Reflection Bridge	
MA2201A	Reflection Bridge	
MA2203A	Reflection Bridge	
MA2301A	Reflection Bridge	
MA2302A	Reflection Bridge	
MA2303A	Reflection Bridge	
MA2204A	Impedance Probe	
MA2403A	Impedance Probe	
MA414A	Impedance Measurement Kit (for MA2403A)	
MA1506A	π Network (DC to 125 MHz, for resonator measurement)	
MA4605A	Impedance Adapter (for MS4630B, 10 Hz to 300 MHz, 50/75 Ω, unbalanced)	
P0005	Memory card (32 KB)	
P0006	Memory card (64 KB))	
P0007	Memory card (128 KB)	
P0008	Memory card (256 KB)	
P0009	Memory card (512 KB)	
MC3305A	PTA Key Board (JIS type)	
MC3306A	PTA Key Board (ASCII type)	
B0329C	Front cover (1MW4U)	
B0333C	Rack mount kit	
B0334C	Carrying case (hard type)	
	Optional instruments	
ME010 series	Test Fixture (PIN, SMD, tip-inductor, etc.)	

REFLECTION BRIDGES

When connected to a reflection bridge, the network analyzers can measure reflection coefficient. This system is used to measure the input and output impedance of telecommunication, video, and audio equipment, and the S-parameter (S_{11} and S_{22}) of two-port networks.

MA2401A

MA2201A

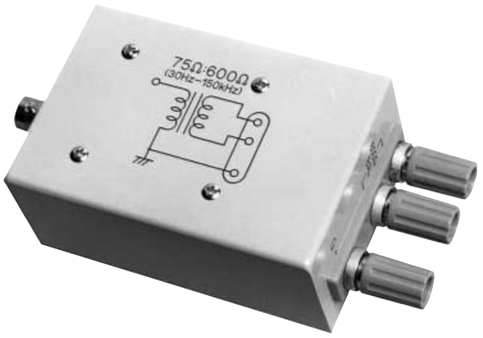
TRANSFORMERS

The transformers are impedance-conversion devices used with the network analyzers to measure the magnitude, phase, delay, level, and spectrum of devices with balanced input and output impedances.

Features

- Input connector is a BNC-type in an unbalanced circuit
- Output connector is a terminal compatible with M-214
- Frequency response: <0.3 dB
- Return loss: >25 dB

Model	Impedance (Ω)		Frequency range
	Input	Output	
MA29A	75	600	30 Hz to 150 kHz
MA29J	50	600	30 Hz to 150 kHz
MA313A	75	75	4 kHz to 2 MHz
MA313J	50	75	4 kHz to 2 MHz
MA314A	75	135	4 kHz to 2 MHz
MA314J	50	135	4 kHz to 2 MHz
MA315A	75	150	4 kHz to 2 MHz
MA315J	50	150	4 kHz to 2 MHz
MA422A1	75	110	10 Hz to 30 kHz



SIGNAL GENERATORS

Synthesizer selection guide (measurement Function)

Group	Name	Functions																													Remarks
		Frequency extensions					Level extensions								Modulation						Others										
		10 MHz to 2 GHz	10 MHz to 2.2 GHz	0.1 Hz to 10 MHz	mm Wave (50 to 75 GHz) signal source	mm Wave (75 to 110 GHz) signal source	110 dB step attenuator (<20 GHz)	110 dB step attenuator (<40 GHz)	90 dB step attenuator (>40 GHz)	120 dB step attenuator (<10 GHz)	+18 dBm high power (<20 GHz)	+18 dBm high power(<20 GHz, with Option 13)	+18 dBm high power (<40 GHz)	+18 dBm high power (<40 GHz, with Option 13)	AM modulation (Internal signal source is another)	FM/øM modulation (Internal signal source is another)	Pulse modulation (Internal signal source is another, <40 GHz)	Pulse modulation (Internal signal source is another, >40 GHz)	For AM/FM/øM modulation (Internal signal source)	For pulse modulation (Internal signal source)	Low phase noise	Analog sweep	High stability time base	Creation software of an arbitrary waveform	IF Up-conversion	Rear panel RF output (<40 GHz)	Rear panel RF output (>40 GHz)	Delete front panel	Rack mount kit (without slides)	Rack mount kit (with slides)	
Main frame	MG3691A	√	√	√			√			√	√	√			√	√	√		√	√	√	√	√					√	√	√	2 to 8 GHz
	MG3692A	√	√	√	√	√	√				√	√			√	√	√		√	√	√	√	√					√	√	√	2 to 20 GHz
	MG3693A	√	√	√	*1	*1		√					√	√	√	√	√		√	√	√	√	√					√	√	√	2 to 30 GHz
	MG3694A	√	√	√	*1	*1		√					√	√	√	√	√		√	√	√	√	√					√	√	√	2 to 40 GHz
	MG3695A	√	√	√	*1	*1			√						√	√		√	√	√	√	√	√					√	√	√	2 to 50 GHz
	MG3696A	√	√	√	*1	*1			√						√	√		√	√	√	√	√	√					√	√	√	2 to 65 GHz
Options	1A																												√		Either selection
	1B																													√	
	2A						√																								Chooses with main frame frequency
	2B							√																							
	2C								√																						
	2E									√																					
	3																				√										
	4		√																												
	5	√																													
	6																					√									
	7																								√						<40 GHz model, the combined use with Option 18 is impossible.
	9A																									√					
	9B																										√				
	10																							√							Requires Option 23
	12															√															
	13A																√														Chooses according to main frame frequency
	13B																	√													
	14														√																
	15A										√																				Chooses according to the inclusion situation of main frame frequency and pulse modulation.
	15B											√																			
	15C												√																		
	15D													√																	
	16																						√								
	17																											√			
	18-WR15				√																										Requires mm Wave module
	18-WR10					√																									Requires mm Wave module
	22			√																											Modulation function is un-corresponding
	23																		√												Two signal for AM and FM/øM
	24																			√											
	25A														√	√	√		√	√											Chooses with main frame frequency
	25B														√	√		√	√	√											

*1: The maximum of frequency required for frequency extension to mm Wave is 20 GHz.
Therefore, when using it only by for mm Wave, a model 20 GHz or more is unnecessary.

Synthesizer selection guide (frequency range)

Group	Name	Frequency range																								Remarks
		0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	50 MHz	100 MHz	200 MHz	500 MHz	1 GHz	2 GHz	5 GHz	10 GHz	20 GHz	50 GHz	100 GHz	200 GHz	
Main frame	MG3691A																		▨	▨						2 to 8 GHz
	MG3692A																		▨	▨	▨					2 to 20 GHz
	MG3693A																		▨	▨	▨	▨				2 to 30 GHz
	MG3694A																		▨	▨	▨	▨				2 to 40 GHz
	MG3695A																		▨	▨	▨	▨				2 to 50 GHz
	MG3696A																		▨	▨	▨	▨	▨			2 to 65 GHz
Options	4											▨	▨	▨	▨	▨	▨	▨	▨							10 MHz to 2.2 GHz
	5											▨	▨	▨	▨	▨	▨	▨								10 MHz to 2 GHz
	22	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨															0.1 Hz to 10 MHz
	18-WR15																						▨			50 to 75 GHz
	18-WR10																						▨	▨		75 to 110 GHz

SYNTHESIZED SIGNAL GENERATOR

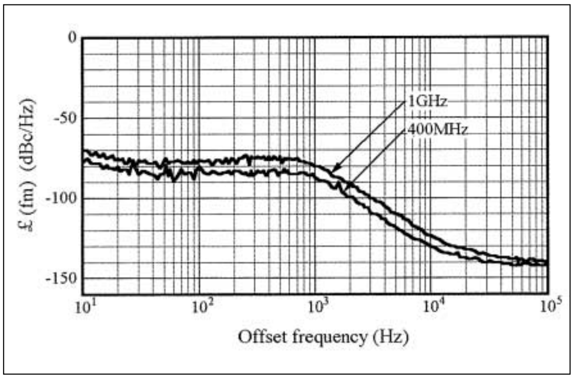
MG3641A/MG3642A

125 kHz to 1040/2080 MHz

CE GPIB

Economic High-Performance Signal Sources

New Anritsu synthesizer technology permits frequency to be set with a resolution of 0.01 Hz across the full frequency range, and the non-harmonic spurious is better than –100 dBc for reliable measurement at any frequency. A unique low-noise YIG oscillator produces a high-purity signal with SSB phase noise of better than –130 dBc/Hz (1 GHz, 20 kHz offset) making these signal generators for interference testing of radio receivers and as sources for various local and reference signals.



SSB phase noise characteristic

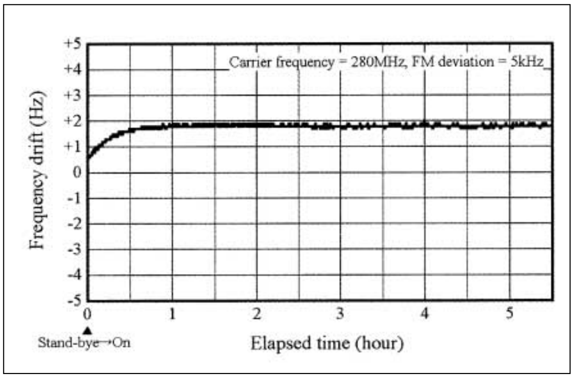
Features

- 0.01 Hz, 0.01 dB setting resolution
- High signal purity (–100 dBc spurious)
- Versatile modulation functions

Performance

- **High-stable carrier frequency**

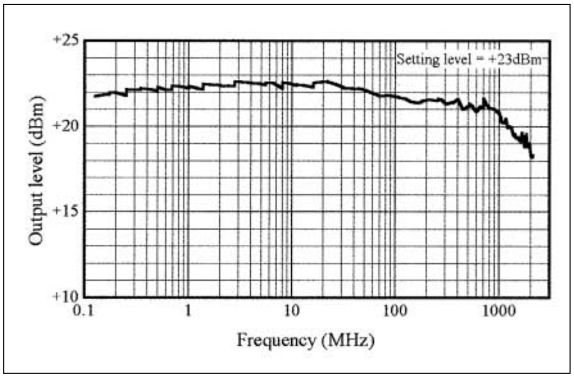
Carrier frequency is produced by a high-stability crystal oscillator. Furthermore, the carrier frequency remains phase locked even at frequency modulation. Then frequency calibration for testing FSK modulation receivers such as paging system is not necessary.



Carrier wave frequency stability at frequency modulation

- **High output**

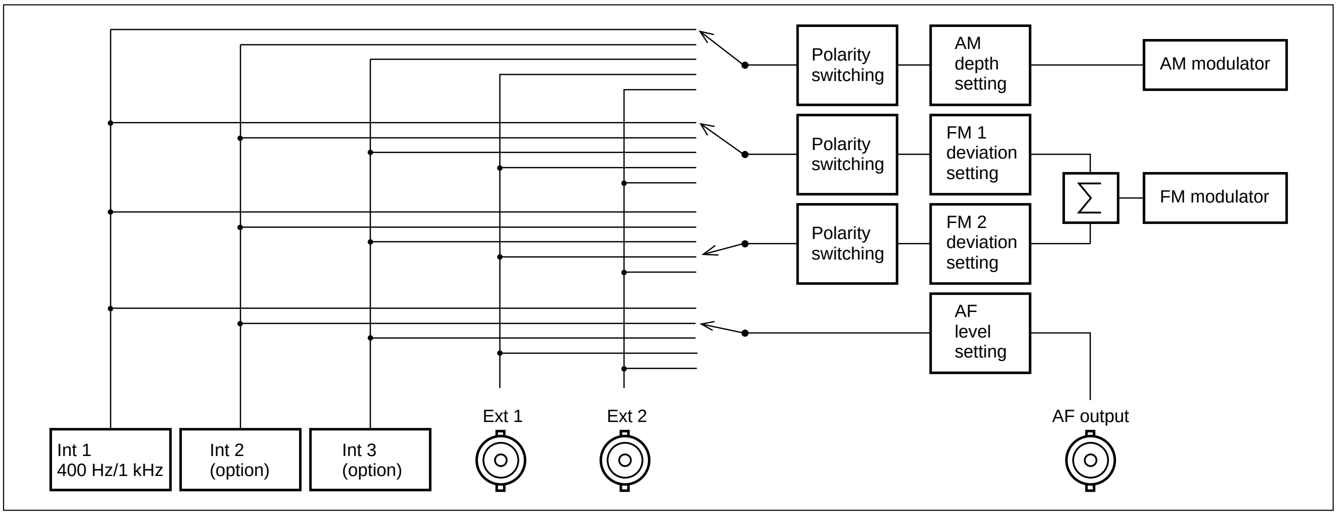
A stable signal with an output of +17 dBm can be output across the full frequency range to drive a variety of local signal sources and power amplifiers. In addition, an overdrive level up to +23 dBm can be set so as to make full use of the internal amplifier capability. If the amplifier's output power comes up to the limitation and output power does not reach the set value, a status message is displayed. This is useful for confirming the output limits.



Maximum output level

- **Various modulation types**

Up to three internal AF signal sources can be incorporated by adding options to the standard sine-wave oscillator (1 kHz, 400 Hz). The AF synthesizer (Option 21) is a digital synthesizer for generating sine-wave, triangular, square, and sawtooth waveforms; it can also be used as a function generator as well as a modulation signal source. In addition to permitting simultaneous one-route AM and two-route FM modulation, the modulation factor and polarity can be set independently. Installing the pulse modulator (Option 11) in the MG3641A/3642A allows them to generate high-speed pulse modulation using an external modulation signal (TTL level). The output can be used for various burst signals with an ON/OFF ratio of more than 80 dB, as well as a pseudo-random signal for radar. Installing the pattern generator (Option 23) in the MG3641A/3642A allows them to generate FSK or pulse modulation combined with FSK encoder (Option 22) or pulse modulator (Option 11) without an external instrument.

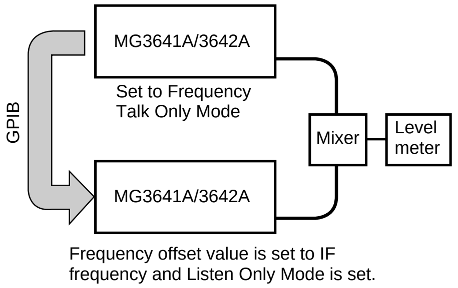


- **GPIB Only-Mode linked operation**

Two sets of MG3641A/3642A can be linked and operated without an external controller using the Frequency and Output Level Only Modes. The Frequency Only Mode in the frequency offset functions is used for evaluating the characteristics of mixers. The Level Only Mode is useful for evaluating the cross-modulation characteristics of non-linear devices such as amplifiers.

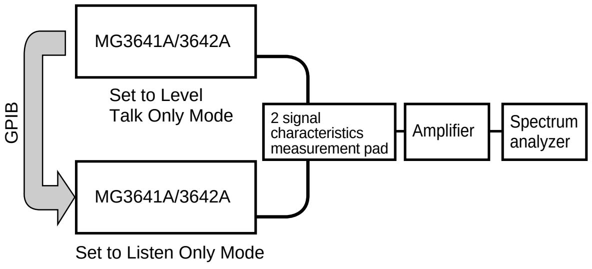
- **Pattern generator (Option 23)**

Installing the pattern generator (Option 23) in the MG3641A/3642A allows them to generate FSK or pulse modulation combined with FSK encoder (Option 22) or pulse modulator (Option 11) without an external instrument.



Frequency offset value is set to IF frequency and Listen Only Mode is set.

Measurement example of mixer characteristics using Frequency Only Mode and frequency offset



Set to Listen Only Mode

An example of amplifier IM3 measurement using Level Only Mode

Specifications

- **MG3641A/3642A (main frame)**

Carrier frequency	Range: 125 kHz to 1040 MHz (MG3641A), 125 kHz to 2080 MHz (MG3642A) Resolution: 0.01 Hz Accuracy: Reference oscillator accuracy; reference oscillator accuracy ±(0.3% of FM setting deviation + 5 Hz) at frequency modulation Internal reference oscillator*1 Frequency: 10 MHz; Aging rate: ±5 x 10^{-9}/day; Start-up characteristics: 1 x 10^{-7}/10 min (for 24 h after power on), Temperature stability: ±3 x 10^{-8} (0° to 50°C) External reference input: 5/10 MHz, ±10 ppm, ≥0.7 Vp-p/50 Ω (AC coupling), BNC connector (rear panel) Buffer output: 10 MHz, TTL level (DC coupling), BNC connector (rear panel) Switching time: <40 ms (external control, response time from last command until becomes within ±0.1 ppm of set frequency)

Continued on next page

<table>
<tr><td>Output</td><td>Range: –143 to +17 dBm (settable range: –143 to +23 dBm)
Units: dBm, dBμ, V, mV, μV (dBμ, V, mV and μV switchable between termination voltage display and open voltage display)
Resolution: 0.01 dB
Frequency characteristics (at 0 dBm): ±0.5 dB, ±1.0 dB (pulse modulation: on)[*2]
Accuracy: ±1 dB (–127 to +17 dBm, upper limit at pulse modulation[*2]: +12 dBm), ±3 dB (<–127 dBm)
Impedance: 50 Ω (N connector), VSWR: <1.5 (≤–3 dBm), <2.5 (>–3 dBm)
Switching time: <50 ms (normal mode), <100 ms (level safety mode), <10 ms (continuous mode)
∗Response time from last command until becomes within ±0.5 dB of final level
Special setting mode
Continuous mode: Variable within set value ±10 dB with no interruption of output
Safety mode: Prevent large spike signal generation when operating mechanical-type attenuator
Interference radiation: <0.1 μV (at output frequency), <1 μV (over entire frequency range, multi-menu display: OFF)
∗At point 25 mm from cabinet measured with 25 mm diameter loop antenna (2 windings) terminated at 50 Ω</td></tr>
<tr><td>Signal purity</td><td>Spurious (CW mode, ≤+7 dBm)
Harmonics: <–30 dBc (2nd, 3rd)
Non-harmonic: <–100 dBc (≥15 kHz offset)
Those related power: <–40 dBc (<15 kHz offset)
SSB phase noise (CW Mode, 20 kHz offset):
<–140 dBc/Hz (10 to <256 MHz), <–136 dBc/Hz (256 to <512 MHz), <–130 dBc/Hz (512 to 1040 MHz),
<–124 dBc/Hz (>1040 MHz, MG3642A only)
Residual AM: <–80 dBc (≥500 kHz, CW mode, +7 dBm, 50 Hz to 15 kHz demodulation band)
Residual FM (CW mode)
300 Hz to 3 kHz demodulation band: <4 Hzrms (10 to <512 MHz), <8 Hzrms (512 to 1040 MHz), <16 Hzrms (>1040 MHz, MG3642A only)
50 Hz to 15 kHz demodulation band: <5 Hzrms (10 to <512 MHz), <10 Hzrms (512 to 1040 MHz), <20 Hzrms (>1040 MHz, MG3642A only)</td></tr>
<tr><td>Amplitude modulation</td><td>Range: 0% to 100%
Resolution: 0.1%
Accuracy: ±(5% of set value + 2%) ∗≥0.4 MHz, ≤+7 dBm, ≤90% AM, source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
Modulation frequency response (output: ≤+7 dBm)
<table>
<tr><th rowspan="2">Carrier frequency</th><th colspan="2">Upper limit frequency</th><th rowspan="2">Lower limit frequency</th></tr>
<tr><th>AM: 30%</th><th>AM: 90%</th></tr>
<tr><td>0.4 to <0.5 MHz</td><td>2 kHz (±1 dB bandwidth)</td><td>1 kHz (±1 dB bandwidth)</td><td rowspan="5">DC: External DC coupling (±1 dB bandwidth)
20 Hz: External AC coupling (±1 dB bandwidth)</td></tr>
<tr><td>0.5 to <2 MHz</td><td>10 kHz (±1 dB bandwidth)</td><td>5 kHz (±1 dB bandwidth)</td></tr>
<tr><td>2 to <32 MHz</td><td colspan="2">20 kHz (±1 dB bandwidth)</td></tr>
<tr><td>32 to <64 MHz</td><td colspan="2">50 kHz (±1 dB bandwidth)</td></tr>
<tr><td>≥64 MHz</td><td colspan="2">50 kHz (±1 dB bandwidth), 100 kHz (±3 dB bandwidth)</td></tr>
</table>
Distortion: <–40 dB (30% AM), <–30 dB (90% AM) ∗≥0.4 MHz, ≤+7 dBm, source: Int 1 (1 kHz)
Incidental FM: <200 Hz peak ∗≥0.4 MHz, ≤AM: 30%, ≤+7 dBm, source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
Modulation signal source: One of internal (Int 1, Int 2, Int 3) and external (Ext 1, Ext 2)
Modulation signal polarity: Positive/negative switchable</td></tr>
<tr><td>Frequency modulation</td><td>Range:
0 to 125 Hz (125 to <250 kHz)
0 to 250 Hz (250 to <500 kHz)
0 to 500 Hz (0.5 to <1 MHz)
0 to 1 kHz (1 to <2 MHz)
0 to 2 kHz (2 to <4 MHz)
0 to 4 kHz (4 to <8 MHz)
0 to 10 kHz (8 to <16 MHz)
0 to 25.6 kHz (16 to <32 MHz)
0 to 51.2 kHz (32 to <64 MHz)
0 to 102 kHz (64 to <128 MHz)
0 to 256 kHz (128 to <256 MHz)
0 to 512 kHz (256 to <512 MHz)
0 to 1024 kHz (512 to 1040 MHz)
0 to 2048 kHz (>1040 MHz, MG3642A only)
Resolution:
1 Hz (0 to 4 kHz deviation)
10 Hz (4.01 to 10 kHz deviation)
25 Hz (10.025 to 25.6 kHz deviation)
50 Hz (25.65 to 51.2 kHz deviation)
100 Hz (51.3 to 102 kHz deviation)
250 Hz (102.25 to 256 kHz deviation)
500 Hz (256.5 to 512 kHz deviation)
1 kHz (513 to 1024 kHz deviation)
1 kHz (1025 to 2048 kHz deviation, MG3642A only)
Accuracy: ± (5% of set value + 10 Hz) (0.4 to <512 MHz), ± (5% of set value + 20 Hz) (512 to 1040 MHz)
± (5% of set value + 40 Hz) (>1040 MHz, MG3642A only)
∗Source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
Modulation frequency response: DC or 20 Hz[*3] to 20 kHz (0.4 to <10 MHz), DC or 20 Hz[*3] to 100 kHz (≥10 MHz) ∗±1 dB bandwidth
Distortion: <–40 dB ∗≥16 MHz, 3.5 kHz deviation, source: Int 1 (1 kHz)
<–45 dB ∗≥16 MHz, 22.5 kHz deviation, source: Int 1 (1 kHz)
Incidental FM: <1% peak ∗≥64 MHz, ≤+7 dBm, 100 kHz deviation, source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
External modulation group delay: <30 μs ∗≥10 MHz, source: external DC coupling mode, modulation rate: ≤100 kHz
Modulation signal source (FM1, FM2): One of internal (Int 1, Int 2, Int 3), and external (Ext 1, Ext 2)
Modulation signal polarity: FM1, FM2 positive/negative switchable</td></tr>
<tr><td>Pulse modulation</td><td>According to option specifications</td></tr>
<tr><td>Modulation signal source</td><td>Internal modulation (Int 1)
Frequency: 400 Hz, 1 kHz
Accuracy: Same as reference oscillator accuracy
Internal modulation (Int 2, Int 3): According to option specifications
External modulation (Ext 1, Ext 2)
Proper input level: 2 Vp-p approx.
Input impedance: 600 Ω, BNC connector
Coupling: DC/AC switchable</td></tr>
<tr><td>AF output</td><td>Output signal source: One of internal (Int 1, Int 2, Int 3), and external (Ext 1, Ext 2)
Output level: 0 to 4 Vp-p
Output level resolution: 1 mVp-p
Output level accuracy: ± (5% of setting level + 2 mVp-p) ∗Source: Int 1 (1 kHz)
Impedance: 600 Ω, BNC connector</td></tr>
</table>

Continued on next page

Simultaneous modulation	Excluding amplitude modulation and pulse modulation*2 combination, simultaneous modulation, modulation rate, deviation independently settable
Sweep function	Sweep parameters: Frequency, output level, memory Sweep patterns Frequency sweep (start/stop): Linear (specified step size and number of points), Log (multiplying factor: 1%) Frequency sweep (center/span): Linear (specified step size and number of points) Level sweep (start/stop, center/span): dB (specified step size and number of points) *Sweep: continuous mode (max. 20 dB width) Memory sweep: Start/stop Sweep mode: Auto, single, manual Sweep time Setting range: 1 ms to 600 s/point *Actual sweep time depends on sweep parameter (frequency, output level) Resolution: 10 µs/point Auxiliary output X-Out: Ramp waveform (sweep start point: 0 V, sweep end point: +10 V), BNC connector (rear panel) Z-Out: TTL level (H-level at sweeping), BNC connector (rear panel) Blanking-Out: TTL level (L-level at switching), BNC connector (rear panel) Maker-Out: TTL level (H-level at marker match), BNC connector (rear panel)
Functions	Relative display: Carrier frequency, output level Offset display: Carrier frequency, output level Memory: Saves/recalls 1000 panel settings; recall contents: panel, frequency, frequency/output level selection Trigger: An external trigger signal (rear panel BNC connector, TTL level) can be used to execute a previously programmed operation sequence (except power switch, preset key, local key and rotary knob operations). Max. number of sequence steps of trigger program: 20 steps Back-up: The panel settings before power-off are back-upped and displayed again at power-on, except data-input contents, GPIB data contents, remote settings, RPP operations GPIB control: All functions, except power switch, local key, rotary knobs, and resolution keys (Interface: SH1, AH1, T5, L3, TE0, SR1, RL1, PP0, DC1, DT1, C0, E2)
Reverse power protection	Max. reverse input power: ≤50 W (≤1040 MHz), ≤25 W (>1040 MHz, MG3642A only), ±50 Vdc
Power supply	*4 Vac (+10%, –15%), 47.5 to 63/380 to 420 Hz, ≤200 VA
Temperature	Operating: 0˚ to +50˚C, Storage: –30˚ to +71˚C
Dimensions and mass	320 (W) x 177 (H) x 451 (D) mm, ≤20 kg
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*1: Can be changed to 5 x 10^{-10}/day using reference crystal oscillator (Option 01)
*2: Only with pulse modulator (Option 11) installed
*3: External DC coupling: DC, External AC coupling: 20 Hz
*4: Specify a nominal voltage of either 100 V and 240 V when ordering; the maximum operating voltage is 250 V.

- **Options**

Option 01 Reference oscillator	Frequency: 10 MHz Aging rate: 5 x 10^{-10}/day Temperature stability: ±5 x 10^{-9} (0˚ to 50˚C)
Option 11 Pulse modulator	Frequency: 125 kHz to 2080 MHz On/off ratio: >80 dB Rise/fall time: <100 ns Min. pulse width: <500 ns Pulse repetition rate: DC to 1 MHz Max. delay time: <100 ns Overshoot, ringing: <20% Video feed-through: <20% Pulse modulation input: 50/600 Ω, TTL (positive logic), BNC connector (rear panel)
Option 21 AF synthesizer	Frequency: 0.01 Hz to 400 kHz (sine-wave), 0.01 Hz to 50 kHz (triangular, square and sawtooth waveforms) Resolution: 0.01 Hz Waveform: Sine-wave, triangular, square and sawtooth waveforms Frequency accuracy: Same as reference oscillator accuracy
Option 22 FSK encoder	Frequency shift (Data 2^1, Data 2^0) = (0, 0): –frequency deviation setting, (Data 2^1, Data 2^0) = (0, 1): –frequency deviation setting/3, (Data 2^1, Data 2^0) = (1, 0): +frequency deviation setting, (Data 2^1, Data 2^0) = (1, 1): +frequency deviation setting/3 Frequency set Free: Frequency shift simultaneously with data input Rise trigger: Frequency shift at external clock rise time Fall trigger: Frequency shift at external clock fall time Baseband filter Filter type: 10-th order Bessel filter Cut-off frequency: 100 Hz to 30 kHz (–3 dB) Setting resolution: Upper 2 digits Frequency deviation accuracy: Depends on frequency modulation deviation accuracy of main frame (at by-pass to baseband filter) External modulation input Data $2^0/2^1$: TTL level (pull-down), BNC connector (rear panel) External clock input: TTL level (pull-up), BNC connector (rear panel)

Continued on next page

Option 23 Pattern generator	Data pattern	Free	Number of memories: 4 (defined: 1 to 4) Memory capacity: 524,288 bits/memory Pattern output Range: Top address and data bit length can be set for the respective free-pattern memories. Top address setting range: 00000 to 65,535 Data bit length setting range: 2 to 524,288 bits (Final address of output: 65,535 or less) Memory: Saves 1-byte units via GPIB interface Saves when pattern generator output off, or idle pattern being output
		Fixed	PN9 pseudorandom pattern (conforming to ITU-T V.52), PN15 pseudorandom pattern (conforming to ITU-T O.151), 01 fixed pattern
	Idle pattern		Number of memories: 1 (idle) Memory capacity: 524,288 bits Pattern output Range: The top address and data bit length can be set. Top address setting range: 00000 to 65,535 Data bit length setting range: 2 to 524,288 bits (final address of output: 65,535 or less.) Memory: Saves 1-byte units via GPIB interface Saves when pattern generator output off
	Output method		Single: Specified data pattern output once only (PN9 and PN15 are output twice.) Continuous: Specified data pattern output continuously When the data pattern is not output, the idle pattern is output continuously.
	Output rate		Range: 1 to 99,999 bps (resolution: 1 bps) Accuracy: Same as reference oscillator of MG3641A/3642A
	Output system		1-bit NRZ output (corresponding to binary data output): Data is output to the Data 2^1 Output sequentially, one bit after another starting from the top bit. The logic of Data 2^0 is fixed to 0. 2-bit NRZ output (corresponding to quadrature data output): Data is output to the Data 2^1 Output and Data 2^0 Output sequentially, two bits after another, starting from the top bit.
	Output level		Data 2^0 Output: TTL level Data 2^1 Output: TTL level Clock Output: TTL level, rising

- **MX364001B Software for Pattern Generator Data Write**

Read-out data format	DOS text file
Write memory	Data pattern memory (defined: 1 to 4), idle pattern memory (idle)
Contents of write data	Pattern data: 2 to 524,288 bits/memory (text format file) Top address of output: 0 to 65,535 (any settable) Data bit length: 2 to 524,288 bits (Bit length of pattern data automatically calculated and written) Data name: Maximum eight characters (Idle pattern memory cannot be named.)
PC	IBM PC/AT compatible
Supporting OS	Microsoft® Windows 95®
Interface	GPIB (National Instruments PCI-GPIB or PCMCIA-GPIB)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MG3641A	Synthesized Signal Generator	
MG3642A	Synthesized Signal Generator	
	Standard accessories	
	Power cord, 2.5 m:	1 pc
B0325	GPIB connector shielded cap:	1 pc
F0013	Fuse, 5 A (for 100 Vac mains):	2 pcs
F0012	Fuse, 3.15 A (for 200 Vac mains):	2 pcs
W1137AE	MG3641A/3642A operation manual:	1 copy
W1137BE	MG3641A/3642A service manual:	1 copy
	Options	
MG364[ ]A-01	Reference oscillator (aging rate: 5 x 10^{-10}/day)	
MG364[ ]A-11	Pulse modulator (pulse repetition rate: DC to 1 MHz)	
MG364[ ]A-21[*1]	AF synthesizer (0.01 Hz to 400 kHz, resolution: 0.01 Hz)	
MG364[ ]A-22[*1]	FSK encoder (2 or 4 levels FSK)	
MG364[ ]A-23[*1]	Pattern generator	
	Application software	
MX364001B[*2]	Software for Pattern Generator Data Write (Microsoft® Windows 95)	
	Optional accessories	
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m	
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
MA1612A	Four-Point Junction Pad	
MP721[ ]	Attenuator (DC to 12.4 GHz)	
B0395C	Rack mount kit (EIA/IEC)	
B0329G	Front cover (3/4MW 4U)	
B0412A	Carrying case (with casters and B0329G front cover)	
B0330B	Tilt bail (3/4MW 450D)	

*1: An option 21, 22 and 23 can be mounted to two.

Convinations

Option 21	Option 21	Analog modulations of two tones, such as a tone squelch test, can be performed.
Option 21	Option 22	FSK modulation by external data input and analog modulation can be performed.
Option 21	Option 23	
Option 22	Option 23	FSK modulation by internal data pattern can be performed.

*2: The following items and the pattern generator (Option 23) are required to use the MX3640001B.

IBM PC/AT® Personal computer	486DX4 (75 MHz or higher), with RAM of 32 MB or more (recommended) on which Windows 95® is installed 3.5 inch FD drive (for program installation)
GPIB interface	PCMCIA-GPIB or PCI-GPIB or equivalent GPIB interface manufactured by National Instruments Inc., supporting NI-488.2®

Microsoft Windows 95 is a registered trademark of Microsoft Corporation in the USA and other countries.
IBM AT is a registered trademark of International Business Machines.
NI-488.2 is a registered trademark of National Instruments Inc.

SYNTHESIZED SIGNAL GENERATOR

MG3633A

10 kHz to 2700 MHz

CE GPIB

For Evaluating of Quasi-Microwaves and Measuring High-Performance Receivers

The MG3633A has excellent frequency resolution, frequency switching speed, signal purity, and a high output level, in addition to amplitude, frequency, and phase modulation functions. Also, sweep functions are provided for carrier frequency, output level, and modulation frequency so an appropriate sweep can be performed for various devices to be measured.
Also, the MG3633A has a frequency memory that can store 1000 carrier frequencies and a function memory that stores 100 panel settings. Moreover, since the maximum output level is +17 dBm, it can be used for various local signal sources.
The MG3633A is suitable for research and development of mobile communications in the quasi-microwave band, performance evaluation, characteristics testing, and adjustment of various types of radio equipment such as digital land-based mobile communications, mobile satellite communications, satellite broadcasting, and radio LANs.

Features

• Low noise
By using both the latest synthesizer and RF-device technologies and optical data links in the internal control circuit, the SSB phase noise has been cut to –140 dBc/Hz (CW, 1.1 GHz, offset 20 kHz). In particular, the MG3633A shows its power in measurement of narrow-band radio equipment S/N ratio and adjacent channel selectivity.

• High accuracy and high-output level
Low levels of –123 dBm can be set with ±1 dB accuracy by using a high-accuracy programmable attenuator. The output level can be displayed in units of dBm, dBμV, V, mV, and μV or as a relative value (dB).

• Modulation characteristics
The MG3633A has AM, FM, øM, and a combination of all three modulation functions. A DC mode is provided for FM, which makes simulation of digital transmissions for a pager possible. Also, a built-in AF oscillator with a 0.1 Hz to 100 kHz synthesizer can handle various modulations.

• Quasi-microwave output
The MG3633A covers a wide range (from 10 kHz to 2700 MHz) and is suitable for research and development, as well as production of quasi-microwave band radio equipment.

Performance

• Signal purity
The MG3633A has excellent spectral purity. As shown in the Fig. 1, the SSB phase noise at 1 GHz with 20 kHz signal offset is –140 dBc/Hz. In particular, this shows its power for generating signals used for testing radio receiver selectivity, for generating high-speed clocks of A/D converters and dividers, as well as for generating standard signals for communications links. Also, since the residual FM is 0.8 Hz rms or less (1.28 GHz or less), even the S/N ratio of narrow-band mobile radio equipment can be measured with sufficient margin (Fig. 2)

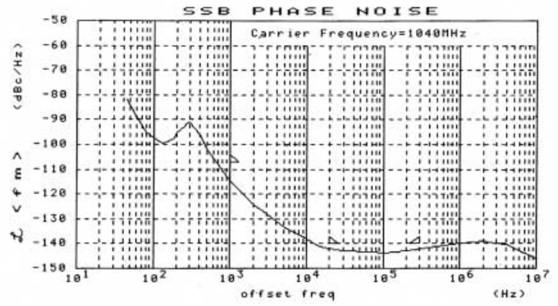


Fig. 1   SSB phase noise

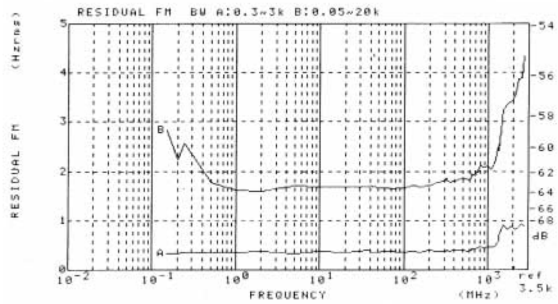


Fig. 2   Residual FM

• Output level characteristics
A maximum output of +17 dBm can be obtained over a wide frequency range so 2-signal or 3-signal testing can be done easily. A high-accuracy highly-reliable programmable attenuator (life cycle over 3 million times) is used and, since flat output characteristics are obtained by internal calibration over a wide range from 10 kHz to 2.7 GHz, it is effective for testing antennas and cables (Fig. 3).
Moreover, compensation data for obtaining flat levels at cable ends can be input by using a power meter, GPIB, controller, and frequency-response compensation software (option).

• Continuously variable output level
The MG3633A can output continuously-variable signals in a 20 dB range with 0.1 dB steps at any level. This is especially convenient for measuring the dynamic range of magnetic tape and squelch sensitivity of radios which produce hysteresis phenomenon as a result of level variation.

• AM
A high-accuracy AM wave is generated over a wide frequency range (Fig. 4). Countermeasures against carrier-wave variation due to vibration permit even SSB radio equipment to be tested with confidence.

• FM
FM with a maximum frequency deviation of 3.2 MHz is possible (1.28 to 2.7 GHz). Also if the frequency deviation is too low, automatic operation is carried out in the stabilized DC-FM mode so even digital data transmission equipment such as papers can be tested (Fig. 5).

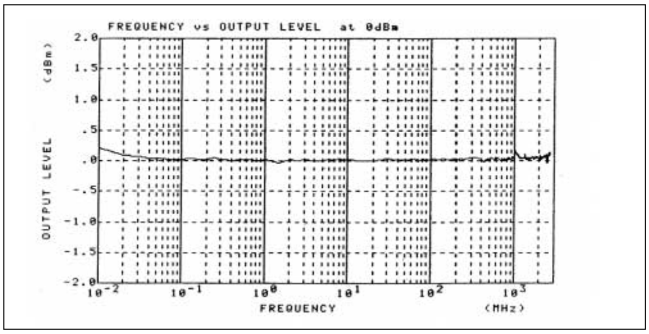


Fig. 3 Output level frequency response

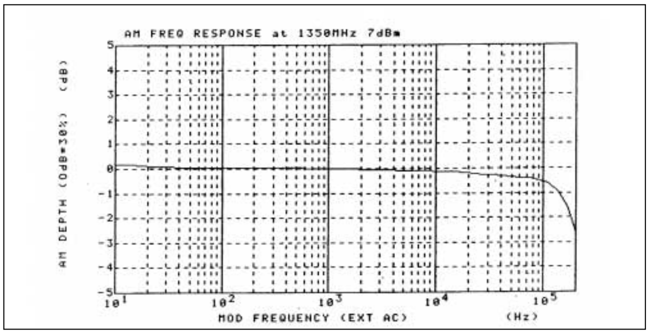


Fig. 4 AM modulation frequency characteristics

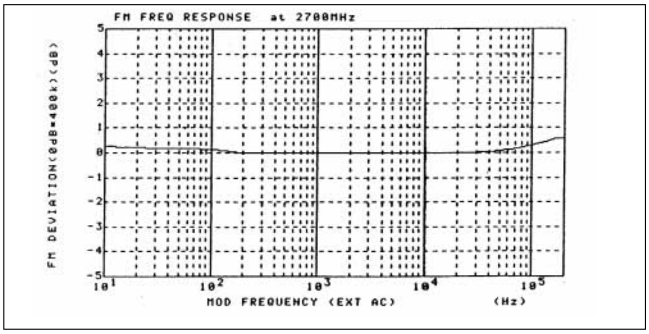


Fig. 5 FM modulation frequency characteristics

Specifications

<table>
<tr><td rowspan="7">Carrier frequency</td><td>Range</td><td colspan="3">10 kHz to 2700 MHz</td></tr>
<tr><td>Resolution</td><td colspan="3">0.01 Hz</td></tr>
<tr><td>Accuracy</td><td colspan="3">Same as that of the reference oscillator</td></tr>
<tr><td>Internal reference oscillator*1</td><td colspan="3">Frequency: 10 MHz
Start-up characteristics: After 30 minutes of operation: ≤1 x 10–7/day, after 60 minutes of operation: ≤5 x 10–8/day,
Aging rate: After 24 hours of operation: ≤2 x 10–8/day,
Temperature characteristics: ±5 x 10–8 (0˚ to 50˚C)</td></tr>
<tr><td>External reference signal input</td><td colspan="3">10 MHz, TTL Level, BNC connector on rear panel</td></tr>
<tr><td>Reference signal output</td><td colspan="3">10 MHz, TTL Level, BNC connector on rear panel</td></tr>
<tr><td>Switching time</td><td colspan="3">≤10 ms (time from last command until frequency has stabilized to within ±500 Hz of set frequency, during remote operation)</td></tr>
<tr><td rowspan="13">Output</td><td>Range</td><td colspan="3">–143 to +23 dBm</td></tr>
<tr><td>Units</td><td colspan="3">dBm, dBμV, V, mV, μV (Terminated and open voltages are selectable for dBμV, V, mV or μV.)</td></tr>
<tr><td>Resolution</td><td colspan="3">0.1 dB</td></tr>
<tr><td>Frequency response</td><td colspan="3">±0.5 dB referred to 0 dBm (<1280 MHz), ±1 dB referred to 0 dBm (≥1280 MHz)</td></tr>
<tr><td rowspan="6">Accuracy</td><td>Frequency / Output level</td><td>10 kHz to <1280 MHz</td><td>≥1280 MHz</td></tr>
<tr><td>+17.1 to +23 dBm</td><td>–</td><td>–</td></tr>
<tr><td>+15.1 to +17 dBm</td><td>±1 dB</td><td>–</td></tr>
<tr><td>–122.9 to +15 dBm</td><td>±1 dB</td><td>±2 dB</td></tr>
<tr><td>–132.9 to –123 dBm</td><td>±3 dB</td><td>±4 dB</td></tr>
<tr><td>–143 to –133 dBm</td><td>–</td><td>–</td></tr>
<tr><td>Impedance</td><td colspan="3">50 Ω, N-type connector
VSWR: ≤1.5 (<1280 MHz, ≤–3 dBm), ≤1.8 (≥1280 MHz, ≤–3 dBm)</td></tr>
<tr><td>Switching time</td><td colspan="3">Time from last command until output level is stabilized, during remote operation:≤25 ms (at LEVEL NORMAL mode)
≤80 ms (when setting level is crossing over –59 dBm, at LEVEL NORMAL mode)
≤5 ms (at LEVEL CONTINUOUS mode)</td></tr>
<tr><td>Interference radiation</td><td colspan="3">≤1 μV (Value is voltage terminated with 50 Ω load, measured 25 mm from front panel with a two-turn 25 mm diameter loop antenna.) Except sweep mode</td></tr>
</table>

Continued on next page

<table>
<tr><td rowspan="13">Signal purity</td><td rowspan="2">Spurious</td><td colspan="4">At +7 dBm, CW mode: (fc: carrier frequency)</td></tr>
<tr><td colspan="4">Harmonics (2nd, 3rd): ≤–30 dBc (at ≥100 kHz)
Sub-harmonics (f_c/2, 3f_c/2, 5f_c/2): None (at <1280 MHz), ≤–30 dBc (at ≥1280 MHz)
Non-harmonics:
≤–80 dBc (f_c<640 MHz, ≥10 kHz offset)
≤–74 dBc (640 MHz≤f_c<1280 MHz, ≥10 kHz offset)
≤–68 dBc (f_c≥1280 MHz, ≥10 kHz offset)</td></tr>
<tr><td rowspan="9">SSB phase noise</td><td colspan="4">At +7 dBm, CW mode, 0˚to 35˚C</td></tr>
<tr><td>Offset frequency</td><td>1 kHz</td><td colspan="2">20 to 300 kHz</td></tr>
<tr><td>0.01 to <40 MHz</td><td>–116 dBc/Hz</td><td colspan="2">–140 dBc/Hz</td></tr>
<tr><td>40 to <300 MHz</td><td>–119 dBc/Hz</td><td colspan="2">–145 dBc/Hz</td></tr>
<tr><td>300 to <600 MHz</td><td>–113 dBc/Hz</td><td colspan="2">–143 dBc/Hz</td></tr>
<tr><td>600 to <1100 MHz</td><td>–107 dBc/Hz</td><td colspan="2">–140 dBc/Hz</td></tr>
<tr><td>1.1 to <2.4 GHz</td><td>–101 dBc/Hz</td><td colspan="2">–132 dBc/Hz</td></tr>
<tr><td>2.4 to 2.7 GHz</td><td>–97 dBc/Hz</td><td colspan="2">–120 dBc/Hz</td></tr>
<tr><td colspan="4">Floor noise: ≤145 dBc/Hz (40 to <1100 MHz)</td></tr>
<tr><td>Residual AM</td><td colspan="4">≤0.02% rms at ≥150 kHz (demodulation band: 300 Hz to 3 kHz)</td></tr>
<tr><td>Residual FM</td><td colspan="4">≤0.8 Hz rms at <1280 MHz (demodulation band: 300 Hz to 3 kHz)
≤4 Hz rms at <1280 MHz (demodulation band: 50 Hz to 20 kHz)</td></tr>
<tr><td rowspan="13">Amplitude modulation</td><td>Range</td><td colspan="4">0 to 100%</td></tr>
<tr><td>Resolution</td><td colspan="4">0.1%</td></tr>
<tr><td>Internal modulation frequency</td><td colspan="4">Fixed frequency: 400 Hz, 1 kHz
Variable frequency: 0.1 Hz to 50 kHz, 0.1 Hz resolution
Frequency accuracy: 100 ppm</td></tr>
<tr><td>Accuracy</td><td colspan="4">± (5% of indicated value +2%) [at ≥250 kHz, ≤+7 dBm, 0 to 90% and internal 1 kHz]</td></tr>
<tr><td rowspan="6">Frequency response</td><td colspan="4">At ≤+7 dBm, ±1 dB bandwidth</td></tr>
<tr><td>Lower modulation frequency limit</td><td colspan="3">20 Hz (EXT AC mode), DC (EXT DC mode)</td></tr>
<tr><td rowspan="4">Upper modulation frequency limit</td><td>Modulation factor
Carrier frequency</td><td>0 to 30%</td><td>30.1 to 80%</td></tr>
<tr><td>0.25 MHz≤f_c<0.5 MHz</td><td>5 kHz</td><td>5 kHz</td></tr>
<tr><td>0.5 MHz≤f_c<80 MHz</td><td>20 kHz</td><td>10 kHz</td></tr>
<tr><td>80MHz≤f_c</td><td>50 kHz</td><td>20 kHz</td></tr>
<tr><td>External modulation</td><td colspan="4">Input level: Approx. 2 Vp-p ,600 Ω
Input Impedance: Nominal 600 Ω</td></tr>
<tr><td>Depth</td><td colspan="4">≤1% (at ≥1 MHz, ≤+7 dBm, internal 1 kHz, 30%)
≤3% (at ≥1 MHz, ≤+7 dBm, internal 1 kHz, 80%)
≤3% (at 250 kHz≤f_c<1 MHz, ≤+7 dBm, internal 1 kHz, 30%)
≤10% (at 250 kHz≤f_c<1 MHz, ≤+7 dBm, internal 1 kHz, 80%)</td></tr>
<tr><td>Incidental FM</td><td colspan="4">≤200 Hz peak (at ≥250 kHz, ≤+7 dBm, 1 kHz, 30%, demodulation band 0.3 to 3 kHz)</td></tr>
<tr><td rowspan="9">Frequency modulation</td><td>Range</td><td>0 to 400 kHz (1 MHz≤f_c<40 MHz)
0 to 100 kHz (40 MHz≤f_c<80 MHz)
0 to 200 kHz (80 MHz≤f_c<160 MHz)
0 to 400 kHz (160 MHz≤f_c<320 MHz)</td><td colspan="3">0 to 800 kHz (320 MHz≤f_c<640 MHz)
0 to 1.6 MHz (640 MHz≤f_c<1280 MHz)
0 to 3.2 MHz (1280 MHz≤f_c)</td></tr>
<tr><td>Resolution</td><td>10 Hz (0 to 9.99 kHz deviation)
100 Hz (10 to 99.9 kHz deviation)</td><td colspan="3">1 kHz (100 to 666 kHz deviation)
10 kHz (1 to 3.2 MHz deviation)</td></tr>
<tr><td>Internal modulation frequency</td><td colspan="4">Fixed frequency: 400 Hz, 1 kHz
Variable frequency: 0.1 to 100 kHz. 0.1 Hz resolution
Frequency accuracy: 100 ppm</td></tr>
<tr><td>Accuracy</td><td colspan="4">± (5% of indicated value +20 Hz) [internal 1 kHz]</td></tr>
<tr><td>Modulation frequency response</td><td colspan="4">±1 dB bandwidth
Frequency range: 20 Hz to 100 kHz (EXT AC mode), DC to 100 kHz (EXT DC mode)</td></tr>
<tr><td>External modulation</td><td colspan="4">Input level: Approx. 2 Vp-p/600 Ω
Input impedance: Nominal 600 Ω</td></tr>
<tr><td>Distortion</td><td colspan="4">≤1% (internal 1 kHz, 3.5 kHz deviation)</td></tr>
<tr><td>Incidental AM</td><td colspan="4">≤0.4% (internal 1 kHz, 22.5 kHz deviation, demodulation band 0.3 to 3 kHz)</td></tr>
<tr><td>Carrier frequency accuracy in DC-FM mode</td><td colspan="4">±500 Hz for 30-minute period after calibration and 2-hour warm-up (at <1280 MHz, <10 kHz deviation)</td></tr>
<tr><td rowspan="6">Phase modulation</td><td rowspan="2">Range</td><td>0 to 80 rad (1 MHz≤f_c<40 MHz)
0 to 20 rad (40 MHz≤f_c<80 MHz)
0 to 40 rad (80 MHz≤f_c<160 MHz)
0 to 80 rad (160 MHz≤f_c<320 MHz)</td><td colspan="3">0 to 160 rad (320 MHz≤f_c<640 MHz)
0 to 320 rad (640 MHz≤f_c<1280 MHz)
0 to 640 rad (1280 MHz≤f_c)</td></tr>
<tr><td colspan="4">Besides radian, deg unit is also possible for phase deviation display. However, max. 999 deg.</td></tr>
<tr><td>Resolution</td><td colspan="4">0.01 rad (0 to 9.99 rad deviation), 1 rad (100 to 640 rad deviation), 0.1 rad (10 to 99.9 rad deviation)</td></tr>
<tr><td>Internal modulation frequency</td><td colspan="4">Fixed frequency: 400 Hz, 1 kHz
Variable frequency: 0.1 Hz to 5 kHz, 0.1 Hz resolution
Frequency accuracy: 100 ppm</td></tr>
<tr><td>Accuracy</td><td colspan="4">±(10% of indicated value +0.05 rad) [internal 1 kHz modulation]</td></tr>
<tr><td>Modulation frequency response</td><td colspan="4">±1 dB bandwidth
Frequency range: 20 Hz to 5 kHz (EXT AC mode), DC to 5 kHz (EXT DC mode)</td></tr>
</table>

Continued on next page

<table>
<tr><td rowspan="2">Phase modulation</td><td>External modulation</td><td>Input level: Approx. 2 Vp-p/600 Ω
Input impedance: Nominal 600 Ω</td></tr>
<tr><td>Distortion</td><td>≤1% (internal 1 kHz, 5 rad modulation)</td></tr>
<tr><td rowspan="4">Internal modulation signal</td><td>Frequency range</td><td>400 Hz, 1 kHz (fixed oscillator)
0.1 Hz to 100 kHz (variable oscillator)
DC voltage signals equivalent peak values of internal modulating sine wave can be applied as a modulating signal using the SPECIAL FUNCTION.</td></tr>
<tr><td>Resolution</td><td>0.1 Hz</td></tr>
<tr><td>Frequency accuracy</td><td>100 ppm</td></tr>
<tr><td>Distortion</td><td>≤0.03% (fixed, 400 Hz and 1 kHz), ≤0.3% (variable, 20 Hz to 50 kHz)</td></tr>
<tr><td rowspan="2">Memory function</td><td>Frequency memory</td><td>1000 carrier frequencies (store/recall)</td></tr>
<tr><td>Function memory</td><td>100 panel settings (store recall)</td></tr>
<tr><td rowspan="5">Sweep function</td><td>Sweep mode</td><td>Carrier frequency, output level, AF frequency</td></tr>
<tr><td>Sweep pattern</td><td>
<table>
<tr><td colspan="2"></td><td>Carrier frequency</td><td>Output level</td><td>AF frequency</td></tr>
<tr><td rowspan="2">Pattern</td><td>Start/stop</td><td>√</td><td>√*2</td><td>√</td></tr>
<tr><td>Center/span</td><td>√</td><td>√*2</td><td>√</td></tr>
<tr><td rowspan="3">Step</td><td>Entering number of steps</td><td>√</td><td>–</td><td>√</td></tr>
<tr><td>Entering step size</td><td>√</td><td>√*3</td><td>√</td></tr>
<tr><td>LOG 1%</td><td>√</td><td>–</td><td>√</td></tr>
</table>
<table>
<tr><td colspan="2"></td><td>Frequency memory</td><td>Function memory</td></tr>
<tr><td rowspan="3">Pattern</td><td>Continuous address</td><td>√</td><td>√</td></tr>
<tr><td>Random address</td><td>√</td><td>√</td></tr>
<tr><td>Continuous, random mixed</td><td>√</td><td>√</td></tr>
<tr><td colspan="2">Maximum number of steps</td><td>20*4</td><td>20*4</td></tr>
</table>
</td></tr>
<tr><td>Sweep time</td><td>0.1 ms to 600 s, 0.01 ms resolution (minimum time depends on the switching time of each function.)</td></tr>
<tr><td>Marker</td><td>One movable marker</td></tr>
<tr><td>Sweep signal output</td><td>Staircase (saw-tooth waveform), Start point: 0 V, Stop point: 10 V</td></tr>
<tr><td rowspan="8">Other functions</td><td>Modulation signal output</td><td>Modulation signal is output when modulating.
Output level: Approx. 2 Vp-p/600 Ω</td></tr>
<tr><td>Simultaneous modulation</td><td>Simultaneous modulation is possible in combinations shown below.
<table>
<tr><td></td><td>INT AM</td><td>EXT AM</td><td>INT FM</td><td>EXT FM</td><td>INT øM</td></tr>
<tr><td>EXT øM</td><td>√</td><td>√</td><td>–</td><td>–</td><td>√*6</td></tr>
<tr><td>INT øM</td><td>√*5</td><td>√</td><td>–</td><td>–</td><td></td></tr>
<tr><td>EXT FM</td><td>√</td><td>√</td><td>√*6</td><td></td><td></td></tr>
<tr><td>INT FM</td><td>√*5</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td>EXT AM</td><td>√</td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Relative value display</td><td>Carrier frequency, output level</td></tr>
<tr><td>Continuously variable output level mode</td><td>Continuously variable within a ±10 dB range of the set level
Step size: 0.1 dB</td></tr>
<tr><td>Trigger function</td><td>Previously programmed operation procedure can be started by a trigger input through its input terminal (on rear panel, BNC connector, TTL level). Maximum program steps for triggered operation: 99 steps</td></tr>
<tr><td>Memory backup</td><td>Last settings are stored when power is turned off.</td></tr>
<tr><td>GPIB</td><td>Interface function: SH1, AH1, T5, L3, TE0, LE0, SR1, RL1, PP0, DC1, DT1, C0</td></tr>
<tr><td colspan="2">Reverse power</td><td>Maximum reverse input power: 50 W (<1000 MHz), 25 W (≥1000 MHz), ±DC 50 V</td></tr>
<tr><td colspan="2">Operating temperature</td><td>0˚ to 50˚C</td></tr>
<tr><td colspan="2">Power</td><td>*7Vac$^{+10}_{-15}$ %, 48 to 63 Hz, ≤270 VA</td></tr>
<tr><td colspan="2">Dimensions and mass</td><td>426 (W) x 177 (H) x 451 (D) mm, ≤32 kg</td></tr>
<tr><td colspan="2">EMC</td><td>EN61326: 1997/A1: 1998 (Class A)
EN61000-3-2: 1995/A2: 1998 (Class A)
EN61326: 1997/A1: 1998 (Annex A)</td></tr>
<tr><td colspan="2">LVD</td><td>EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)</td></tr>
</table>

*1: Aging rates up to 5 x 10^{-10}/day are available as option.
*2: Step width: Max. 20 dB
*3: 0.1 dB step size only
*4: One continuous address setting is counted as 3 steps.
*5: Same one internal modulation frequency is used.
*6: Different deviation settings are possible for INT and EXT modulations (using the SPECIAL FUNCTION).
*7: Specify one nominal line voltage between 100 and 240 V when ordering. However maximum operational voltage is limited to 250 V.

Options

Reference oscillators		Standard model	Option 01	Option 02	Option 03
Start-up characteristics	After 30 minutes operation	1 x 10^{-7}/day	7 x 10^{-8}/day	–	–
	After 60 minutes operation	5 x 10^{-8}/day	3 x 10^{-8}/day	2 x 10^{-8}/day	–
Aging rate	After 24 hours operation	2 x 10^{-8}/day	5 x 10^{-9}/day	2 x 10^{-9}/day	–
	After 48 hours operation	–	–	–	5 x 10^{-10}/day
Temperature characteristics (0˚ to 50˚C)		±5 x 10^{-8}	±5 x 10^{-8}	±1.5 x 10^{-8}	±5 x 10^{-9}

Option 04: Rear RF output, SMA connector

Peripheral equipment

MA1610A Pulse Modulator

The MA1610A is a pulse modulator used in combination with the MG3633A Synthesized Signal Generator to generate high-speed pulse modulated signals. The MA1610A can switch RF signals with a carrier frequency ranging from 10 kHz to 2700 MHz ON and OFF using an input modulation signal (TTL level, 50 Ω terminated). Power is supplied from the MG3633A via its rear panel AUX connector.

Frequency range	10 kHz to 2700 MHz
ON,OFF ratio	≥60 dB (<1000 MHz), ≥40 dB (≥1000 MHz)
Insertion loss	≤2 dB (<1000 MHz), ≤3.5 dB (<1000 MHz)
Rise time	≤15 ns
Fall time	≤5 ns
Minimum pulse width	20 ns
Maximum repetition rate	10 MHz
Maximum delay time	40 ns
Video feed through	≤50 mVp-p
Overshoot/ringing	≤20%
RF input/output	50 Ω, N-type connector, maximum permissible input level: AC 200 mW, DC 3.5 V
Operating temperature	0˚ to 50˚C
Dimensions and mass	131 (W) x 57 (H) x 43 (D) mm, ≤600 g
Standard accessories	J0494: Coaxial cord, 0.3 m (1 pc) J0495: Power cord, 1.0 m (1 pc) W0508AE: MA1610A operation manual (1 copy)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MG3633A	Synthesized Signal Generator
	Standard accessories
J0025A	Coaxial cord (S-5DWP · 5D-2W · S-5DWP), 1 m: 1 pc
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m: 1 pc
	Power cord, 2.5 m: 1 pc
F0013	Fuse, 5 A (for 100 Vac mains): 2 pcs
F0012	Fuse, 3.15 A (for 200 Vac mains): 2 pcs
W0504AE	MG3633A operation manual: 1 copy
	Options
MG3633A-01	Reference oscillator
MG3633A-02	Reference oscillator
MG3633A-03	Reference oscillator
MG3633A-04	Rear RF output: SMA connector (however, replaces front-panel RF connector)
	Peripheral
MA1610A	Pulse Modulator (10 kHz to 2.7 GHz)
	Optional accessories
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 Ω ↔ 75 Ω, 10 MHz to 1.2 GHz)
MA1612A	Four-Port Junction Pad (5 MHz to 3 GHz)
MP659A	Four-Port Junction Pad (40 to 1000 MHz)
Z-164A	T-pad (DC to 1000 MHz)
MB24A	Portable Test Rack

RF MICROWAVE SIGNAL GENERATOR
MG3690A
0.1 Hz to 65 GHz / 110 GHz

GPIB

The Ideal Signal Generator

NEW

Value without compromise
Your microwave signal generation requirements have never been tougher, and yet your capital equipment budget has never been tighter. You need the most value you can get in a synthesizer, but you can't compromise performance. You need a synthesizer that meets today's needs yet can be upgraded at a reasonable cost to satisfy future requirements without shattering your test equipment budget. Anritsu's MG3690A series of synthesizers deliver the highest performance and the highest value available today.

Features
Basic CW Generators configurable to full-featured Signal Generators.

- Broad Frequency Coverage, in a Single Output: 0.1 Hz to 65 GHz
    - 6 Models, 2 to 8.4, 20, 30, 40, 50, and 65 GHz
    - 10 MHz Coverage Optional (Analog or Digital Down-Conversion)
    - 0.1 Hz Coverage Optional
- mmW Coverage up to 110 GHz, in Waveguide
- Ultra-Low SSB Phase Noise Option
- –110 dBc/Hz (typically) at 1 kHz Offset, 10 GHz Carrier
- Excellent Harmonics and Spurious Response
- High Output Power Option
    - +19 dBm to 10 GHz
    - +17 dBm to 20 GHz
    - +14 dBm to 40 GHz
    - +3 dBm to 65 GHz
- CW and Step Sweep Modes; Analog Sweep Optional
- <5 ms Switching Time (typically) for <100 MHz steps
- 0.01 Hz standard Frequency Resolution
- Phase Offset Capability
- AM, FM/ΦM Modulations Optional
    - Internal LF Generator Optional
- Pulse Modulation Optional
    - 100 ns Leveled Width, >2 GHz
    - Internal Pulse Generator Optional
- IF Up-Conversion Option, for IQ Modulation Solutions
- Intuitive, Menu-driven Front Panel
- Small and Light
- Proven Reliability with 3 Year Standard Warranty
- Completely Configurable and Upgradable

High performance signal generators
The ultimate in full-function signal generation. They provide all the features of the other families along with comprehensive, high-performance modulation for signal simulation applications. Additional features in these units include:

- Internal pulse generator with swept delay capability for moving target simulation
- Flexible pulse triggering including free-run, delayed, gated, and composite
- 0 to 90% AM, log or linear, over DC to 100 kHz rates
- Four FM modes for up to 10 MHz deviation at 8 MHz rates or 100 MHz deviation at 100 Hz rates
- Phase modulation (ΦM) up to 400 radians deviation at 1 MHz rates
- Internal AM, FM, and ΦM generators, each with 7 modulating waveforms
- Optional user-defined, downloaded complex modulation

A new standard for a new millennium
The MG3690A leverages the proven design of earlier Anritsu synthesizers, adding new features to meet the latest needs of the new millennium. The MG3690A builds on a proven reliability record of >49,000 hours MTBF. This allows the MG3690A to offer a standard 3-year warranty. From the sleek new lines of the front panel, the larger 1/4 VGA LCD, the reduced front panel buttons and menu depth, to the 10 kg lighter and 15 cm shallower depth, the MG3690A meets the new millennium value-based needs.

Automatic Test Equipment
The MG3690A is an ideal signal generator for an A.T.E. system. It packs the highest performance available in a 13.3 cm (3u) package, with a 450 mm depth that minimizes rack space. High output power assures adequate signal strength to the device under test even after A.T.E. switching and cabling losses. Accurately leveled output power to –120 dBm in 0.01 dB steps facilitates receiver sensitivity measurements. For improved MTBF, an electronic step attenuator replaces the traditional mechanical step attenuator. Fast 5 ms switching time maximizes system throughput. Internal list mode frees the A.T.E. controller to perform measurement analysis tasks. Free application drivers, including the IVI-COM driver and National Instruments LabView® drivers, save you time and money in code generation and maintenance. For additional cost savings, Option 17 eliminates the complete front panel, including circuitry.

Interchangeable Virtual Instruments Standard
The IVI standard defines a standard instrument driver model that enables instrument interchangeability and interoperability without software changes. Anritsu's IVI-driver supported synthesizer minimizes instrument development and maintenance cost through the use of IVI-standard interfaces as well as instrument-specific interfaces for unique

instrument features. The IVI standard provides a single driver that supports the common application development environments such as Visual Basic, Visual C++, and Labview. The flexible I/O model supports new communication technologies such as USB, Ethernet, and Firewire. Anritsu Corporation leads the way with IVI technology, having released the first COM-based IVI driver supporting the Signal Generator instrument class, and includes the driver with every MG3690A series synthesizer. As an active member of the IVI Foundation, Anritsu supports the Foundation's drive toward instrument driver standardization as a powerful means of delivering interchangeable ATE instrumentation solutions.

Specifications

CW mode	Output		Twenty independent, presettable CW frequencies (F0 – F9 and M0 – M9)
	Accuracy		Same as internal or external 10 MHz time base
	Internal time base stability	With aging	<2 x 10^{-9}/day (<5 x 10^{-10}/day with Option 16)
		With temperature	<2 x 10^{-8}/°C over 0°C to 55°C (<2 x 10^{-10}/°C with Option 16)
	Resolution		0.01 Hz
	External 10 MHz reference input		Accepts external 10 MHz ±100 Hz, Φ to +20 dBm time base signal. Automatically disconnects the internal high-stability time-base option, if installed. BNC, rear panel, 50 Ω impedance
	10 MHz reference output		0.5 Vp-p into 50 Ω, AC coupled. Rear panel BNC; 50 Ω impedance
	Switching time (typical maximum)		<40 ms to be within 1 kHz of final frequency
	Phase offset		Adjustable in 0.1° steps
	Electronic Frequency Control (EFC) input		–5V to +5V input range; Fout/(2 x 10^6) Hz/v sensitivity typical; ≤250 Hz modulation BW; rear panel BNC; high impedance
Phase-locked step sweep mode	Sweep width		Independently selected, 0.01 Hz to full range. Every frequency step in sweep range is phase-locked
	Accuracy		Same as internal or external 10 MHz time base
	Resolution (minimum step size)		0.01 Hz
	Linear/log sweep		User-selectable linear or log sweep. In log sweep, step size logarithmically increases with frequency
	Steps		User-selectable number of steps or the step size
	Number of Steps		Variable from 1 to 10,000
	Step size		0.01 Hz to the full frequency range of the instrument. (If the step size does not divide into the selected frequency range, the last step is truncated.)
	Dwell time per step		Variable from 1 ms to 99 seconds
	Fixed rate sweep		Allows the user to set the total time of the sweep, including lock time. Variable from 20 ms to 99 seconds
	Switching time (typical maximum)		<15 ms + 1 ms/GHz step size or <40 ms, whichever is less, to be within 1 kHz of final frequency
Alternate sweep mode	Sweeps alternately in step sweep between any two sweep ranges. Each sweep range may be associated with a power level.		
Analog Sweep Mode (Option 6)	Sweep Width		Independently selected from 1 MHz to full frequency range. With Option 4, Digital Down Converter, analog sweep is only available •500 MHz. Analog sweep is not available <10 MHz with option 22.
	Accuracy		The lesser of ± 30 MHz or (± 2 MHz + 0.25% of sweep width) for sweep speeds of ≤50 MHz/ms.
	Sweep Time Range		30 ms to 99 seconds
Manual sweep mode	Provides stepped, phase-locked adjustment of frequency between sweep limits. User-selectable number of steps or step size.		
List sweep mode	Under GPIB control or via the front panel, up to 4 tables with 2000 non-sequential frequency/power sets can be stored and then addressed as a phase-locked step sweep. One table of 2000 points is stored in non-volatile memory, all other tables are stored in volatile memory.		
	Switching time (typical maximum)		<25 ms to be within 1 kHz of final frequency
Programmable frequency agility	Under GPIB control, up to 3202 non-sequential frequency/power sets can be stored and then addressed as a phase-locked step sweep. Data is stored in volatile memory.		
	Switching time (typical maximum)		<25 ms to be within 1 kHz of final frequency
Markers	Up to 20 independent, settable markers (F0 – F9 and M0 – M9)		
	Video markers		+5V or –5V marker output, selectable from system menus. AUX I/O connector, rear panel
	Marker accuracy		Same as sweep frequency accuracy
	Marker resolution		1 kHz (0.1 Hz with Option 11)
Sweep triggering	Sweep triggering is provided for step frequency sweep, list frequency sweep, and CW power sweep.		
	Auto		Triggers sweep automatically
	External		Triggers a sweep on the low-to-high transition of an external TTL signal. AUX I/O connector, rear panel
	Single		Triggers, aborts, and resets a single sweep. Reset sweep may be selected to be at the top or bottom of the sweep

Continued on next page

General	Stored setups		Stores front panel settings and nine additional front-panel setups in a non-volatile RAM. A system menu allows for saving and recalling instrument setups. Whenever the instrument is turned on, control settings and values are the same as when last turned off.
	Memory sequencing input		TTL low-level signal provides sequencing through ten stored setups. AUX I/O connector, rear panel
	Self-test		Instrument self-test is performed when Selftest soft-key is selected. If an error is detected, an error message is displayed in a window on the LCD identifying the probable cause and remedy.
	Secure mode		Disables all frequency and power level state displays. Stored setups saved in secure mode remain secured when recalled. Mode selectable from a system menu and via GPIB.
	Parameter entry		Instrument-controlled parameters can be entered in three ways—keypad, rotary data knob, or the "^" and "∨" touch pads of the cursor-control key (use up/down-arrow symbol). The keypad is used to enter new parameter values; the rotary data knob and the cursor-control key are used to edit existing parameter values. The "<" and ">" touch pads of the cursor-control key move the cursor left and right one digit under the open parameter. The rotary data knob or the "<" and ">" touch pads will increment or decrement the digit position over the cursor. Controlled parameters are frequency, power level, sweep time, dwell time, and number of steps. Keypad entries are terminated by pressing the appropriate soft key. Edits are terminated by exiting the edit menu
	Reset		Returns all instrument parameters to predefined default states or values. Any pending GPIB I/O is aborted. Selectable from the system menu
	Master/slave operation		Allows two output signals to be swept with a user-selected frequency offset. One instrument controls the other via AUX I/O and SERIAL I/O connections. Requires a Master/Slave Interface Cable Set (Part No. ND36329)
	User level flatness correction		Provides compensation for path loss due to external switching and cables. Compensation may come from a power table in a GPIB power meter, or it may be from calculated data. When user level correction is activated, entered power levels are delivered at the point where calibration was performed. Supported power meters are Anritsu ML2437A, ML2438A, and ML4803A and HP 437B, 438A, and 70100A. Five user tables are available with up to 801 points/table
	Warm up time	From standby	30 minutes
		From cold start (0°C)	120 hours to achieve specified frequency stability with aging. Instruments disconnected from ac line power for more than 72 hours require 30 days to return to specified frequency stability with aging
	Power		90-264 Vac, 48-440 Hz, 250 VA maximum
	Standby		With AC line power connected, unit is placed in standby when front panel power switch is released from the OPERATE position
	Weight		18 kg maximum
	Dimensions		133 H x 429 W x 450 D mm
Remote operation	All instrument functions, settings, and operating modes (except for power on/standby) are controllable using commands sent from an external computer via the GPIB (IEEE-488 interface bus)		
	GPIB address		Selectable from a system menu
	IEEE-488 Interface Function Subset	Source handshake	SH1
		Acceptor handshake	AH1
		Talker	T6
		Listener	L4
		Service request	SR1
		Remote/local	RL1
		Parallel poll	PP1
		Device clear	DC1
		Device trigger	DT1
		Controller capability	C0, C1, C2, C3, C28
		Tri-state driver	E2
	GPIB Status Annunciators	When the instrument is operating in remote, the GPIB status annunciators (listed below) will appear in a window on the front panel display	
		Remote	Under GPIB control (all instrument front panel keys except for the SYSTEM key and the RETURN TO LOCAL soft-key will be ignored)
		LLO (local lockout)	Disables the RETURN TO LOCAL soft-key. Instrument can be placed in local mode only via GPIB or by cycling line power
	Emulations		The instrument responds to the published GPIB commands and responses of the Anritsu Models 6600, 6700, and 6XX00-series signal sources. When emulating another signal source, the instrument will be limited to the capabilities, mnemonics, and parameter resolutions of the emulated instrument
Environmental	Storage temperature range		-40 to +75°C
	Operating temperature range		0 to +50°C
	Relative humidity		5% to 95% at 40°
	Altitude		4,600 meters, 43.9 cm Hg
	EMI		EMI: Meets the emission and immunity requirements of EN61326: 1998 EN55011:1991/CISPR-11:1990 Group 1 Class A EN61000-4-2: 1995 – 4 kV CD, 8 kV AD EN61000-4-3: 1997 – 3 V/m EN61000-4-4: 1995 – 0.5 kV SL, 1 kV PL EN61000-4-5: 1995 – 1 kV – 2 kV L-E EN61000-4-6: 1996 EN61000-4-11: 1994

Spectral purity

All specifications apply at the lesser of +10 dBm output or maximum specified leveled output power, unless otherwise noted.

Spurious signals

Harmonic and harmonic helated

Frequency range	Standard
0.1 Hz to 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤100 MHz (Option 4)	<–40 dBc
>100 MHz to ≤2.2 GHz (Option 4)	<–50 dBc
10 MHz to ≤50 MHz (Option 5)	<–30 dBc
>50 MHz to ≤2 GHz (Option 5)	<–40 dBc
>2 GHz (2.2 GHz w/Option 4) to ≤20 GHz	<–60 dBc
>20 GHz to ≤40 GHz	<–40 dBc
>40 GHz to ≤50 GHz (MG3695A)	<–40 dBc
>40 GHz to ≤65 GHz (MG3696A)	<–25 dBc

Harmonic and harmonic related (for models with Option 15, at maximum specified leveled output power)

Frequency range	Standard
0.1 Hz 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤100 MHz (Option 4)	<–40 dBc
>100 MHz to ≤2.2 GHz (Option 4)	<–50 dBc
10 MHz to ≤50 MHz (Option 5)	<–30 dBc
>50 MHz to ≤2 GHz (Option 5)	<–40 dBc
>2 GHz (2.2 GHz w/Option 4) to ≤20 GHz	<–50 dBc
>20 GHz to ≤40 GHz	<–30 dBc*

* Typical

Non-harmonics

Frequency range	Standard
0.1 Hz to 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤2.2 GHz (Option 4)	<–60 dBc
10 MHz to ≤2 GHz (Option 5)	<–40 dBc
>2 GHz (2.2 GHz w/Option 4) to ≤65 GHz	<–60 dBc

Power line and fan rotation spurious emissions (dBc)

Frequency range	Offset from carrier		
	<300 Hz	300 Hz to 1 kHz	>1 kHz
≥10 to ≤500 MHz (Option 4)	<–68	<–72	<–72
>500 to =1050 MHz (Option 4)	<–62	<–72	<–72
>1050 to ≤2200 MHz (Option 4)	<–56	<–66	<–66
≥0.01 to ≤8.4 GHz	<–50	<–60	<–60
>8.4 to ≤20 GHz	<–46	<–56	<–60
>20 to ≤40 GHz	<–40	<–50	<–54
>20 to ≤65 GHz	<–34	<–44	<–48

Residual FM (CW and Step Sweep modes, 50 Hz - 15 kHz BW)

Frequency range	Residual FM (Hz RMS) option 3,4	Standard
≥0.01 to ≤8.4 GHz	<40	<120
>8.4 to ≤20 GHz	<40	<220
>20 to ≤40 GHz	<80	<440
>40 to ≤65 GHz	<160	<880

Residual FM (Analog Sweep and Unlocked FM modes, 50 Hz - 15 kHz BW)

Frequency range	Residual FM (kHz RMS)	
	Unlocked Narrow FM mode	Unlocked Wide FM mode or Analog Sweep
>0.01 to <20 GHz	<5	<25
>20 GHz to <40 GHz	<10	<50
>40 GHz to <65 GHz	<20	<100

AM noise floor

Typically <–145 dBm/Hz at 0 dBm output and offsets >5 MHz from carrier.

Single-sideband phase noise

Single-sideband phase noise (dBc/Hz)

Frequency range	Offset from carrier			
	100 Hz	1 kHz	10 kHz	100 kHz
≥0.1 Hz to <10 MHz (Option 22)	–90	–120	–130	–130
≥10 MHz to <500 MHz (Option 4)	–94	–106	–104	–120
≥500 MHz to <2200 MHz (Option 4)	–82	–94	–92	–108
≥10 MHz to <2 GHz (Option 5)	–77	–88	–85	–100
≥2 GHz to ≤6 GHz	–77	–88	–86	–102
>6 GHz to ≤10 GHz	–73	–86	–83	–102
>10 GHz to ≤20 GHz	–66	–78	–77	–100
>20 GHz to ≤40 GHz	–60	–75	–72	–94
>40 GHz to ≤65 GHz	–54	–69	–64	–88

Single-sideband phase noise (dBc/Hz) – Option 3

Frequency range	Offset from carrier					
	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
≥0.1 Hz to <10 MHz (Option 22)	–60	–90	–120	–130	–130	–130
≥10 MHz to <15.625 MHz (Option 4)	–105	–126	–139	–142	–141	–145
15.625 MHz to ≤31.25 MHz (Option 4)	–99	–120	–134	–137	–137	–145
>31.25 MHz to ≤62.5 MHz (Option 4)	–90	–114	–129	–136	–136	–144
>62.5 MHz to ≤125 MHz (Option 4)	–84	–108	–127	–135	–133	–144
>125 MHz to ≤250 MHz (Option 4)	–88	–102	–125	–132	–130	–143
>250 MHz to ≤500 MHz (Option 4)	–77	–99	–123	–125	–124	–142
>500 MHz to ≤1050 MHz (Option 4)	–71	–93	–118	–121	–119	–138
>1050 MHz to ≤2200 MHz (Option 4)	–66	–86	–112	–115	–113	–135
≥10 MHz to <2 GHz (Option 5)	–64	–83	–100	–102	–102	–111
≥2 GHz to ≤6 GHz	–54	–87	–104	–108	–107	–130
>6 GHz to ≤10 GHz	–52	–73	–100	–107	–107	–128
>10 GHz to ≤20 GHz	–45	–68	–94	–102	–102	–125
>20 GHz to ≤40 GHz	–45	–63	–92	–98	–98	–119
>40 GHz to ≤65 GHz	–37	–57	–86	–92	–90	–113

RF output

Power level specifications apply at 25° ±10°C.

Maximum leveled output power

Model number	Configuration	Frequency range (GHz)	Output power (dBm)	Output power with step attenuator (dBm)	Output power with electronic step attenuator (dBm)
MG3691A	With option 4 With option 5 Standard	≤2.2 GHz ≤2 GHz >2 to ≤8.4 GHz	+17.0 +17.0 +13.0	+15.0 +15.0 +11.0	+13.0 +13.0 +9.0
MG3692A	With option 4 With option 5 Standard Standard	≤2.2 GHz ≤2 GHz >2 to ≤8.4 GHz >8.4 to ≤20 GHz	+17.0 +17.0 +13.0 +13.0	+15.0 +15.0 +11.0 +11.0	Not available
MG3693A	With option 4 With option 5 Standard Standard	≤2.2 GHz ≤2 GHz >2 to ≤20 GHz >20 to ≤30 GHz	+13.0 +13.0 +9.0 +6.0	+11.0 +11.0 +7.0 +3.0	Not available
MG3694A	With option 4 With option 5 Standard Standard	≤2.2 GHz ≤2 GHz >2 to ≤20 GHz >20 to ≤40 GHz	+13.0 +13.0 +9.0 +6.0	+11.0 +11.0 +7.0 +3.0	Not available
MG3695A	With option 4 With option 5 Standard Standard	≤2.2 GHz ≤2 GHz >2 to ≤20 GHz >20 to ≤50 GHz	+12.0 +12.0 +10.0 +3.0	+10.0 +10.0 +8.0 +0.0	Not available
MG3696A	With option 4 With option 5 Standard Standard	≤2.2 GHz ≤2 GHz >2 to ≤20 GHz >20 to ≤65 GHz	+12.0 +12.0 +10.0 +3.0	+10.0 +10.0 +8.0 +0.0	Not available

Maximum leveled output power with option 15 (high power) installed

Model number	Configuration	Frequency range (GHz)	Output power (dBm)	Output power with step attenuator (dBm)	Output power with electronic step attenuator (dBm)
MG3691A	With option 4 With option 5 Standard	≤2.2 GHz ≤2 GHz >2 to ≤8.4 GHz	+19.0 +19.0 +19.0	+18.0 +18.0 +18.0	+15.0 +15.0 +13.0
MG3692A	With option 4 With option 5 Standard Standard	≤2.2 GHz ≤2 GHz >10 to ≤10 GHz >20 to ≤20 GHz	+19.0 +19.0 +19.0 +17.0	+18.0 +18.0 +18.0 +15.0	Not available
MG3693A	With option 4 With option 5 Standard Standard Standard	≤2.2 GHz ≤2 GHz >2 to ≤10 GHz >10 to ≤20 GHz >20 to ≤30 GHz	+15.0 +15.0 +15.0 +12.0 +14.0	+14.0 +14.0 +14.0 +10.0 +12.0	Not available
MG3694A	With option 4 With option 5 Standard Standard Standard	≤2.2 GHz ≤2 GHz >2 to ≤10 GHz >10 to ≤20 GHz >20 to ≤40 GHz	+15.0 +15.0 +15.0 +12.0 +14.0	+14.0 +14.0 +14.0 +10.0 +12.0	Not available

Leveled output power range	Standard units	Without an attenuator	Maximum leveled output power to –15 dBm (–20 dBm typical)
		With an attenuator	Maximum leveled output power to –120 dBm
		With an electronic attenuator	Maximum leveled output power to –140 dBm
	Units with option 15, high power	Without an attenuator	Maximum leveled output power to –5 dBm (–10 dBm typical)
		With an attenuator	Maximum leveled power to –115 dBm (–120 dBm typical). For units with Option 15A, minimum settable power is –105 dBm (–110 dBm typical)
		With an electronic attenuator	Maximum leveled power to –115 dBm (–110 dBm typical)
Unleveled output power range (typical)		Without an attenuator	>40 dB below max power
		With an attenuator	>130 dB below max power
Power level switching time (to within specified accuracy)		Without change in step attenuator	<3ms typical
		With change in step attenuator	<20 ms typical
		With change in electronic step attenuator	<3 ms typical. Power level changes across –70 dB step will result in 20 ms delay

<table>
<tr><td rowspan="14">Accuracy and flatness</td><td colspan="7">Accuracy specifies the total worst case accuracy. Flatness is included within the accuracy</td></tr>
<tr><td rowspan="4">Step sweep and CW modes</td><td colspan="2" rowspan="2">Attenuation below max power</td><td colspan="4">Frequency (GHz)</td></tr>
<tr><td>≤40</td><td>40-50</td><td>50-60</td><td>60-65</td></tr>
<tr><td>Accuracy[*2]</td><td>0-25 dB
25-60 dB
>60 dB</td><td>±1.0 dB
±1.0 dB
±1.0 dB</td><td>±1.5 dB
±1.5 dB
±1.5 dB[*1]</td><td>±1.5 dB
±3.5 dB[*1]
±3.5 dB[*1]</td><td>±1.5 dB
N/A
N/A</td></tr>
<tr><td>Flatness[*2]</td><td>0-25 dB
25-60 dB
>60 dB</td><td>±0.8 dB
±0.8 dB
±0.8 dB</td><td>±0.8 dB
±0.8 dB
±0.8 dB[*1]</td><td>±1.1 dB
±3.1 dB[*1]
±3.1 dB[*1]</td><td>±1.1 dB
N/A
N/A</td></tr>
<tr><td rowspan="4">Analog sweep mode (typical)</td><td colspan="2" rowspan="2">Attenuation below max power</td><td colspan="4">Frequency (GHz)</td></tr>
<tr><td>0.01-0.05</td><td>0.05-20</td><td>20-40</td><td>40-65</td></tr>
<tr><td>Accuracy</td><td>0-12 dB
12-30 dB
30-60 dB
60-122 dB</td><td>±2.0 dB
±3.5 dB
±4.0 dB
±5.0 dB</td><td>±2.0 dB
±3.5 dB
±4.0 dB
±5.0 dB</td><td>±2.0 dB
±4.6 dB
±5.2 dB
±6.2 dB</td><td>±3.0 dB
±5.6 dB
±6.2 dB
±7.2 dB</td></tr>
<tr><td>Flatness</td><td>0-12 dB
12-30 dB
30-60 dB
60-122 dB</td><td>±2.0 dB
±3.5 dB
±4.0 dB
±5.0 dB</td><td>±2.0 dB
±3.5 dB
±4.0 dB
±5.0 dB</td><td>±2.0 dB
±4.1 dB
±4.6 dB
±5.2 dB</td><td>±2.5 dB
±5.1 dB
±5.6 dB
±6.2 dB</td></tr>
<tr><td rowspan="14">Other output power specifications</td><td colspan="3">Output units</td><td colspan="4">Output units selectable as either dBm or mV. Selection of mV assumes 50 Ω load. All data entry and display are in the selected units</td></tr>
<tr><td colspan="3">Output power resolution</td><td colspan="4">0.01 dB or 0.001 mV</td></tr>
<tr><td colspan="3">Source impedance</td><td colspan="4">50 Ω nominal</td></tr>
<tr><td colspan="3">Source SWR (internal leveling)</td><td colspan="4"><2.0 typical</td></tr>
<tr><td colspan="3">Power level stability with temperature</td><td colspan="4">0.04 dB/°C typical</td></tr>
<tr><td colspan="3">Level offset</td><td colspan="4">Offsets the displayed power level to establish a new reference level</td></tr>
<tr><td colspan="3">Output on/off</td><td colspan="4">Toggles the RF output between an off and on state. During the off state, the RF oscillator is turned off. The on or off state is indicated by two LEDs located below the OUTPUT ON/OFF key on the front panel</td></tr>
<tr><td colspan="3">RF on/off between frequency steps</td><td colspan="4">System menu selection of RF on or RF off during frequency switching in CW, step sweep, and list sweep modes</td></tr>
<tr><td colspan="3">RF on/off during retrace</td><td colspan="4">System menu selection of RF on or RF off during retrace</td></tr>
<tr><td colspan="3">Internal leveling</td><td colspan="4">Power is leveled at the output connector in all modes</td></tr>
<tr><td colspan="2" rowspan="4">External leveling</td><td>External detector</td><td colspan="4">Levels output power at a remote detector location. Accepts a positive or negative 0.5 mV to 500 mV input signal from the remote detector. EXT ALC ADJ adjusts the input signal range to an optimum value. BNC connector, front and rear panel</td></tr>
<tr><td>External power meter</td><td colspan="4">Levels output power at a remote power meter location. Accepts a ±1 V full scale input signal from the remote power meter. EXT ALC ADJ adjusts the input signal range to an optimum value. BNC connector, rear panel</td></tr>
<tr><td>External leveling bandwidth</td><td colspan="4">30 kHz typical in detector mode. 0.7 Hz typical in power meter mode</td></tr>
<tr><td>User level flatness correction</td><td colspan="4">Number of points: 2 to 801 points per table
Number of tables: 5 available
Entry modes: GPIB power meter or computed data</td></tr>
<tr><td rowspan="6">CW power sweep</td><td colspan="3">Range</td><td colspan="4">Sweeps between any two power levels at a single CW frequency</td></tr>
<tr><td colspan="3">Resolution</td><td colspan="4">0.01 dB/step (Log) or 0.001 mV (Linear)</td></tr>
<tr><td colspan="3">Accuracy</td><td colspan="4">Same as CW power accuracy</td></tr>
<tr><td colspan="3">Log/linear sweep</td><td colspan="4">Power sweep selectable as either log or linear. Log sweep is in dB; linear sweep is in mV</td></tr>
<tr><td colspan="3">Step size</td><td colspan="4">User-controlled, 0.01 dB (Log) or 0.001 mV (Linear) to the full power range of the instrument</td></tr>
<tr><td colspan="3">Step dwell time</td><td colspan="4">Variable from 1 ms to 99 seconds. If the sweep crosses a step attenuator setting, there will be a sweep dwell of approximately 20 ms to allow setting of the step attenuator</td></tr>
<tr><td>Sweep frequency/ step power</td><td colspan="7">A power level step occurs after each frequency sweep. Power level remains constant for the length of time required to complete each sweep</td></tr>
</table>

*1: Typical
*2: 0 to 25 dB or to minimum rated power whichever is higher.

Frequency/Phase Modulation (Option 12)

Option 12 adds frequency and phase modulation, driven externally via a rear panel BNC connector, 50Ω. For internal modulation, add LF Generator Option 23. Frequency/Phase Modulation is not available <10 MHz with Option 22.

FM Sensitivity: Continuously variable from ±10 kHz per volt to ±20 MHz per volt (Locked, Locked Low Noise and Unlocked Narrow FM modes), or ±100 kHz per volt to ±100 MHz per volt (Unlocked Wide FM mode), selectable from modulation menu.

ΦM Sensitivity: Continuously variable from ±0.0025 radians per volt to ±5.0 radians per volt (Narrow ΦM mode) or ±0.25 radians per volt to ±500.0 radians per volt (Wide ΦM mode), selectable from modulation menu.

Maximum Input: ±1V

Frequency Generator Multiplication/Division Ratios	Frequency Range	Divide Ratio, n
	<10 MHz (Option 22)	modulation not available
	≥10 to ≤15.625 MHz (Option 4)	256
	>15.625 to ≤31.25 MHz (Option 4)	128
	>31.25 to ≤62.5 MHz (Option 4)	64
	>62.5 to ≤125 MHz (Option 4)	32
	>125 to ≤250 MHz (Option 4)	16
	>250 to ≤500 MHz (Option 4)	8
	>500 to ≤1050 MHz (Option 4)	4
	>1050 to ≤2200 MHz (Option 4)	2
	>10 to ≤2000 MHz (Option 5)	1
	>2 to ≤20 GHz	1
	>20 to ≤40 GHz	1/2
	>40 to ≤65 GHz	1/4

	Parameter	Modes	Conditions	Specifications
Frequency Modulation	Deviation	Locked Locked Low-noise Unlocked Narrow Unlocked Wide	Rate= 1 kHz to (Lesser of 8 MHz or 0.03 * Fcarrier) Rate= 50 kHz to Lesser of 8 MHz or 0.03 * Fcarrier) Rate= DC to (Lesser of 8 MHz or 0.03 * Fcarrier) Rate= DC to 100 Hz	±[Lesser of 10 MHz or 300 * (mod rate)]/n ±[Lesser of 10 MHz or 3 * (mod rate)]/n ±(10 MHz)/n ±(100 MHz)/n
	Bandwidth (3 dB)	Locked Locked Low-noise Unlocked Narrow Unlocked Wide	100 kHz rate 100 kHz rate 100 kHz rate DC rate	1 kHz to (Lesser of 10 MHz or 0.03 * Fcarrier) 30 kHz to (Lesser of 10 MHz or 0.03 * Fcarrier) DC to (Lesser of 10 MHz or 0.03 * Fcarrier) DC to 100 Hz
	Flatness	Locked	Rate= 10 kHz to (Lesser of 1 MHz or 0.01 * Fcarrier)	±1 dB relative to 100 kHz
	Accuracy	Locked and Low-noise Unlocked Narrow	Rate= 100 kHz, Sinewave, Int. or 1Vpk Ext.	10% (5% typical)
	Incidental AM	Locked, Low-noise, Unlocked Narrow	Rate and Dev.= Lesser of 1 MHz or 0.01 * Fcarrier	<2% typical
	Harmonic Distortion	Locked	Rate= 10 kHz, Dev.= ±(1 MHz)/n	<1%
	External Sensitivity	Locked Locked Low-noise Unlocked Narrow Unlocked Wide		±(10 kHz/V to 20 MHz/V)/n ±(100 kHz/V to 100 MHz/V)/n
Phase Modulation	Deviation	Narrow Wide	Rate= DC to (Lesser of 8 MHz or 0.03 * Fcarrier) Rate= DC to (Lesser of 1 MHz or 0.03 * Fcarrier)	±[Lesser of 3 rad or (5 MHz)/(mod rate)]/n ±[Lesser of 400 rad or (10 MHz)/(mod rate)]/n
	Bandwidth (3 dB)	Narrow Wide	100 kHz rate 100 kHz rate	DC to (Lesser of 10 MHz or 0.03 * Fcarrier) DC to (Lesser of 1 MHz or 0.03 * Fcarrier)
	Flatness	Narrow Wide	Rate= DC to (Lesser of 1 MHz or 0.01 * Fcarrier) Rate= DC to (Lesser of 500 kHz or 0.01 * Fcarrier)	±1 dB relative to 100 kHz rate ±1 dB relative to 100 kHz rate
	Accuracy	Narrow and Wide	100 kHz, Int. or 1Vpk Ext., sine	10%
	External Sensitivity	Narrow Wide		±(0.0025 rad/V to 5 rad/V)/m ±(0.25 rad/V to 500 rad/V)/n

Amplitude Modulation (Option 14)

All amplitude modulation specifications apply at 50% depth, 1 kHz rate, with RF level set 6 dB below maximum specified leveled output power, unless otherwise noted. Amplitude Modulation is not available <10 MHz with Option 22.

AM Depth (typical)	0-90% linear; 20 dB log	
AM Bandwidth (3 dB)	DC to 50 kHz minimum DC to 100 kHz typical	
Flatness (DC to 10 kHz rates)	±0.3 dB	
Accuracy	±5%	
Distortion	<5% typical	
Incidental Phase Modulation (30% depth, 10 kHz rate)	<0.2 radians typical	
External AM Input	Log AM or Linear AM input, rear-panel BNC, 50 Ω input impedance. For internal modulation, add LF Generator Option 23.	
	Sensitivity	Log AM: Continuously variable from 0 dB per volt to 25 dB per volt.
		Linear AM: Continuously variable from 0% per volt to 100% per volt.
	Maximum Input	±1V

LF Generator (Option 23)

Two internal waveform generators are added, one providing a frequency or phase modulating signal and the other an amplitude modulating signal. This Low Frequency (LF) Generator option can only be ordered in combination with either FM/ΦM or AM options, 12 and 14 respectively.

Waveforms	Sinusoid, square-wave, triangle, positive ramp, negative ramp, Gaussian noise, uniform noise. (Check Option 10 for User-Defined)
Rate	0.1 Hz to 1 MHz sinusoidal 0.1 Hz to 100 kHz square-wave, triangle, ramps
Resolution	0.1 Hz
Accuracy	Same as instrument timebase
Output	Two BNC connectors on the rear panel, FM/ΦM OUT and AM OUT

External Pulse Modulation (Option 13)

Pulse modulation specifications apply at maximum rated power, unless otherwise noted. Pulse modulation is not available <10 MHz with Option 22.

On/Off Ratio	>80 dB			
Minimum Leveled Pulse Width	100 ns, ≥2 GHz[*1] 1µs, <2 GHz[1]			
Minimum Unleveled Pulse Width	<10 ns			
Level Accuracy Relative to CW (100 Hz to 1 MHz PRF)	±0.5 dB, ≥1 µs pulse width ±1.0 dB, <1 µs pulse width			
Pulse Delay (typical)	External Mode: 50 ns			
PRF Range	DC to 10 MHz, unleveled 100 Hz to 5 MHz, leveled			
Frequency Range	Rise & Fall Time (10% to 90%)	Overshoot	Pulse Width Compression	Video Feedthrough
≥10 to <31.25 MHz (Opt. 4)	400 ns*	33%*	40 ns*	±70 mV*
≥31.25 to <125 MHz (Opt. 4)	90 ns*	22%*	12 ns*	±130 mV*
≥125 to <500 MHz (Opt. 4)	33 ns*	11%*	12 ns*	±70 mV*
≥500 to <2200 MHz (Opt. 4	15 ns	10%*	12 ns*	±15 mV*
≥10 to <1000 MHz (Opt. 5)	15 ns / 10 ns*	10%*	8 ns*	±15 mV*
≥1 to <2 GHz (Opt. 5)	10 ns / 5 ns*	10%*	8 ns*	±15 mV*
≥2 to ≤65 GHz	10 ns / 5 ns*	10%[*2]	8 ns*	
External Input	Rear-panel BNC. For internal modulation, add Pulse Generator Option 24.			
	Drive Level	TTL compatible input		
	Input Logic	Positive-true or negative-true, selectable from modulation menu.		

Pulse Generator (Option 24)

Pulse Generator option is not available without Pulse Modulation Option 13.

Modes	Free-run, triggered, gated, delayed, singlet, doublet, triplet, quadruplet.	
Parameter	Selectable Clock Rate	
	40 MHz	10 MHz
Pulse Width	25 ns to 419 ms	100 ns to 1.6
Pulse Period[*3]	250 ns to 419 ms	600 ns to 1.6s
Variable Delay Singlet Doublet Triplet Quadruplet	0 to 419 ms 100 ns to 419 ms 100 ns to 419 ms 100 ns to 419 ms	0 to 1.6s 300 ns to 1.6s 300 ns to 1.6s 300 ns to 1.6s
Resolution	25 ns	100 ns
Accuracy	10 ns (5 ns typical)	
Inputs/Outputs	Inputs/Outputs: Video pulse and sync out, rear-panel BNC connectors	

*1: 2.2 GHz with Option 4, DDC.
*2: For 50 and 65 GHz units, overshoot >40 GHz is 20% typical at rated power.
*3: Period must be longer than the sum of delay and width by 5 clock cycles minimum.

* Typical

Millimeter Wave Multipliers (54000 Series plus Option 18)

External multipliers can be added to the MG3690A to provide coverage as high as 110 GHz. Please call us for solutions beyond 110 GHz.

Parameter	54000-4WR15, 54000-5WR15	54000-4WR10, 54000-5WR10
Frequency	50-75 GHz	75-110 GHz
Waveguide Output	WR15	WR10
Flange	UG-387/U	UG-385/U
Source Match	<1.7 typical	<1.7 typical
Output Power	0.0 dBm (+4 dBm typical)	–5 dBm (+1 dBm typical)
Power Flatness, Unleveled	±3.0 dB typical	±3.0 dB typical
Power Flatness, Leveled (54000-5WRxx)	±1.0 dB typical	±1.0 dB typical
Power Leveling Range (54000-5WRxx)	10 dB typical	10 dB typical
Required Input Frequency	12.75 to 18.75 GHz	12.75 to 18.75 GHz
Multiplication Factor	x4	x6
Frequency Accuracy	Synthesizer Accuracy x4	Synthesizer Accuracy x6
Frequency Resolution	Synthesizer Resolution x4	Synthesizer Resolution x6
Filters		
FL1 (Through)	50 to 75 GHz	75 to 110 GHz
FL2	50 to 58 GHz	75 to 92 GHz
FL3	57 to 75 GHz	89 to 110 GHz
Spurious		
with FL2, FL3	–50 dBc	–50 dBc
with FL1 (Through)	–20 dBc typical	–20 dBc typical
Input	N(f)	N(f)

Inputs and Outputs

EXT ALC IN	Provides for leveling the RF output signal externally with either a detector or power meter. Signal requirements are shown in the RF Output specifications.
RF OUTPUT	Provides for RF output from 50 Ω source impedance. K Connector, female. Option 9 moves the RF Output connector to the rear panel.
10 MHz REF IN	Accepts an external 10 MHz ±100 Hz, 0 to +20 dBm time-base signal. Automatically disconnects the internal high-stability time-base option, if installed. 50 Ω impedance.
10 MHz REF OUT	Provides a 0.5 Vp-p, AC coupled, 10 MHz signal derived from the internal frequency standard. 50 Ω impedance.
HORIZ OUT (Horizontal Sweep Output)	Provides 0V at beginning and +10V at end of sweep, regardless of sweep width. In CW mode, the voltage is proportional to frequency between 0V at low end and +10V at the high end of range. In CW mode, if CW RAMP is enabled, a repetitive, 0V to +10V ramp is provided.
EFC IN:	Provides the capability to frequency modulate the internal crystal oscillator, allowing phase locking the synthesizer inside an external lock loop.
AUX I/O (Auxiliary Input/Output)	Provides for most of the rear panel BNC connections through a single, 25-pin, D type connector. Supports master-slave operation with another synthesizer or allows for a single-cable interface with the Model 56100A Scalar Network Analyzer and other Anritsu instruments.
SERIAL I/O (Serial Input/Output)	Provides access to RS-232 terminal ports to support service and calibration functions and master slave operations.
IEEE-488 GPIB	Provides input/output connections for the General Purpose Interface Bus (GPIB).
mmW BIAS	Provides the bias for the external waveguide multipliers for coverage up to 110 GHz.
RF, LO, IF	Provides access to an internal IF up-conversion mixer, Option 7.
PULSE TRIG IN	Accepts an external TTL compatible signal to pulse modulate the RF output signal or to trigger or to gate the optional internal pulse generator. Available with Option 13, Pulse Modulation.
PULSE SYNC OUT	Provides a TTL compatible signal, synchronized to the internal pulse modulation output, Option 24.
PULSE VIDEO OUT	Provides a video modulating signal from the internal pulse generator, Option 24.
AM IN	Accepts an external signal to amplitude modulate the RF output signal, Option 14. 50 Ω impedance
FM/ΦM IN	Accepts an external signal to frequency or phase modulate the RF output signal, Option 12. 50 Ω impedance
AM OUT	Provides the amplitude modulation waveform from the internal LF generator, Option 23.
FM/ΦM OUT	Provides the frequency or phase modulation waveform from the internal LF generator, Option 23.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Models
MG3691A	2 – 8.4 GHz CW Generator
MG3692A	2 – 20 GHz CW Generator
MG3693A	2 – 30 GHz CW Generator
MG3694A	2 – 40 GHz CW Generator
MG3695A	2 – 50 GHz CW Generator
MG3696A	2 – 65 GHz CW Generator
	Options and accessories
MG3690A/1A	Rack Mount with slides – Rack mount kit containing a set of track slides (90 degree tilt capability), mounting ears, and front panel handles to let the instrument be mounted in a standard 19-inch equipment rack.
MG3690A/1B	Rack Mount without slides – Modifies rack mounting hardware to install unit in a console that has mounting shelves. Includes mounting ears and front panel handles.
MG3690A/2X	Mechanical Step Attenuator – Adds a 10 dB/step attenuator. Rated RF output power is reduced. (This option comes in different versions, based on instrument configuration.)
MG3690A/2E	Electronic Step Attenuator – Adds a 10 dB/step electronic attenuator with a 120 dB range for the MG3691A. Rated RF output power is reduced.
MG3690A/3	Ultra Low Phase Noise, main band – Adds new modules to significantly reduce SSB phase noise.
MG3690A/4	10 MHz to 2.2 GHz RF coverage, Ultra-Low Phase Noise version – Uses a digital down converter to significantly reduce SSB phase noise.
MG3690A/5	10 MHz to 2 GHz RF coverage – Uses an analog down converter.
MG3690A/6	Analog Sweep Capability (limited to •500 MHz when used with Option 4)
MG3690A/7	IF Up-Conversion – Adds an internal 40 GHz mixer for up-converting an IF signal. (Not available with MG3695A, MG3696A, or with Option 18)
MG3690A/9X	Rear Panel Output – Moves the RF output connector to the rear panel. (This option comes in different versions, based on instrument configuration.)
MG3690A/10	User-Defined Modulation Waveform Software – External software package provides the ability to download user-defined waveforms into the memory of the internal waveform generator, serially or via GPIB. External PC and an instrument with LF Generator, Option 23, are required. This external software package can only be used with Option 10 enabled instruments.
MG3690A/12	Frequency and Phase Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally LF Generator, Option 23.
MG3690A/13X	Pulse Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally Pulse Generator, Option 24. (This option comes in different versions, based on instrument configuration.)
MG3690A/14	Amplitude Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally LF Generator, Option 23.
MG3690A/15X	High Power – Adds high-power RF components to the instrument to increase its output power level. (This option comes in different versions, based on instrument configuration.)

Model/Order No.	Name
MG3690A/16	High Stability Time Base – Adds an ovenized, 10 MHz crystal oscillator as a high-stability time base.
MG3690A/17	Delete Front Panel – Deletes the front panel for use in remote control applications where a front panel display and keyboard control are not needed.
MG3690A/18	mmW Bias Output – Adds a rear panel BNC Twinax connector required to bias the 5400-xWRxx millimeter wave source modules, sold separately (Not available with Option 7).
MG3690A/22	0.1 Hz to 10 MHz Audio coverage – Uses a DDS for coverage down to approximately DC. When adding Option 22, the output power is derated by 2 dB. The frequency resolution below 10 MHz is 0.02 Hz. No modulation is available in the 0.1 Hz to 10 MHz band (Not available without Option 4 or 5).
MG3690A/23	LF Generator – Provides modulation waveforms for internal AM, FM, or ΦM (Not available without Option 12 or 14).
MG3690A/24	Pulse Generator – Provides pulse waveforms for internal Pulse Modulation (Not available without Option 13).
MG3690A/25X	Analog Modulation Suite – For ease of ordering and package pricing, this option bundles Options 12, 13, 14, 23 and 24, offering internal and external AM, FM, ΦM, and Pulse Modulation. (This option comes in different versions, based on instrument configuration.)
	Accessories
34RKNF50	DC to 20 GHz, Ruggedized Type N female adapter for units with a K connector output
ND36329	Master/Slave interface cable set
760-212A	Transit case
2300-469	IVI Driver, includes LabView® driver
806-97	Aux I/O cable, 25 pin to BNC: Provides BNC access to V/GHz and Sequential Sync connections and other AUX I/O data lines
	Millimeter wave accessories (requires MG3690A/18)
54000-4WR15	50 to 75 GHz, V band X4 multiplier-source module, (includes A36599 power cable and 3 filters).
54000-5WR15	50 to 75 GHz, V band X4 multiplier-Ssource module with internal reference coupler/detector (includes A36599 power cable, 3 filters, and 560-10BX-2 detector adapter cable).
54000-4WR10	75-110 GHz, W band X6 multiplier-source module (includes A36599 power cable and 3 filters).
54000-5WR10	75-110 GHz, W band X6 multiplier-source module with internal reference coupler/detector (includes A36599 power cable, 3 filters, and 560-10BX-2 detector adapter cable).
N120-6	Semi-rigid cable, N(m) to N(m), 15 cm long, connects synthesizer's RF output to multiplier's RF input. (Also requires 34RKNF50 or 34RVNF50 Adapter).
	Upgrades Economical upgrades are available to upgrade any model to any higher performing model. Consult Anritsu for details.

SYNTHESIZER/LEVEL GENERATOR
MG443B
10 Hz to 30 MHz

For Frequency Tracking with ML422C

GPIB

The MG443B is carefully designed. Its output level is highly stable, so it can be used for applications within the telecommunications industry without the need for a separate standard level meter.

Features
- Wide frequency range with 1 Hz resolution
- As many as 20 panel settings can be memorized; memory sweep capability
- High output level characteristics
  Flatness: ±0.07 dB (0˚ to +50˚C)
  Level accuracy: ±0.15 dB (0˚ to +50˚C)
- High precision output level setting of 0.01 dB
- Continuous output level variable within approximately 4.5 dB
- Variety of output impedances
  Unbalanced: 50, 75 Ω
  Balanced: 75, 135, 150, 600 Ω

SYNTHESIZED LEVEL GENERATOR
MG442A
10 Hz to 20 MHz

Compact and Lightweight

The MG442A is a compactly designed level generator with excellent stability and accuracy in frequency and output level. Because it is a synthesized level generator, its output frequency is highly stable. It has an excellent output level accuracy and a superb frequency response unrivaled by similar level generators.

The MG442A can be used for many applications as a measurement signal source where high frequency stability and level accuracy are required.The MG442A is best suited for use as a signal source for measuring baseband circuits from audio to video and various types of communications systems.

With its ease of operation and excellent portability, it can be utilized for many purposes as a fundamental measuring instrument in laboratories and manufacturing plants.

Features
- Universal output impedance
- Excellent operation: Digital frequency setting with 4 digits and output level with 3 digits
- Compact and lightweight

RF MICROWAVE MEASURING INSTRUMENTS

MICROWAVE FREQUENCY COUNTER

MF2400B Series

10 Hz to 20/27/40 GHz

GPIB

For Measuring CW Frequency and Pulse Width of Burst Signals

The MF2400B series consists of three frequency counters: the MF2412B (20 GHz), the MF2413B (27 GHz), and the MF2414B (40 GHz). They are ideal for evaluating mobile radio communications devices and circuits, with the ability to measure the carrier frequency and pulse width of burst signals. In addition to displaying measurement results on a 12-digit LCD, the frequency values can be read using the analog display function, which is ideal for monitoring evaluation and especially for frequency adjustment, etc., as in the case of various types of oscillators.
Furthermore, the template function is useful for assessing quickly whether or not the measurement results fall within the upper and lower frequency limit specifications; the evaluation result is output from the AUX connector on the rear panel as a Go/No-go signal. An easy-to-use automatic measurement system can be configured using the GPIB function.

Features

- Measures carrier frequency and pulse width of burst signals
- Analog frequency display
- Pass/Fail evaluation for frequency range specified by template function
- Measurement of any burst section using gating function

Functions

• Wide band measurement
The three counters, with upper frequency limits of 20, 27 and 40 GHz, meet every usage requirement. In addition, a high-frequency fuse holder and fuse element protects the input circuit from excessively powerful signals, and a variety of adapters are available for coupling each connector.

• High-accuracy burst measurement
The carrier frequency, burst width, and burst repetition rate of a 100 ns to 0.1 s burst signal input from INPUT 1 can be measured quickly with high accuracy.

• Save and recall functions added
Up to a maximum of 10 setups can be stored in the internal memory, and these can be freely recalled. Storing complex setups in advance, such as burst triggers and gate settings, makes it possible to recall them immediately when needed for measurement, which makes it possible to reduce the measurement setup time and to prevent malfunctions from setup mistakes.

• Analog display function
Using this function, the entire LCD becomes an analog meter and the measured values are indicated by the position of the meter needle. In addition to measuring changes in the frequency, this permits faster frequency adjustment and Go/No-go judgement of oscillators, which had to be read many digits of measured data before. This analog meter also solves problems associated with misreading frequency values.

Moves left/right and indicates frequency value

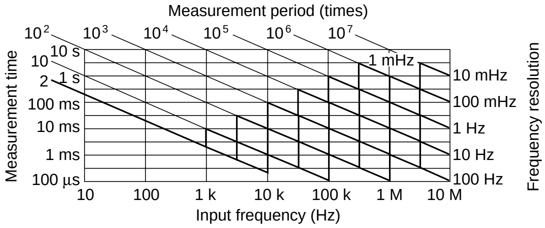
• Template function
After the upper and lower frequency limits have been preset, if the measured frequency is within the preset range, Go is displayed; if it is out of range, No-go is displayed. In addition, the Go/No-go signal can be output from the AUX connector on the back panel as a TTL signal. This is very useful for configuring an automatic device Pass/Fail evaluation system (using analog display).

• High-speed transient measurement
Frequency counters have an interval when measurement is not performed (sample rate), so that sudden frequency changes during this period cannot be measured. However, the MF2400B series overcomes this problem by capturing frequency changes at speeds of up to 10 µs and saving a maximum of 2000 sampling points. When it is combined with a host computer, frequency changes can be displayed graphically. This is very effective for measuring VCO start-up characteristics and PLL lock times.

• Gating function
With burst signal measurements, the carrier frequency may be different at the start, middle, and end of the burst. In the MF2400B series, the carrier signal frequency at any position of the signal (delay time from trigger signal leading edge) and at any specified time (gate time) can be measured using a combination of the gating and trigger delay functions.

Specifications

• MF2400B series

<table>
<tr><td rowspan="4">Input</td><td>Frequency range</td><td>INPUT 1
MF2412B: 600 MHz to 20 GHz, MF2413B: 600 MHz to 27 GHz, MF2414B: 600 MHz to 40 GHz
INPUT 2
10 MHz to 1 GHz (50 Ω), 10 Hz to 10 MHz (1 MΩ)</td></tr>
<tr><td>Input level range (sine wave input)</td><td>INPUT 1
–33 to +10 dBm (<12.4 GHz), –28 to +10 dBm (<20 GHz),
–25 to +10 dBm (<27 GHz), [–44.6 + 0.741 x frequency (GHz)] to +10 dBm (≤40 GHz)
INPUT 2
25 mVrms to 2 Vrms (50 Ω), 25 mVrms to 10 Vrms (1 MΩ)</td></tr>
<tr><td>Impedance, coupling</td><td>INPUT 1: 50 Ω, AC couple
INPUT 2: 50 Ω or ≥1 MΩ (≤35 pF), AC couple</td></tr>
<tr><td>Connector</td><td>INPUT 1
MF2412B: N-type, MF2413B: SMA-type, MF2414B: K-type
INPUT 2: BNC-type</td></tr>
<tr><td rowspan="3">Gating function</td><td>Trigger mode</td><td>INT: Triggered by measurement signal
EXT: Triggered by external signal
∗Trigger level: 1.5 V ± (2 to 10 Vp-p), Trigger pulse width: ≥1 µs, Impedance: ≥100 Ω, Coupling: DC
LINE: Triggered by AC line signal</td></tr>
<tr><td>Trigger delay</td><td>20 ns to 0.1 s[*1], off
(≤320 ns in 20 ns steps, and <1 µs in 40 ns steps variable; ≥1 µs in continuously variable as effective two digits)</td></tr>
<tr><td>Gate width</td><td>100 ns to 0.1 s (<1 µs in 20 ns steps variable; ≥1 µs in continuously variable as effective two digits</td></tr>
<tr><td rowspan="6">Pulse modulation wave measurement</td><td>Frequency range</td><td>MF2412B: 600 MHz to 20 GHz, MF2413B: 600 MHz to 27 GHz, MF2414B: 600 MHz to 40 GHz</td></tr>
<tr><td>Pulse width</td><td>100 ns to 0.1 s (NARROW), 1 µs to 0.1 s (WIDE)</td></tr>
<tr><td>Pulse repetition frequency</td><td>10 Hz to 4 MHz (pulse off time: ≥240 ns)</td></tr>
<tr><td>Carrier frequency measurement[*2]</td><td>Max. resolution: 10 kHz (pulse width: 100 ns to 1 µs), 1 kHz (pulse width: 1 to 10 µs), 100 Hz (pulse width: 10 to 100 µs),
10 Hz (pulse width: 0.1 to 1 ms), 1 Hz (pulse width: 1 to 10 ms), 0.1 Hz (pulse width: 10 to 100 ms)
Measurement time: (T or T_S whichever is greater) x $\{1/(f_R \text{ x } TGW)\}^2$ [*3]
<table>
<tr><td>Resolution</td><td>1 Hz</td><td>10 Hz</td><td>100 Hz</td><td>1 kHz</td><td>10 kHz</td><td>100 kHz</td><td>1 MHz</td></tr>
<tr><td>Measurement time</td><td>200 s</td><td>20 s</td><td>2 s</td><td>200 ms</td><td>20 ms</td><td>5 ms</td><td>5 ms</td></tr>
</table>
∗Measurement carrier frequency: 1 GHz (TGW[*3] = $0.1/f_R$)
Accuracy: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy ±residual error[*5]
±1/TGW[*3]</td></tr>
<tr><td>Pulse width measurement</td><td>Resolution: 1 ns
Accuracy: ±20 ns ±time base accuracy x measurement pulse width ±trigger accuracy
Unit indication: µs (fixed)</td></tr>
<tr><td>Pulse period measurement</td><td>Resolution: 1 ns
Accuracy: ±20 ns ±time base accuracy x measurement period ±trigger accuracy
Unit indication: µs (fixed)</td></tr>
<tr><td rowspan="2">Carrier wave frequency measurement</td><td>Resolution, gate time</td><td>INPUT 1
NORMAL: 1 MHz/1 µs to 0.1 Hz/10 s
FAST: 1 MHz/0.18 µs to 0.1 Hz/1.8 s (typical)
INPUT 2
10 MHz to 1 GHz (50 Ω): 1 MHz/1 µs to 0.1 Hz/10 s
10 Hz to 10 MHz (1 MΩ): Shown below

</td></tr>
<tr><td>Measurement accuracy</td><td>INPUT 1
NORMAL: ±1 count ±time base accuracy x measurement frequency ±residual error[*4]
FAST: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy ±residual error[*5]
INPUT 2
10 MHz to 1 GHz: ±1 count ±time base accuracy x measurement frequency
10 Hz to 10 MHz: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy</td></tr>
<tr><td colspan="2">Auto/manual measurement</td><td>Auto
FM tolerance: 35 MHzp-p, Acquisition time: ≤50 ms
Manual (CW measurement)
Input allowable frequency range: ±30 MHz (600 MHz to 1 GHz), ±40 MHz (≥1 GHz)
Acquisition time: ≤15 ms
Manual (Burst measurement)
Input allowable frequency range:
±30 MHz (600 MHz to 1 GHz, pulse width mode: WIDE), ±20 MHz (≥1 GHz, pulse width mode: NARROW),
±40 MHz (≥1 GHz, pulse width mode: WIDE)
Acquisition time: ≤15 ms</td></tr>
</table>

Continued on next page

Functions	Template: Inputs in upper/lower limit of frequency, judged on GO/NO-GO Frequency offset: +offset, –offset, ppm Statistical processing: mean, maximum, minimum, p-p Save/recall: 10 panel settings (Max.)
AUX output	Output for GO/NO-GO, count end, input level detection, internal gating, restart, and acquisition signal
Sample rate	1 ms to 10 s (1-2-5 steps), hold
High-speed sample period/ frequency resolution	INPUT 1: 10 µs/10 kHz, 100 µs/1 kHz, 1 ms/100 Hz INPUT 2: 10 µs/100 kHz, 100 µs/10 kHz, 1 ms/1 kHz *Measurement frequency: 100 MHz
Memory back up	Store in non-volatile memory at instrument power-down
Display	Display digits: 12 digits and 1 digit (– mark) LCD: 248 x 60 dots (with back light)
Reference crystal oscillator	Frequency: 10 MHz Warm-up: ≤±5 x 10^{-8}/day (after 30 min. warm-up) Aging rate: ≤±2 x 10^{-8}/day (after 24 h warm-up) Temperature characteristics: ±5 x 10^{-8} (0˚ to 50 ˚C)
External reference input	1/2/5/10 MHz, Input voltage: 1 to 5 Vp-p (AC coupling), Input impedance: ≥1 kΩ
External reference output	1/2/5/10 MHz[*6], Output voltage: ≥2 Vp-p (open end, AC coupling), Output impedance: ≤400 Ω
External control	GPIB (conforms to IEEE488.2 standards): SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Power	85 to 132/170 to 250 V (auto switch), 47.5 to 63 Hz, ≤80 VA
Operating temperature	0˚ to 50 ˚C
Dimensions and mass	213 (W) x 88 (H) x 350 (D) mm, ≤5 kg
EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class D) EN61326: 1997/A1: 1998 (Annex A)
LVD	EN610101-1: 1993/A2, 1995 (Installation Category II, Pollution degree 2)

*1: Delay time until counter started by trigger detection
*2: MANUAL measurement mode
*3: f_R; frequency resolution, TGW; gate width, Ts; processing time (50 µs), T; period ($2/f_R$)
*4: Measurement frequency (GHz)/10 count (rms)
*5: Measurement frequency (GHz)/2 count (rms)
*6: 10 MHz when using internal reference signal; outputs signal based on this signal (1/2/5/10 MHz) when using external reference signal

- **Options 01/02/03: Crystal oscillator**

Option number	01	02	03
Frequency	10 MHz		
Aging rate	5 x 10^{-9}/day, 5 x 10^{-8}/month, 7.5 x 10^{-8}/year *After power on, with reference to frequency after 24 h	2 x 10^{-9}/day, 3 x 10^{-8}/month, 4.5 x 10^{-8}/year *After power on, with reference to frequency after 24 h	5 x 10^{-10}/day, 1 x 10^{-8}/month, 1.5 x 10^{-8}/year *After power on, with reference to frequency after 48 h
Temperature characteristics	±5 x 10^{-8}	±1.5 x 10^{-8}	±5 x 10^{-9}
	–10˚ to 60˚C (with reference to 25˚C)		

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Main frame	
MF2412B	Microwave Frequency Counter	
MF2413B	Microwave Frequency Counter	
MF2414B	Microwave Frequency Counter	
	Standard accessories	
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A:	2 pcs
W1520AE	MF2412B/2413B/2414B operation manual:	1 copy
	Options	
MF2412B-01	Crystal oscillator (5 x 10^{-9}/day)	
MF2413B-01	Crystal oscillator (5 x 10^{-9}/day)	
MF2414B-01	Crystal oscillator (5 x 10^{-9}/day)	
MF2412B-02	Crystal oscillator (2 x 10^{-9}/day)	
MF2413B-02	Crystal oscillator (2 x 10^{-9}/day)	
MF2414B-02	Crystal oscillator (2 x 10^{-9}/day)	
MF2412B-03	Crystal oscillator (5 x 10^{-10}/day)	
MF2413B-03	Crystal oscillator (5 x 10^{-10}/day)	
MF2414B-03	Crystal oscillator (5 x 10^{-10}/day)	

Model/order No.	Name
	Optional accessories
K224B[*1]	Coaxial adapter (K-P · K-J, SMA compatible, DC to 40 GHz, SWR: 1.2)
34RKNF50	Coaxial adapter (ruggedized K-P · N-J, DC to 20 GHz, SWR: 1.25)
J0060	Coaxial adapter (N-J · SMA-P)
J0526	Coaxial adapter (N-J · SMA-J)
J0527	Coaxial cord (K-P · K-P), 2 ft
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0853	Coaxial cord (N-P · SF104P · N-P), 2 m
J0854	Coaxial cord (APC3.5-P · SF104P · APC3.5-P), 2 m
MP612A[*2]	Fuse Holder (N-P · N-J, DC to 1 GHz)
MP613A[*2]	Fuse Element (DC to 1 GHz, Power rating: +17 dBm, Blow rating: ≥+35 dBm)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0426A	Carrying bag (soft type)
B0409	Carrying case (with B0329L protection cover)
B0329L	Protection cover
B0390G	Rack mount kit (19 inch type, one unit)
B0411A	Rack mount kit (19 inch type, two units, side by side)
ERV713-H	Portable power supply (Matsushita product)

*1: The K224 adapter is used to prevent damage to the input connector.
*2: The MF2400B series has the MP612A Fuse Holder (with MP613A Fuse Element) to prevent input of excessive power. In addition, the MP612A Fuse Holder has an N-type connector, so an adapter is required according to the coupled connector type.

WIDEBAND PEAK POWER METERS

ML2480A Series

10 MHz to 50 GHz*

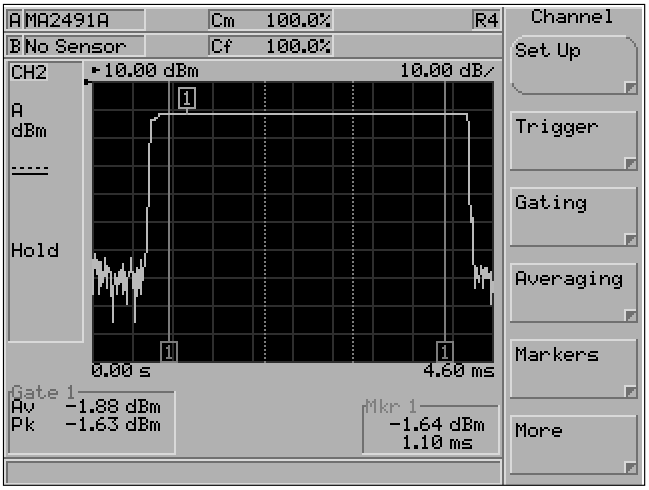
GPIB

For High Speed Modulated and Pulsed Power Measurements

NEW

The ML2480A series Power Meters are especially designed for accurate power measurements on high speed modulated measurements. The power meter combines advances in diode sensor technology with DSP to produce a compact and economical high speed peak power meter. A new color display is used to display the results in graphical or numerical format. The power meter incorporates features normally found in digital oscilloscopes to produce an easy to use high speed peak power meter. A high speed GPIB interface can be used for the rapid automation of the power measurement.

The ML2480A series have been designed to use the new MA2491A Wideband Sensor. The ML2480A is fully compatible with the wide range of Anritsu diode, fast thermal and universal sensors. See the section on the ML2430A Series Power Meters for more details on these sensors. Two versions of the product are available; the ML2487A Single Input unit and the ML2488A Dual Input unit.



```
A MA2491A      Cm   100.0%     R4
B No Sensor    Cf   100.0%
CH2  ▸10.00 dBm           10.00 dB/
A
dBm
Hold
     0.00 s                4.60 ms
Gate 1
Av   -1.88 dBm          Mkr 1
Pk   -1.63 dBm           -1.64 dBm
                          1.10 ms
```

Performance

The ML2480A has a 20 MHz signal amplifier bandwidth and a sampling rate of 64 MS/s. This makes the power meter especially suitable for measuring signals with high modulation rates such as WLAN, 3G or EDGE signals as well as providing fast rise times for examining pulsed signals such as radar.

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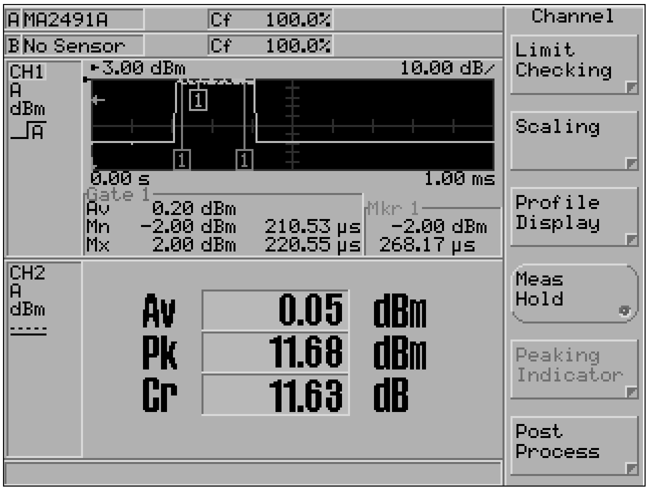
* Frequency range is sensor dependent.

The new MA2491A wideband sensor has been designed for a variety of applications. With a selectable 5/20 MHz bandwidth, measurements can be made on the rising edges of pulsed systems as well as CDMA waveforms. The new sensor has a dynamic range of –60 dBm to +20 dBm.

The new power meter combines the very best of high speed measurement technology and CW stability.



```
A MA2491A      Cf   100.0%
B No Sensor    Cf   100.0%
CH1  ▸3.00 dBm                 10.00 dB/
A
dBm
     0.00 s                     1.00 ms
Gate 1                        Mkr 1
Av    0.20 dBm                 -2.00 dBm
Mn   -2.00 dBm   210.53 μs     268.17 μs
Mx    2.00 dBm   220.55 μs
CH2
A
dBm
        Av    0.05  dBm
        Pk   11.68  dBm
        Cr   11.63  dB
```

Profile or Readout Displays can be chosen

Features

- **Dual Display Channel**

The ML2480 supports dual display channels. Each display channel is a measurement set up and can use any selection or combination of the sensor inputs. The instrument can be configured to view one display channel or two. The instrument can be switched between display channels quickly and simply via the CH1/CH2 "hot" key on the front panel. The user can choose to view the measurement results as a graph profile or numerical readout.

- **Measurement Gates**

At the heart of the new power meter's signal processing lies the measurement gate facility. The new power meter supports up to four independently set gates or eight gates repeated in a pattern. The gate allows the user to capture the relevant information from the signal under test. The wide bandwidth and high speed A/D allow the positioning of the gate very accurately within the signal profile. The user can choose between several measurements performed within the gate. Average, peak, crest, max and min are available as selections for the output.

The max and min data are time stamped so that the position of these signals is recorded within the gate and can be used to record the overshoot and undershoot of a pulsed signal.

Exclusion zones within the measurement gate are also available. Termed fences, these can be used to exclude sections of the signal from the measurement gate. Particularly useful for excluding mid-burst training sequences. Each gate has a switchable fence associated with it.

- **Markers**

Four independent markers are available for denoting points of interest on the signal profile. The active marker can be scrolled directly from the front panel. A delta marker can be set independently from the active marker to read the difference or the average power result. The delta marker can linked to provide continuous scrolling through the signal.

A set of specialized automatic marker functions has been provided to ease the measurement of pulsed systems. These functions are automatic pulse rise time, pulse fall time, off time and pulse repetition interval.

- **Trigger facilities**

High speed measurements require precise triggering. The ML24380A series offer the following trigger modes:

Continuous, internal trigger on the rising or falling edge of either input A or input B and external TTL trigger. The external trigger allows the power meter to be synchronized to external equipment. Data collection can be delayed for a pre-determined time after the trigger point. The trigger facility incorporates a settable hold off facility which prevents the trigger from being re-armed and re-triggering on a noisy signal. A pre-trigger facility allows the capture and display of pre-trigger information on the signal.

The single shot trigger facility can be used to capture specific one off events.

- **Test Limits**

The ML2480 series has two different types of automatic test limits. For many applications a simple power limit can be set up to test the upper and /or lower boundaries of the signal. For pulsed systems such as RADAR, TDMA phone systems or WLAN, a time varying limit line can be set up to test all aspects of the pulse profile. The power meter can be set up to indicate pass or fail and to hold the measurement display on failure which is important when trying to track down intermittent faults. An internal limit editor enables the user to create and select their own limit profiles.

- **Presets**

The ML2480 offers a number of radio system presets. Each preset configures the power meter settings to measure a radio system. GSM, GPRS, WCDMA, WLAN and Bluetooth are some of the examples of radio systems supported by this facility.

- **Settings stores**

The power meter has 20 settings stores. These provide a convenient way of having application specific measurement set ups for easy recall by the user.

- **Remote Interfaces**

The ML2480A series supports GPIB and RS-232 as standard. USB and Ethernet will be available as options.

- **Secure mode**

The ML2480A series has a secure mode for operations in security sensitive areas. Once activated the secure mode wipes all information stored in the non-volatile RAM on power up.

Applications

- **Radar**

The high bandwidth and sample rate of the ML2480A provide accurate peak measurements on a variety of RADAR, Radio navigation and Radio location systems.

The ML2480A series has a number of features tailored for peak power measurement on pulsed systems. The power meter can be easily set up to trigger on a pulse or sequence of pulses. Up to four independent gates can be set to measure the average, max and min powers on a sequence of pulses. The data for the max and min includes the time-stamp and gives the user automatic display of the position and value of the maximum overshoot and minimum undershoot in each pulse.

A set of automatic marker functions gives pulse rise time, fall time, off time and Pulse Repetition Interval. The Delta marker can be set up to measure the droop of the pulse top.

A single shot trigger is available to capture one-off pulse events.

The offset table function corrects the power meter reading to read the true output power when the power meter is being used with a coupler or high power attenuator in the radar test system.

- **WLAN**

The ML2480A series is the ideal power meter for all variants of the 802.11 WLAN specification. The 20 MHz bandwidth allows users for the first time to get an accurate peak power reading without having to resort to manual correction of the peak reading due to bandwidth limitations. The wide bandwidth of the signal channel allows for the accurate placement of the gate to measure precise selections of the signal such as the OFDM training sequence at the start of the 802.11g signal.

- **GSM/EDGE /GPRS**

The graphical display and the measurement gates make the measurement of GSM and PCS systems straightforward.

The power meter is set up to trigger on the GSM pulse. The active gate is set up to measure the power within the 10% to 90% section of the burst profile. An automatic limit can be used to give pass or fail indication. The display shows the results from the active gate, indicating the average power within the burst.

GPRS and GSM test modes can be tested easily with the use of the multiple gates. A GSM gate pattern can be repeated up to eight times to allow the power meter to capture and read back the power from each of the slots, giving up to eight simultaneous measurements.

EDGE measurements are quick and simple to make. The high sample rate leads to improved settling time and the use of the trigger hold off facility prevents re-triggering on the symbol transitions. PHS and IS-136 systems can also be measured effectively and quickly in this way.

- **3G-CDMA**

The ML2488A has been designed to measure the peak power of all the major CDMA systems in the world including those that use Time Division Duplexing such as TD-SCDMA. The display can be configured to measure Average, Peak and Crest Factor. The measurement period can be set for accurate results. TDD systems can be displayed as a graph profile and the measurement gates can be set to measure and display the peak and crest factor during the transmission.

CCDF, CDF and PDF statistical functions are supported on the CDMA measurements and enable the designers of power amplifiers to correctly estimate the margins on the peak power handling capabilities of the amplifiers.

- **Amplifier and Return Loss Measurements**

Use the dual input ML2488A to measure the gain or the return loss of an amplifier under its correct operating conditions. Power amplifiers designed for peak applications, whether pulsed or CDMA , cannot operate at full peak power with CW test inputs. The gain and output power can only be measured accurately using a peak power meter under representative conditions. The return loss of amplifiers and other devices can only be evaluated under high power pulsed conditions with a peak power meter connected to a high directivity coupler.

- **MA2490A and MA2491A Wideband Sensors**

The MA2490 series sensors are wideband sensors suitable for pulse and CDMA applications. They have a selectable 5/20 MHz bandwidth. The MA2490A covers the range 50 MHz to 8 GHz and the MA2491A extends the range to 18 GHz. Rise time on this sensor is 18 ns. The sensor incorporates a 'chopper' which extends the RMS measurement range to –60 dBm. Upper limit is +20 dBm.

- **MA2411A Pulse Sensor**

The MA2411A Pulse sensor is specifically designed for fast measurements on pulsed systems. The bandwidth of this sensor is 50 MHz and has a rise time of 8 ns. This sensor covers the frequency range 300 MHz to 40 GHz. Requires 1 GHz Calibrator option no. ML2400A/15.

Specifications

	Frequency Range	100 kHz to 65 GHz, sensor dependent
	Power Sensors	Meter compatible with the MA2400 A/B series sensors
	Sensor Dynamic Range	–70 dBm to +20 dBm for standard MA2400 A/B Sensor Range
	Power Measurement Range	–70 to +200 dBm dependent upon sensor range, external coupler or attenuator
	Channel Bandwidth	20 MHz, CW and lower bandwidth mode sensors supported
	Sampling Rate	Up to 64 MS/s dependent upon settings
	Instrumentation Accuracy	<0.5% ±0.02 dB absolute Accuracy ±0.04 dB relative Accuracy
	Display Resolution	Selectable from 0.1 to 0.001 dB
	Display Units	Linear: nW to W, % Log: dBm, dBW, dB
Power Reference	Output Level	1.00 mW, Nominal 50 MHz,Traceable to National Standards
	Connector	Type N female
	VSWR	1.04
Sensor/Channel Control	Operating Modes	Readout Dual Display Channel RF power Profile CDMA Average, Peak Power, Crest factor CDF,PDF and CCDF
	Limit Lines	Simple pass/ fail as per ML24XX Profile shape for pulsed and TDMA systems Profiles can be stored in the instrument
	Markers	4 Markers Delta Marker Marker to Max/Min Pulse Rise/Fall time, off period and PRI
	Gates	4 Independently set Gates or 8 Repeated Gates 1 Fence per Measurement Gate Gate Measurement supports Average, Peak, Crest, Max and Min
Triggering	Trigger Sources	Continuous, Internal, External TTL, GPIB or external Bus.
	Delay Range	0-999 ms
	Delay Resolution	0.5% of display period or 1 ns
	Internal Trigger Range	–15 dBm to +20 dBm Selectable to –25 dBm
System Configuration	Display	LCD, Color
	Save / Recall	20 settings stores Preset accessible on Front Panel Offset tables
	Secure Mode	Wipes non-volatile ram on power up when active
	Interfaces	GPIB, RS232, Ethernet, USB

General Specifications	General	MIL-T28800F, Class 3
	Operating Temperature Range	0 to +50°C
	Storage Temperature Range	–40 to +70°C
	Power Requirements	AC 90V to 250 VAC, 47 to 440 Hz
	EMI	Complies with requirements for CE Marking
	Warranty	1 year Standard 3 year Optional
	Dimensions	8.39 inches (213mm) wide, 3.46 inches (88mm) high, 9.84 (390mm) inches deep

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
ML2487A	Power Meter, Single Input
ML2488A	Power Meter, Dual Input
	Options
ML2400A-01	Rack Mount, single unit
ML2400A-03	Rack Mount, side by side
ML2400A-05	Front Bail Handle
ML2480A-06	Rear Mount input A
ML2480A-07	Rear Input A and Reference
ML2480A-08	Rear Mount inputs A,B and Reference
ML2480A-09	Rear Mount Inputs A and B
ML2400A-12	Front Panel Cover
ML2480A-15	1 GHz Calibrator (for use with MA2411A Sensor)
ML2480A-16	Ethernet and USB
ML2480A-17	Blank Front Panel
ML2400A-20	Spare 1.5m Sensor Cable
ML2400A-21	0.3m Sensor Cable
ML2480A-33	Extra Operating Manual ML2487/8A
ML2480A-34	Extra Programming Manual ML2487/8A
ML2480A-98	Premium cal to Z540 ISO guide 25
ML2480A-99	Service cal to Z540 ISO guide 25
760-209	Hardside Transit Case
D41310	Soft Carry Case with Shoulder Strap
MA2418A	50 MHz Reference Oscillator with Power Supply

CALIBRATION RECEIVER

ML2530A

100 kHz to 3 GHz

CE GPIB

Measuring Level while Observing Signals under Test

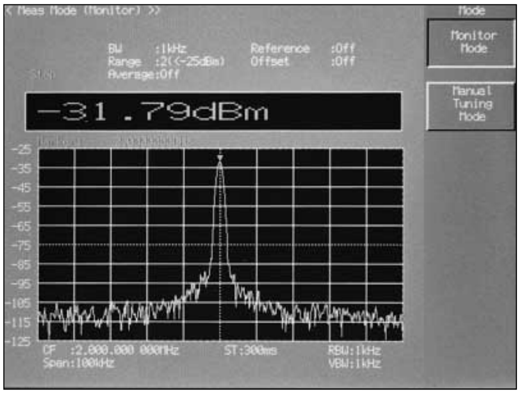
The ML2530A is a receiver for calibrating the output power level of such devices as signal generators and attenuators, covering the range of 100 kHz to 3 GHz. It is suitable for use as a reference level meter for the RF communications bands used by the world's mobile communications markets. High linearity is achieved by using a level detector that uses DSP technology. The level can be measured while observing the signal waveform to be measured by using the spectrum monitor function.

Features

- Wide dynamic range of –140 to +20 dBm and high linearity
- Provides measurement bandwidth of 1 Hz to 100 kHz, so that even signals with large residual FM can be measured using the 1 Hz bandwidth.
- Supports level units

```
< Meas Mode (Manual Tuning) >>
REL
Range:1-2   BW      :100Hz          Reference    :Off
            Range   :2(<-25dBm)     Offset       :Off
            Average:Off
-31 .67dBm
2,000.000 000MHz
Freq = 2,000.000 000MHz
```

Manual tuning mode



```
< Meas Mode (Monitor) >>
            BW      :1kHz           Reference    :Off
            Range   :2(<-25dBm)     Offset       :Off
            Average:Off
-31 .79dBm
CF  :2,000.000 000MHz      ST:300ms       RBW:1kHz
Span:100kHz                               VBW:1kHz
```

Monitor mode

Specifications

• ML2530A (main frame)

General	Frequency range	0.1 to 3000 MHz
	Level range	–140 to +20 dBm
	RF input connector	Connector: N-J Impedance: 50 Ω VSWR: ≤1.25 (Range 1), ≤1.40 (Range 2), ≤1.50 (Range 3) Max. input level: +20 dBm, 0 Vdc
	CAL output*1	Connector: N-J Impedance: 50 Ω Frequency: 50 MHz ±500 kHz Level: 1.000 mW Level accuracy: ±1.2% (RSS: ±0.9%) Harmonic frequency: ≤–50 dBc
	Reference oscillator	Frequency: 10 MHz Start-up characteristics: ≤±5.1 x 10^{-8}/day (10 minutes after power on, with reference to frequency at 24 hours after power on) Aging rate: ≤±2.1 x 10^{-8}/day, ≤±10.1 x 10^{-8}/year (with reference to frequency at 24 hours after power on) Temperature characteristics: ≤±5.1 x 10^{-8} (with reference to frequency at 25˚C in 0˚ to 50˚C temperature range) Accuracy: ≤±15.1 x 10^{-8} (24 hours after power on, within 6 months of calibration)
	External reference input	Connector: BNC-J Impedance: 50 Ω Frequency: 10 MHz ±10 Hz Level: 0.5 to 5.0 Vp-p
	Internal reference output	Connector: BNC-J Impedance: 50 Ω Frequency: 10 MHz Frequency accuracy: Same as reference oscillator Level: 2.1 V ±0.6 Vp-p (when 2 m coaxial cable terminated with 50 Ω)
Level measurement	Measurement modes	Manual tuning: Measures level of frequency input directly by ten keys and encoder Monitor: Measures level of frequency specified by marker on spectrum monitor
	Measured frequencies	Range: 100 kHz to 3000 MHz, Resolution: 1 Hz
	Measurement bandwidth	Range: 1 Hz to 100 kHz (1-10 sequence) Filter: Gaussian type Accuracy (3 dB width): ±20% (BW: 1 Hz), ±5% (BW: 10 Hz to 100 kHz)
	Measured level	Range: –140 to +20 dBm Resolution: 0.1, 0.01, 0.001 dB
	Range	Range 1: –35 to +20 dBm, Range 2: –80 to –25 dBm, Range 3: –140 to –70 dBm
	Error*2	Total relative error: In-range linearity + range switching error + noise floor error +1 digit error Total absolute error: Total relative error + CAL output level accuracy + mismatch error at CAL + sensor module calibration factor uncertainty + calibration receiver linearity + sensor module insertion loss reproducibility + mismatch error In-range linearity: ±0.05 dB/55 dB (BW: 1/10/100 Hz, RSS: ±0.03 dB/55 dB) ±0.09 dB/55 dB (BW: 1/10 kHz, RSS: ±0.07 dB/55 dB) ±0.22 dB/55 dB (BW: 100 kHz, RSS: ±0.20 dB/55 dB) *In same range, BW: 100 kHz, frequency: ≥1 MHz Range switching error: ±0.01 dB (at range switch point: –30, –75 dBm) Noise floor (BW: at 100 Hz): ≤–70 dBm (Range 1, ≤11 MHz), ≤–80 dBm (Range 1, >11 MHz), ≤–115 dBm (Range 2, ≤11 MHz), ≤–120 dBm (Range 2, >11 MHz), ≤–125 dBm (Range 3, ≤11 MHz), ≤–135 dBm (Range 3, >11 MHz), Noise floor error: ±0.05 dB (S/N: ≤35 dB), ±0.04 dB (S/N: ≤25 dB), not specified (S/N: ≤10 dB) Frequency drift error: ±0.007 dB (1% of BW frequency drift relative to set signal frequency) BW switching error: ±0.01 dB (BW: 1 Hz to 10 kHz), ±0.05 dB (BW: 1 Hz to 100 kHz, frequency: ≥1 MHz) *Excluding effect of measured signal residual FM
	Average	Measurement times: 1 to 256
	Display units	dBm, dB, dBµ, dBµ (emf) W, mW, µW, pW, fW, aW (automatically chosen best unit for measured value) V, mV, µV, nV, pV (automatically chosen best unit for measured value)
	Display digits	dB units: 0.1, 0.01, 0.001 dB W/V units: 3, 4, 5 digits
	Reference	Set any value: –180 to +60 dBm Meas → Ref: Obtain current measured value
	Offset	Setting range: –100 to +100 dB
	Calibration	Calibration frequency count: 300 Calibration level: 0 dBm +3/–4 dB (relative level calibration at Range 1, using MA2540A) –30 dBm +3/–4 dB (calibration between Range 1 and Range 2) –75 dBm +3/–4 dB (calibration between Range 2 and Range 3)
Spectrum monitor	Center frequency	100 kHz to 3000 MHz, Min. setting resolution: 1 Hz
	Frequency span	10 kHz to 1 MHz, Setting resolution: 1 Hz
	Resolution bandwidth	300 Hz to 100 kHz (1-3 sequence)
	Video bandwidth	10 Hz to 100 kHz (1-3 sequence)
	Sweep time	100 ms to 1000 s
	Reference level	Range 1: +20 dBm, Range 2: –25 dBm, Range 3: –70 dBm

Continued on next page

Spectrum monitor	Markers	Functions MKR → PEAK: Moves marker to max. level in monitored range MKR → CNTR: Sets marker frequency to center frequency of monitored range PEAK → CNTR: Sets max. level frequency to center frequency of monitored range Frequency readout level Range 1: ≥–35 dBm, Range 2: ≥–80 dBm, Range 3: ≥–100 dBm Zone marker width: Spot, 1, 5, 10 div.
	Auto-tune	Signal detection frequency range: 30 to 3000 MHz Signal detection level: ≥–30 dBm
Other	Save/recall	Save count: 100
	Panel lock	Function: Disables all key and encoder functions except power switch and panel lock key
	GPIB	Function: Used to control ML2530A as device from controller Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
	Power	100 to 120 V/200 to 240 V (auto-switching), 47.5 to 63 Hz, ≤120 VA
	Dimensions and mass	426 (W) x 221.5 (H) x 451 (D) mm, ≤17.9 kg
	Environmental conditions	Operating temperature range: 0° to 50°C Storage temperature range: –20° to +60°C
	EMC	EN61326: 1997/A1: 1998 (Class A) EN61000-3-2: 1995/A2: 1998 (Class A) EN61326: 1997/A1: 1998 (Annex A)
	LVD	EN61010-1: 1993/A2: 1995 (Installation Category II, Pollution degree 2)

*1: At constant temperature in operating range of 15° to 35°C
*2: At fixed temperature in ambient temperature range of +15° to +35°C, and level calibration after 1 hour warm-up

MA2540A Sensor Module

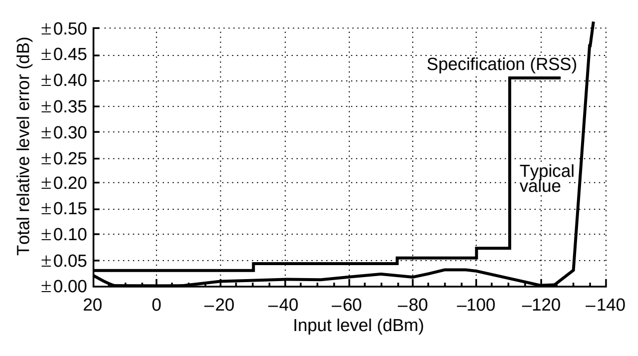
Frequency range	100 kHz to 3000 MHz
Level	Level range: –140 to +20 dBm, Max. input level: +20 dBm
RF input connector	Type: N-J Nominal impedance: 50 Ω VSWR (power sensor side): ≤1.30 (100 to 300 kHz), ≤1.20 (0.3 to 1 MHz), ≤1.36 (1 to 3000 MHz) VSWR (through side): ≤1.12 (0.1 to 100 MHz), ≤1.35 (100 to 3000 MHz)
RF output connector	Type: N-J, Nominal impedance: 50 Ω
RF input/output characteristics	Through side insertion loss: ≤0.7 dB Through side insertion loss reproducibility: ±0.006 dB
Dimensions and mass	63 (W) x 54 (H) x 206 (D) mm, ≤1 kg
Environmental conditions	Same as the ML2530A

Sensor module calibration factor uncertainty

Frequency	Simple total	RSS total
0.1 MHz	±3.0%	±1.4%
10 MHz	±2.4%	±1.1%
100 MHz	±2.4%	±1.1%
1000 MHz	±3.0%	±1.4%
2000 MHz	±3.0%	±1.4%
3000 MHz	±3.2%	±1.5%

Total level error

The total level error is the total of each error source. For example, the total relative level error at a frequency of 1 GHz and a BW of 100 Hz is as shown below.



The absolute level error for a measured signal at a frequency of 1 GHz, measurement bandwidth of 100 Hz, device under test VSWR of 1.5, and signal level of –100 dBm is as follows.

Source of uncertainty	NIST traceable uncertainty
Relative level error at –100 dBm	1.6% (±0.07 dB)
CAL output level error	±0.93%
Mismatch error at calibration	±0.23%
Sensor module calibration factor error at measured frequency	±1.4%
Linearity error of the ML2530A power measurement section	±1.0%
Sensor module relay repeatability	±0.14% (±0.006 dB)
DUT mismatch error sensor module + calibration receiver VSWR: 1.2 (typ.)	±3.7%
Total (RSS)	±4.5 (±0.19 dB)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
ML2530A	Calibration Receiver
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0012	Fuse, 3.15 A: 2 pcs
W1492AE	ML2530A operation manual: 1 copy
	Optional accessories
MP721A	Fixed attenuator (3 dB, 2 W)
MP721B	Fixed attenuator (6 dB, 2 W)
MP721C	Fixed attenuator (10 dB, 2 W)
MP721D	Fixed attenuator (20 dB, 2 W)
MP721E	Fixed attenuator (30 dB, 2 W)
MP721F	Fixed attenuator (40 dB, 2 W)
MP721G	Fixed attenuator (50 dB, 2 W)
MP721H	Fixed attenuator (60 dB, 2 W)
J0078	High power fixed attenuator (20 dB, 10 W)
J0063	High power fixed attenuator (30 dB, 10 W)
J0395	High power fixed attenuator (30 dB, 30 W)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0431F	Coaxial cable (BNC-P · RG55A/U · BNC-P), 1 m
J0431G	Coaxial cable (BNC-P · RG55A/U · BNC-P), 2 m
J0903A	Coaxial cable (NP · RG-142B/U · N-P), 1.5 m
J0904A	Sensor module cable, 1.5 m (for MA2540A control)
B0333D	Rack mount kit
B0329D	Front cover
B0331D	Front handle (2 pcs/set)
B0332	Joint plate (4 pcs/set)
B0334D	Carrying case (hard type, with protective cover and casters)
	Peripheral instruments
MG3633A	Synthesized Signal Generator (10 kHz to 2700 MHz)
	Sensor module
MA2540A	Sensor Module
	Standard accessories
J0903A	Coaxial cable (N-P · RG-142B/U · N-P), 1.5 m: 1 pc
J0904A	Sensor module cable, 1.5 m (for MA2540A control): 1 pc
W1491AE	MA2540A operation manual: 1 copy

ELECTRONIC VOLTMETER
ML69B
10 kHz to 1000 MHz

Popular High-Frequency Voltmeter

Custom-made product

The ML69B is a high-sensitivity, high-frequency electronic voltmeter using semiconductor diodes and a high-sensitivity chopper amplifier. It can measure high-frequency voltages ranging from 10 kHz to 1000 MHz with a full-scale sensitivity of 1 mV. It has a pen-type Probe MA61B, which can measure at high impedance with minimal effect on the device under test.

Features
- High input impedance
- Easy measuring operation
- Multipurpose usage with accessories
- DC output

INTERFERENCE/FIELD STRENGTH METER
ML428B
9 kHz to 30 MHz

For Measuring Noise Field Strength (in Conformance with CISPR Specifications)

GPIB

The ML428B not only enables measurement of the field strength of general broadcasts and radio communications, but it can also perform measurements of interference waves in accordance with CISPR, VDE, FCC, or other specifications. The ML428B possesses a local synthesizer and high-precision sine-wave comparison oscillator to obtain data with excellent repeatability. In addition, the built-in microprocessor allows level calibrations and attenuator operation to be automatically performed to enable direct reading of the field strength and efficient measurement.

Features
- Correct interference measurement can be performed in accordance with CISPR specifications.
- The use of a frequency synthesizer in the local oscillator enables a high degree of frequency stability to be gained.
- Allows direct reading of the field strength.
- Up to a maximum of any 100 frequencies can be stored.
- Prompt measurement is possible through use of the auto-range function.
- Direct readout of field strength is possible arbitrarily for conventional antenna by memorizing its coefficient via GPIB.
- Convenient outdoor operation through the use of a DC power source.

RESISTANCE ATTENUATOR
MN510C/D
DC to 500 MHz

Custom-made product

MN510D

These are variable resistance attenuators for measurement of 50 and 75 Ω impedance systems. Each of these attenuators has a wide frequency range and is highly accurate, compact, lightweight with good articulation, and easy to handle. Moreover, comparison measurement can be made far more smoothly when used in conjunction with a key box.

PROGRAMMABLE ATTENUATOR

MN63A, MN65A, MN72A, MN64B

DC to 2 GHz DC to 6 GHz DC to 18 GHz DC to 1 GHz

For Configuring Automated Measurement Systems

MN63A

GPIB

The MN63A/65A/72A/64B provide GPIB as a standard feature and are suitable for automatic measuring system components used in R&D, inspection, or production. The 50 Ω models are available in three different frequency ranges, which can be selected to match the application for maximum economy. The attenuation calibration value is stored in the internal memory and can be uploaded to the system controller for checking against measured values, permitting a significant increase in system accuracy. A relative setting function is also provided, which allows measurement to be referenced to any arbitrary level. Rotary encoders are standard, allowing simple, smooth setting under manual control.

Features

- Wide frequency range
- High accuracy
- Long operating life
- High-speed switching
- Readout of attenuation calibration via GPIB
- Relative attenuation display function
- Rotary encoders for smooth manual setting

PRE-AMPLIFIER

MH648A

100 kHz to 1200 MHz

For Amplifying Low-Level Signals

The MH648A is a pre-amplifier for improving sensitivity in spectrum analyzers, field strength meters, frequency counters, etc.

EMI PROBE

MA2601B/C

Custom-made product

The MA2601B/C is a compact loop antenna to use with a spectrum analyzer or a field strength meter for EMI measurement. The combination is used to locate noise sources and to compare relative noise source levels.

Features

- Exact detection of magnetic field components (because MA2601B/C is electrostatically shielded)
- Approximately flat magnetic-field detection characteristics in the range from 100 to 1000 MHz (MA2601B)

Applications

- Sensing magnetic fields when it is connected to a spectrum analyzer, etc.
- Noise immunity testing of electronic components or electrostatic shield-effect testing with using a signal generator

EMI PROBE KIT
MA8611A

In addition to the MA8610A Pre-amplifier that can be directly mounted on the input connector of the MS610C and MS2601B Spectrum Analyzers, this kit also includes MA2601B/C EMI Probes and connecting cables.

Specifications (MA8610A Pre-amplifier)

Frequency range	9 kHz to 2.2 GHz, 50 Ω
Gain	20 dB
Frequency response	±0.5 dB (20 kHz to 1 GHz)
Noise figure	6 dB typ. (≤1 GHz)

DIPOLE ANTENNA
MP534A/B, MP651A/B, MP663A
25 to 520 MHz **470 to 1700 MHz** **300 to 1000 MHz**

Those half-wavelength dipole antennas are reference antennas, but the element length must be adjusted for each frequency to be measured.

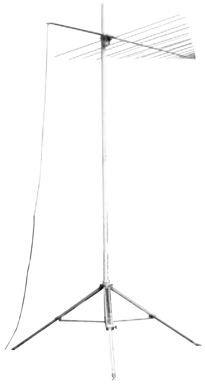
*Tripod sold separately

MP534A

MP663A

LOG-PERIODIC ANTENNA
MP635A, MP666A
80 to 1000 MHz **200 to 2000 MHz**

The gain remains roughly constant over a wide range so the element length does not require adjustment. Compared with dipole antennas, these antennas have a gain of 5 dB.



Specifications

Model	MP635A	MP666A
Frequency range	80 to 1000 MHz	200 to 2000 MHz
Input impedance	50 Ω (connector: N-type)	
VSWR	≤2.5	
Average relative again	5 dB	
Maximum input power	10 W	
Front-to-back ratio	≥15 dB	
Dimensions and mass	200 x 200 x 1750 mm, ≤7 kg	ø140 x 900 mm, ≤5 kg

LOOP ANTENNA, ROD ANTENNA
MP414B, MP415B

The MP414B/415B can be used with the ML428B Interference Field Strength Meter.

Custom-made product

MICROWAVE REPEATER CHECKER
MS75B

For Maintaining Microwave Repeaters

Custom-made product

The Microwave Repeater Checker (MRC) is an integrated microwave measuring instrument packed in a handy carrying case. It consists of three devices most frequently used for the maintenance of microwave communications systems: a power meter (10 MHz to 14 GHz) and frequency counter (10 Hz to 18 GHz) are standard accessories, and a signal generator is sold separately. The signal generator can be changed according to the frequency band to be measured. There are eight difference generators available for the frequency range 1.7 to 13 GHz.

Features

- Maintains and adjusts microwave line repeaters
- All parts and accessories are contained in the carrying case so the measurement procedure is less time-consuming.
- When removed from the carrying case, the power meter can be mounted independently in a specially designed case (optional accessory). It can run on either batteries or AC line power when used separately.

SIGNAL GENERATOR
MG724E1/G1
1.7 to 13 GHz

For Maintaining and Adjusting Microwave Links

Custom-made product

The MG724E1/G1 are a compact lightweight microwave signal generator, designed for medium – and small – capacity microwave line repeater maintenance or adjustment. The instrument is best suited to measure AGC characteristics, squelch function, and signal-to-noise ratio. Its high signal purity and frequency stability also enable it to be used as a general-purpose signal source for microwave receiver adjustment on a production line.

Features

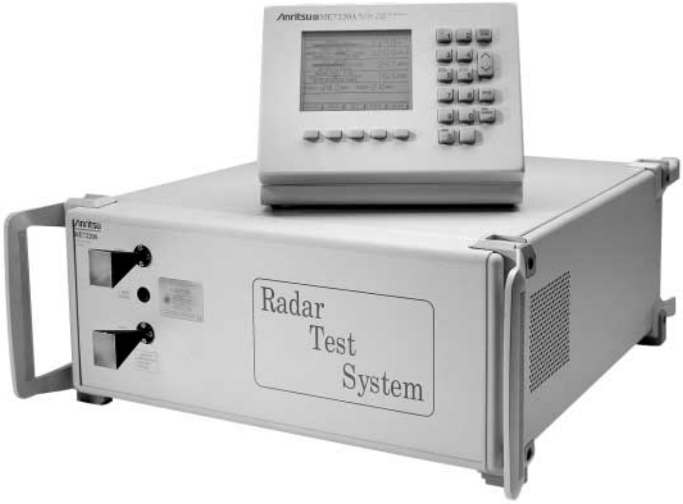
- High signal purity
- High frequency stability
- Wide output level range
- Low price
- Small and lightweight

RADAR TEST SYSTEM (RTS)

ME7220A

76 to 77 GHz

Target Simulation & Signal Analysis for Automotive Radar
Exceptional Performance at an Affordable Price



Description

The ME7220A Radar Test System (RTS) accurately and repeatedly characterizes 76-77 GHz automotive radar modules and systems, in a confined and controlled environment, to ensure quality and optimum functionality. The RTS is designed to work with current and future generations of automotive radar, including Adaptive Cruise Control (ACC) radar and collision warning or avoidance radar. The test system provides a simulated radar target response with one of two set target ranges with an adjustable target Radar Cross Section (RCS). The signal response can be Doppler shifted to simulate the speed of a moving target. The system also allows the measurement of the power characteristics or Effective Isotropic Radiated Power (EIRP) of the transmitted radar signal as well as its spectral characteristics (bandwidth, spurious signals, AM/FM Noise, etc.).

The ME7220A RTS is the ideal solution for your testing environment, including research and development, radar module manufacturing, or vehicle manufacturing. Whether you are involved in the development of components and systems, setting up for production of sensors, or installing modules on automobiles, you will find that the ME7220A is an essential tool for dramatically reducing your development and test times and for helping you deliver a superior product.

Features

- Verifies operation under realistic conditions by simulating moving targets (other vehicles or roadside objects) at multiple target distances
- Fully characterizes the radar module by quantifying transmitter, receiver and antenna performance
- Integrated functionality allows radar signal power and frequency measurements without external equipment. Interfaces with external test accessories including spectrum analyzers and power meters for complete test flexibility
- Suited for stand-alone, bench-top or anechoic-chamber testing, but easily integrates with other instruments into an automated test bench or into standard production lines for complete testing of the radar modules
- Built-in laser allows accurate alignment of the radar-under-test to the RTS antennas without additional mechanical fixtures
- Speeds automobile production by simplifying functional testing and alignment of the radar sensor (antenna) when installed on the vehicle
- Easily controlled from an external computer (via RS-232) or by using the included handheld manual controller

Specifications

General	Frequency range*1			76 GHz to 77 GHz
	Antenna E-field polarization			Horizontal standard (other polarization options available)
	Alignment laser			Class II laser, 600-700 nm, output power <1 mW (alignment laser shuts off above 40°C)
Radar signal analysis	Received radar power (at RTS waveguide input)			–10 dBm, specifications below apply
	Measured radar power	Internal meter	Range	30 dB, minimum
			Accuracy	±2 dB accuracy
		External meter	Range	35 dB, minimum (50 dB, typical, with option 5)
			Accuracy	±1 dB accuracy, including IF measurement and EIRP Cal Factor
	Maximum radar occupied frequency			Full band 76 to 77 GHz (translated to IF of 4.7 to 5.7 GHz)
	Radar transmit frequency spectrum	External spectrum analyzer		Accuracy of 76-77 GHz frequency limited by spectrum analyzer external reference and specifications. If RTS internal reference is used, accuracy is 50 ppm.
		Internal frequency measurement		Accuracy of displayed frequency is ±50 MHz, maximum
	Spurious signals, in-band			38 dBc maximum, referenced to output signal

Continued on next page

Target simulation	Received radar power (at RTS waveguide input)			–15 dBm, specifications below apply
	Radar occupied bandwidth			300 MHz, maximum, in the 76-77 GHz range
	Number of simultaneous targets			1 (either near target or far target)
	Target distance[*2]		Near target	3.5m nominal (+ distance from RTS to radar)
			Far target	116.5m nominal (+ distance from RTS to radar)
			Distance accuracy	NEAR Target = ±0.5m, maximum FAR Target = ±2.0m, maximum
			Distance from RTS to DUT radar	1.5 meter, minimum
	Radar cross section (RCS)		Maximum RCS	–4 dBsm, minimum (near target)
				50 dBsm, minimum (far target)
			RCS adjustment range	50 dB, 1 dB steps
			RCS accuracy	±0.75 dB ± 5% of attenuation, maximum (measured at a single frequency of 76.5 GHz
				±2.5 dB, maximum (measured over 76-77 GHz)
	Target speed simulation (Doppler frequency)		Speed range	0 to ±250 km/h, minimum (0 to ±35 kHz, minimum)
			Speed step size	0.1 km/h, minimum (15 Hz, minimum)
			Speed error	0.2 km/h, maximum (30 Hz, maximum)
			Doppler carrier & sideband suppression	40 dBc, minimum
	Signal Characteristics	Spurious signals (measured at waveguide output)	In-band responses	40 dBc, maximum
			Out of band	Local oscillator signal: –5 dBm, maximum (at 70.8 to 71.8 GHz)
				Image response: –3 dBc, maximum (65.6 to 66.6 GHz)
		RF noise density (CW)	Local oscillator phase noise	–80 dBc/Hz @ 100 kHz offset, maximum
			AM noise for target simulation	–130 dBm/Hz @ 2 MHz offset, maximum
Display module			Display screen	160 x 128 dot matrix monochrome LCD, with backlight
			Cable from main module	1 meter
Power requirements			Primary power	85 - 240 Volts AC, 50-60 Hz, 200 VA maximum
Environmental			Operating temperature range	+15°C to +35°C (0°C to +50°C, with reduced performance)
			Operating humidity	5% to 95% at 40°C
			Warm-up time	30 minutes, maximum, for ambient +15°C to +35°C
			Storage temperature	–15°C to 75°C
			EMC & safety	Meets European community requirements for CE marking
Size and weight			Dimensions	197.6 x 485.6 x 553.6 mm, main module 178.8 x 228 x 76.5 mm, display module
			Weight	10 kg, main module 1 kg, display module
Front panel connectors			Antenna input/output	WR12 waveguide, 0 dBm maximum no damage
Rear panel connectors			Power meter port	N (F), 50 Ω, 10 dBm maximum output
			Spectrum analyzer port	N (F), 50 Ω, 10 dBm maximum output
			10 MHz reference input	BNC (F), 50 Ω, +15 dBm to –5 dBm, 25 V DC, max
			RS-232 serial port	D-Sub 9-pin (M)
			IF external loop	2 SMA (F), 0 dBm maximum input/output

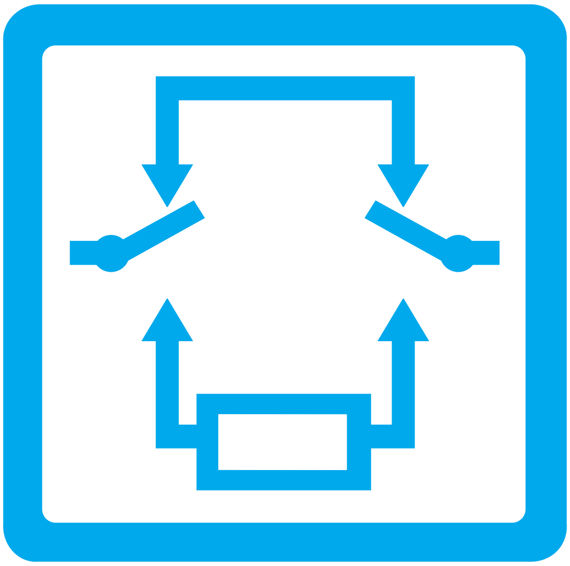
*1: 24 GHz or other frequency range options available – contact factory.
*2: Other target distance options available – contact factory.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
ME7220A	Radar Test System includes, in addition to the main and display modules, the following accessories: - WR12 Horn Antennas, quantity 2 - Operation and programming manual - N-type, 50 Ω termination - Display interface cable - Serial interface cable - Power cord
	Options
1A	Rack mount kit with handles
2A	Antenna polarization – vertical
2B	Antenna polarization – 45° slant left
2C	Antenna polarization – 45° slant right
3A	Input/Output port waveguide extensions, 5.08 cm (2.0 in)
5	Wider dynamic range at power meter port using external bandpass filter

Model/Order No.	Name
	Recommended accessories to increase the measurement capabilities of the ME7220A:
MS2663C	Spectrum Analyzer, 9 kHz to 8.1 GHz
ML2437A	Power Meter, Single Channel
MA2472A	Power Sensor, 10 MHz to 18 GHz
	Optional accessories:
15NN50-1.5C	50 Ω Cable, N(M)-N(M), 1.5m, 6 GHz
15NN50-3.0C	50 Ω Cable, N(M)-N(M), 3.0m, 6 GHz
15NN50-5.0C	50 Ω Cable, N(M)-N(M), 5.0m, 6 GHz



ANALOG TRANSMISSION CHARACTERISTICS MEASURING INSTRUMENTS

LEVEL METER

ML424A, ML424B

10 Hz to 20 MHz 10 Hz to 30 MHz

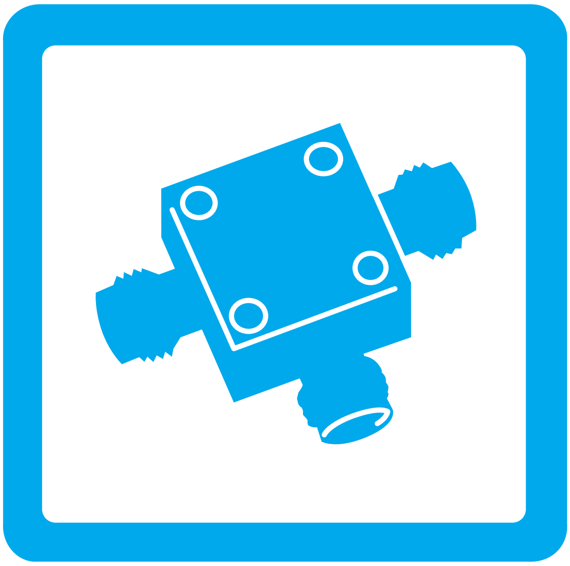
For Constructing and Maintaining FDM Communication Lines

Custom-made product

The ML424A/B is a compactly designed level-meter of high level-measuring accuracy with a calibration signal internally provided. It is also capable of measuring noise levels in conformity with the ITU-T Recommendations with the necessary psophometer option.

Features

- Excellent frequency response of ±0.1 dB over the range from 100 Hz to 13 MHz
- High measuring accuracy of ±0.2 dB including the frequency response, attenuator step accuracy, and temperature stability
- A psophometer option can be incorporated (option 01) for measuring noise levels of telephone and sound program circuits. The characteristics of the weighting filters conform to the ITU-T Recommendations P.53 and J.16.
- The ML424B provides true RMS detection



COMPONENTS

FIXED ATTENUATOR FOR HIGH POWER MEASUREMENT

Order No.	Attenuation	Frequency range	Remarks
J0063	30 dB	DC to 12.4 GHz	N-type connector, permissible max. power 10 W (+40 dBm), 50 Ω
J0078	20 dB	DC to 18 GHz	
J0395	30 dB	DC to 8 GHz	N-type connector, permissible max. power 30 W (+44.7 dBm), 50 Ω
B0472	30 dB	DC to 18 GHz	N-type connector, permissible max. power 100 W (+50 dBm), 50 Ω

50 Ω ↔ 75 Ω IMPEDANCE TRANSFORMER

MP614B, MB-009

50 to 1200 MHz **DC to 2 GHz**

The MP614B is used over the range from 50 to 1200 MHz mainly for changing the impedance of a measuring signal source such as a signal generator. It is a transformer type, so that it has a smaller loss than a resistance attenuator type, and does not lower the signal source level. When the output level of a signal generator is shown in a power unit as in dBm, the output level after impedance transforming by the MP614B will have a value which is obtained by subtracting the insertion loss (dB) of the impedance transformer from the output level of the signal generator.
The MB-009 is constructed so that the central connector will not be damaged if 50 Ω N-type plug is connected by mistake to the 75 Ω side.

CM DIRECTIONAL COUPLER

MP520 series

25 to 1700 MHz

MP520A

This coupler is used in the measurement of fundamental frequency power and spurious power which supplies coaxial feeders in VHF and UHF bands. Various models are provided in accordance with feeder impedance and frequency. It is also capable of measuring the VSWR of antenna systems.

DIRECTIONAL COUPLER

MP654A, MP655A

0.8 to 3 GHz 3.0 to 4.4 GHz

MP654A **MP655A**

Custom-made product

The MP654A and MP655A are used to branch one part of the transmitted output for such measurements as those of fundamental wave and higher harmonic spurious characteristics using a spectrum analyzer. The MP654A is used for measuring personal radio transceivers and automobile telephones while the MP655A is used for measuring microwave band ratio equipment.

Specifications

Model	MP654A	MP655A
Frequency range	0.8 to 3 GHz	3 to 4.4 GHz
Impedance	50 Ω (N connector)	
Coupling	Approx. 30 dB*	
Input power (max.)	50 W	

*: Calibration data reattached

T-PAD

Z-164A, Z-164B

DC to 1 GHz DC to 200 MHz

Z-164A

The Z-164A/B is used as a matching pad for applying the mixed output of two signal generators to the input terminal of a receiver for measuring two-signal characteristics (such as the blocking and intermodulation characteristic) of the receiver.

Specifications

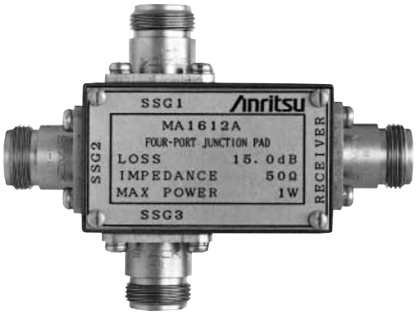
Model	Z-164A	Z-164B
Frequency range	0 to 1000 MHz	0 to 200 MHz
Insertion loss	6±0.5 dB (voltage ratio)	
Impedance characteristics	50 Ω VSWR: ≤1.3 (up to 500 MHz) ≤1.5 (≥500 MHz)	75 Ω VSWR: ≤1.2 (up to 200 MHz)
Connector	N (S)-J	M-J
Operating temperature	0° to 45°C	

Note: The maximum allowable power is 0.5 W

FOUR-PORT JUNCTION PAD

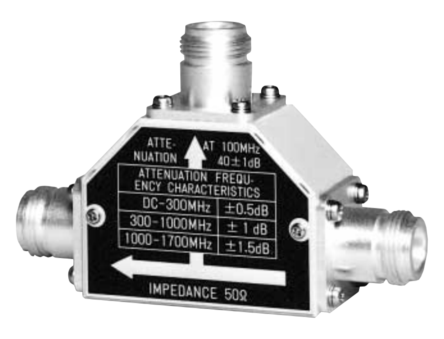
MP659A, MA1612A

40 MHz to 1 GHz 5 MHz to 3 GHz



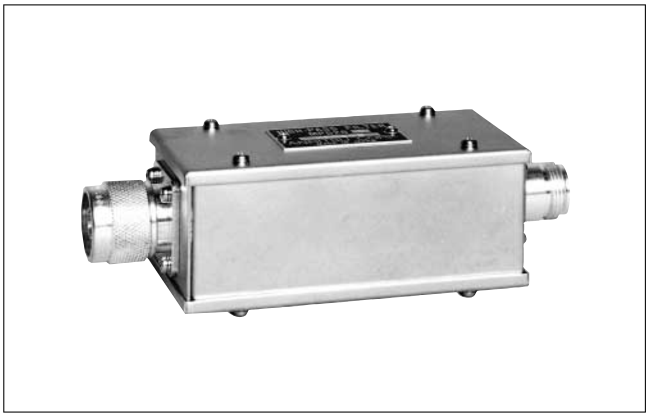
The MP659A and MA1612A are used as an impedance matching box applying the mixed output of three RF signal generators to a receiver input terminal for measurement of three-signal characteristics (such as receiver SINAD performance).

BRANCH
MP640A
DC to 1700 MHz



The MP640A is used for branching a part of the transmitted signal in measuring the spurious characteristics of a transmitter with a field strength meter or a spectrum analyzer. Its frequency characteristics of attenuation is flat over DC to 1700 MHz, so that it can be conveniently utilized for measurement without taking the frequency characteristic into consideration. The maximum allowable input power is 16 W.

HIGH-PASS FILTER
MP526 series
27/60/150/250/400 MHz bands



The MP526 series is for measuring the spurious characteristics with a field strength meter or a spectrum analyzer. Eliminating the fundamental signal by using a filter prevents the internal spurious of the field strength meter or spectrum analyzer due to an excessive input to facilitate measurement. A, B, C, D, and G are available to suit the five different frequency bands. The maximum allowable input level is +10 dBm.

BAND PASS FILTER

MA2512A

1.92 to 2.17 GHz

CE GPIB

When the signal generator outputs IMT-2000 test signal, sometimes spurious signals generated by the circuits in the signal generator are an obstacle for tests. In this case, connect the MA2512A to filter these unwanted signals. The MA2512A has excellent amplitude ripple and group delay characteristics in the frequency band of IMT-2000, because the MA2512A does not degrade modulation accuracy of the signal generator.

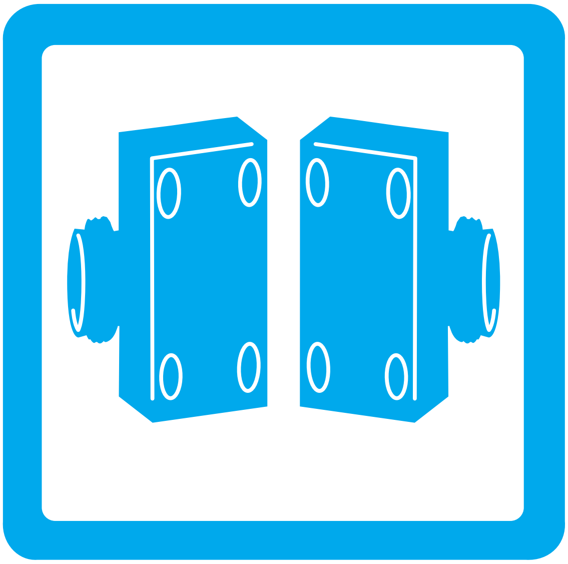
Specifications

Pass band	Frequency range: 1.92 to 2.17 GHz Insertion loss: ≤3.5 dB Ripple: ≤0.2 dB (at 5 MHz bandwidth) Group delay: ≤1 ns (at 5 MHz bandwidth) Impedance: 50 Ω Return loss: ≥15 dB
Filter band	Frequency range: DC to 1.5 GHz, 2.58 to 7 GHz Attenuation: ≥20 dB (<5 GHz), ≥10 dB (≥5 GHz)
I/O connector	N-J
Max. input power	1 W
Dimensions and mass	148 x 35 x 31 mm, ≤500 g

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MA2512A	Band Pass Filter
	Standard accessory
W1876AE	MA2512A operation manual: 1 copy
	Peripherals
MG3681A	Digital Modulation Signal Generator



MICROWAVE COMPONENTS

OUTLINE OF MICROWAVE COMPONENTS

Precision Components-Precision Measurements

Anritsu is a leader in the design and production of precision microwave components.

- Precision Coaxial Connector Systems to 65 GHz
- Precision Coaxial and Waveguide to Coax Adapters
- High Directivity SWR Autotesters and Bridges
- RF Detectors
- Precision Terminations and Air lines
- Precision Fixed Attenuators
- Precision Step Attenuators
- Precision Power Dividers and Splitters
- Precision Bias Tees
- Broadband Microwave Limiters

Connector Design Leadership

Anritsu is the leader in high frequency microwave connector technology and is driven by an ongoing commitment to exceed customer needs. Anritsu created and trademarked the K Connector® with coverage to 40 GHz, along with a complete family of 40 GHz test equipment. It was an immediate success and today is used on many commercial components, test fixtures, and military systems.

The V Connector® offers coaxial coverage to 65 GHz and uses a 1.85 mm geometry endorsed by the International Electrotechnical Commission (IEC). It mates with commercially available 2.4 mm connectors.

Anritsu continues its leadership role with the introduction of the Integrated V Connector, which combines compatibility with V Connectors with easy installation and consistent excellent performance.

The VP™ Connector delivers push-on simplicity with excellent performance to 65 GHz.

Coaxial and Waveguide to Coax Adapters

A series of precision measurement adapters are available to adapt one connector type to another. Poor adapter VSWR (or poor return loss) can be a major source of measurement error and, therefore, adapters must be carefully selected. Anritsu precision adapters typically have 6-12 dB better return loss than competitive units. Waveguide-to-Coax Adapters are available to 65 GHz.

Precision Terminations and Air Lines

Anritsu is recognized as the leader in the field of impedance standards. Anritsu air lines and terminations are unsurpassed for accuracy and impedance matching. Not only do these products increase measurement accuracy, they also provide the only method of certifying the performance of SWR Autotesters, bridges, directional couplers, and other devices.

Precision Fixed Attenuators

Anritsu attenuators offer superior performance in a low cost package. The low VSWR (excellent return loss) minimizes signal reflections and simultaneously reduces ripple effects in the output frequency response. This assures flat, consistent attenuation characteristics regardless of other devices reflection characteristics. One of the simplest ways to improve impedance match is to insert a precision attenuator between the device under test and the source or RF detector. The 41K and 41V Series attenuators are specifically designed for such applications where accuracy is a basic requirement.

In addition to being available as individual units of 3, 6, 10, or 20 dB, the 41K and 41V Series Fixed Attenuators are also available in sets with certified calibration data. Available frequency ranges cover DC to 26.5 GHz, 40 GHz, or 60 GHz.

Many other attenuator applications have as their principal objective the reduction of power. Since the attenuator might not be inserted at a measurement point, the measurement precision discussed earlier is not required. In such a power-reducing system application, attenuators are often required in large quantities, making price an important consideration. The 43K Series includes models covering DC to 26.5 GHz, and DC to 40 GHz. All are available with 3, 6, 10, or 20 dB attenuation values. All have the Anritsu K Connectors and are compatible with SMA connectors.

Whatever your fixed attenuator needs might be, Anritsu provides the solution.

Precision Step Attenuators

Anritsu offers low loss, high precision step attenuators. These programmable step attenuators are available with 10 dB steps from 0 to 70 dB or 0 to 110 dB ranges. DC to 40 GHz frequency range ensures the broadest attenuation and frequency coverage available. Contact Anritsu for needs above 40 GHz.

Precision Power Dividers and Splitters

Anritsu produces precision V Connector® dividers and splitters to 60 GHz and precision K Connector® dividers and splitters to 40 GHz.

All Anritsu power dividers are 3-resistor symmetrical designs with excellent amplitude and phase tracking. Anritsu power splitters are 2-resistor designs, used to accurately split signals for ratio measurements.

Precision Bias Tees

Anritsu Bias Tees are used to combine DC and RF for active device measurements. Low RF throughline loss and low SWR ensure negligible effect on measurements from 50 kHz to 60 GHz.

Broadband Microwave Limiters

Anritsu broadband microwave limiters provide the widest frequency range available in a limiter. Designed to protect sensitive microwave equipment, these limiters incorporate unique single-side limiting to provide soft limiting characteristics over 10 MHz to 26.5 GHz.

High Directivity SWR Autotesters and Bridges

SWR Autotesters and SWR Bridges are directional measurement devices that separate the incident and the reflected signals of a device under test. The reflected component can then be compared to the incident signal to determine the difference between the device's impedance and its characteristic impedance.

An SWR bridge has a precision termination inside the bridge, eliminating the need for an external reference. An autotester further simplifies the user interface by incorporating a detector into the RF output that provides a DC output proportional to the DUT mismatch.

The directivity of the SWR Autotester or bridge is the measure of how well the incident and reflected signals can be separated. For example, 40 dB directivity means that the error signal in the output is 40 dB below the reflected signal to be measured.

Anritsu's high directivity bridges and autotesters set the standards for reflection measurements. High directivity translates to accurate measurements. Anritsu high directivity bridges are available for GPC-7, 50Ω and 75Ω Type N. High directivity autotesters are available with GPC-7, Type N, and SMA, 3.5, K Connectors®, and V Connectors®.

RF Detectors

Just as directivity is the principal error contributor in reflection measurements, the impedance match of the signal source and RF detector is a significant error contributor in transmission measurements.

Anritsu offers a complete line of coaxial RF detectors covering from 100 kHz to 50 GHz with the lowest SWR available. The excellent impedance match of the detectors, along with that of the test port on the SWR Autotesters and bridges, minimize errors when making simultaneous transmission and measurements.

Calibration and Verification Kits

Anritsu offers calibration kits which contain all the precision components and tools required to calibrate an Anritsu VNA in a connector style of your choice.

Specials

Anritsu also manufactures assemblies and components to meet specific customer requirements in both coaxial and waveguide structures. These include such components as Connectors, Bias Tee, Step Attenuator, Detector, Power Sensors, Waveguide, Coaxial Adapters, and RF Cables.

When requesting quotations on special assemblies, as a minimum please provide: frequency range, electrical characteristics, mechanical details and outline dimensions if any.

CONNECTORS

K Connector®

DC to 40 GHz

The K Connector® is a precision coaxial connector system that operates up to 40 GHz. It is compatible with SMA, WSMA, and 3.5 mm connectors. It is well suited to applications in components, systems, or instrumentation.

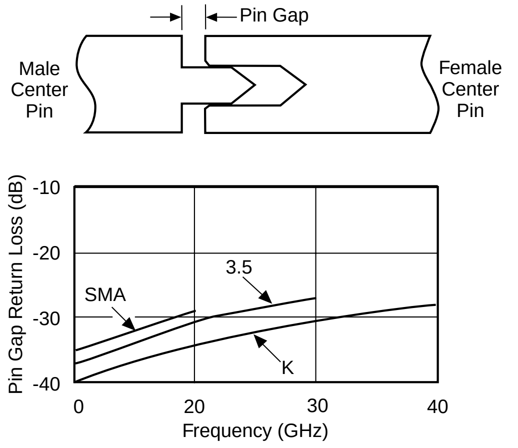
K Connector features

- Excellent performance up to 40 GHz
- Performance exceeding SMA below 18 GHz
- Superior reliability
- Compatibility with SMA, WSMA, and 3.5 mm
- Complete testability on existing network analyzers

Exceptional reliability and repeatability

Microwave connector reliability is affected by insertion force, outer conductor strength, stress relief while mating, and mating alignment. The K Connector exhibits exceptional performance in all of these areas.

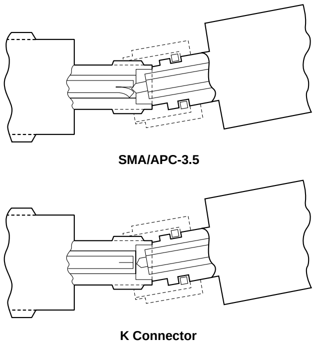
For proper seating, a standard SMA or 3.5 mm connector can require in excess of 27N* of insertion force, In contrast, the K Connector requires only 2.3N*. The reduced wear on the female center conductor improves reliability. In addition, the K Connectors outer conductor is four times thicker than that of SMA. Taken together, the lower insertion force and the thicker wall offer more reliable connections than available from an SMA connector. Life tests show that the K Connector makes greater than 10,000 connections with negligible change in electrical characteristics.



Effect of pin gap

All K Connectors, including the cable connectors, incorporate a feature that eliminates a major cause of connector failure; misalignment of the male pin with respect to the female contacts. To solve the problems, the K Connector male pin is deliberately made shorter than the SMA or 3.5 mm pin. With this arrangement, the outer housing is properly aligned prior to the mating of the center conductors. Thus a proper, non-destructive alignment before mating is ensured.

The effect of pin gap on a connection is often overlooked, but is the dominant source of error in many connection systems. Pin gap is the short length of smaller diameter caused when a connector pair is mated. Pin gap causes a discontinuity at the connector interface. The K Connector has considerably less susceptibility to pin gap than either SMA or 3.5 mm connectors.



Shortened male pin eliminates damage to female K Connector

Many connector manufacturers specify connector performance assuming no pin gap, an unrealistic assumption. K Connectors are specified assuming pin gap to be at its maximum tolerance, to provide you the assurance of real-world specifications.

Compatibility

The K Connector interfaces electrically and mechanically with 3.5 mm connectors, including SMA and 3.5 mm without degradation in performance.

Launcher design

At the heart of the K Connector product line are the launchers. As their name implies, the launchers “launch” (make the transition) from a microwave circuit (microstrip, suspended substrate, stripline, or coplanar waveguide) to a coaxial connector and an outside transmission line. The key to making the transition without compromising electrical and mechanical objectives is the glass bead in the launcher assembly.

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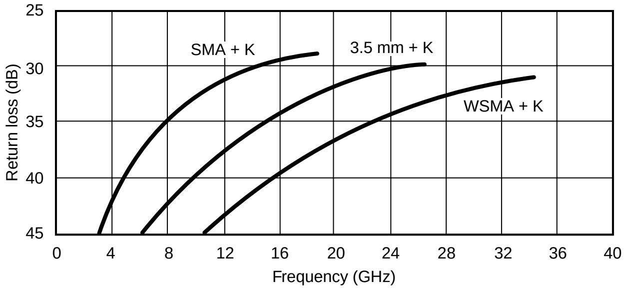
*Force is measured in Newtons (N).

Low-reflection bead

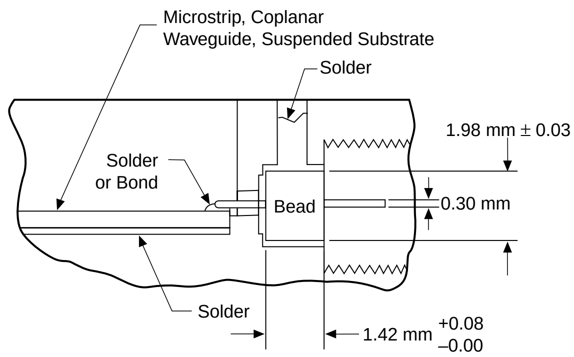
The K Connector's standard glass bead has a 0.30 mm center conductor and readily connects to fragile devices. The bead is appropriate for most applications employing Duroid and ceramic (Alumina) microstrip, such as the 0.25 mm wide transmission line on a 0.25 mm thick Alumina substrate. Applications using suspended substrate geometry are equally well satisfied. The bead is constructed of Corning 7070 glass and has a gold-plated center conductor and a gold-plated Kovar collar.

The outstanding design of the bead is largely accountable for the excellent performance of the K Connector launchers. Because the small 0.30 mm pin introduces minimal discontinuity, return loss is typically better than 20 dB at 40 GHz and better than 25 dB below 18 GHz. In addition, the design provides for soldering the bead to achieve a hermetic seal. A 310°C maximum soldering temperature is recommended.



Return loss characteristics

Both the sparkplug (screw-in) and the flange-mount K Connector launchers offer an additional advantage over existing designs. These launchers do not use an epoxy pin to secure the center conductor, as used in some SMA designs. Without an epoxy pin, the outer conductor remains solid, and thereby eliminates the leakage path common to pin-captivated designs. Furthermore, K launchers have a wall thickness that is four times that of typical launchers (0.8 vs. 0.2 mm). The heavier wall results in superior resistance to over-torquing. Finally, the K Connector launcher can be removed for repair without removal of the glass bead. This ensures that during removal the critical microcircuit-to-glass bead interface is not disturbed, hermeticity is preserved, and the micro-circuit will not be subjected to the additional stress caused by heating to soldering temperature. Hardware locking compound such as removable Loctite® should be used to further secure the screw-in launcher in its housing.



Transition from microcircuit to external transmission line

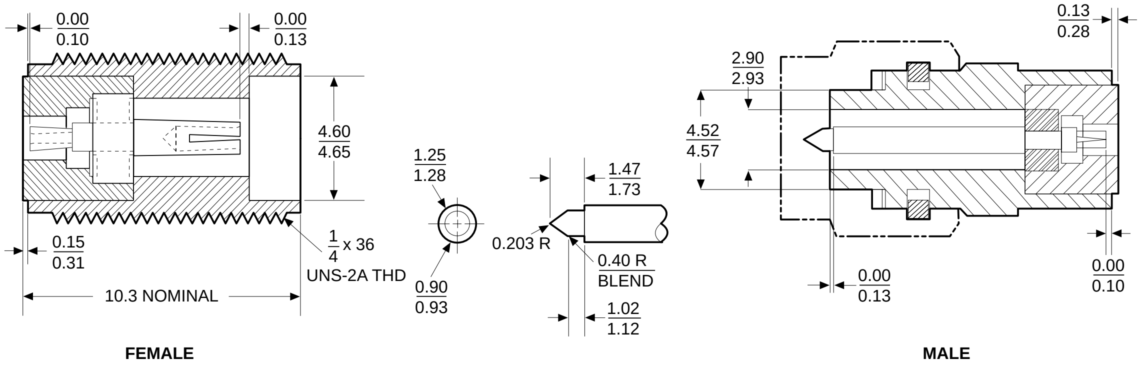
Complete family

Virtually every interface need can be satisfied by one or more of the K Connector items offered. There are six different models of K Connector launchers. Two sparkplug (screw-in) launchers are available, the K102F female version and the K102M male version. Both screw into the housing that encloses the microwave circuit, and, like all Anritsu launchers, they can be easily removed for replacement or repair without unsoldering the glass bead and its interface to the microwave circuit.

When the housing that encloses the microwave circuit is not thick enough to support a threaded, screw-in launcher, flush-mounted (flange) launchers are required. Models with two mounting holes are available in both male and female versions, K103M and K103F. Two other models, the K104F and K104M, have four mounting holes. Mounting hole spacing is identical to that of similar SMA flange launchers. The glass bead interface, of course, is the same design used for the sparkplug launcher.

Cable connectors

Both male and female cable connectors are available. The cable connectors, K101M and K101F, use gold-plated, beryllium-copper center conductors for optimum performance and wear characteristics. Typical return loss at 40 GHz for finished cables exceeds 16 dB (1.35 SWR).



Dimensions in millimeters

K Connector® interface dimensions

Evaluation kit

- **01-101A evaluation kit**

Kit contains one K120 25 cm male/male cable assembly, two K102F female sparkplug launcher connector assemblies, two K104F female flange launcher connector assemblies, five K100 glass beads, one 01-102A test fixture, one 01-104 drill and tap set, five K110-1 microstrip sliding contacts, and all other parts and fixtures required to assemble launchers with or without sliding contacts.

Tools and fixtures

- **01-103 soldering fixture**

For sparkplug launcher glass beads, package of 10.

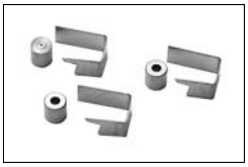
- **01-104 drill and tap set**

For precision machining of concentric holes for mounting K Connector® in microwave housing (drill part No. B14094, tap part No. 783-255).

- **01-105A male and female sparkplug torquing kit**

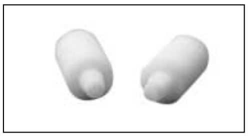
- **01-106 K soldering fixture**

For flange launcher glass bead, package of 5.



- **01-107M or 01-107F cable sleeve soldering fixture**

For K101M male and K101F female cable connectors, package of 10.



- **01-108 drill and tap set**

For precision machining of concentric holes for mounting K Connector in microwave housing in applications where stress relief contacts are used (drill part No. B16526, tap part No. 783-255).

- **01-118 K Connector cable assembling fixture kit**

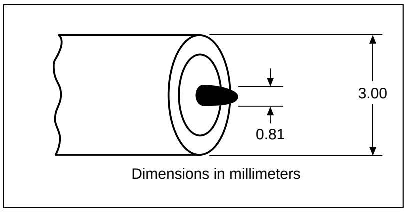
For K118 semi-rigid coaxial cable.

Semirigid coaxial cable

Type	Semirigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor
Impedance	50 ±2 Ω
Dielectric type	Microporous Teflon, 0.24 cm diameter
Dielectric constant	1.687
Relative velocity	0.77
Outside diameter	3.00 mm
Center conductor diameter	0.81 mm
Minimum bend radius	0.65 cm
Attenuation	1.6 dB/m at 10 GHz 2.3 dB/m at 20 GHz 3.3 dB/m at 30 GHz 4.7 dB/m at 40 GHz

- **K118 Semi-rigid coaxial cable**

1.5 m length of 3.00 mm semi-rigid cable for K101 series connector

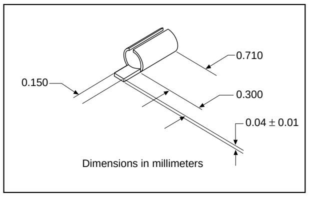


Stress relief contacts

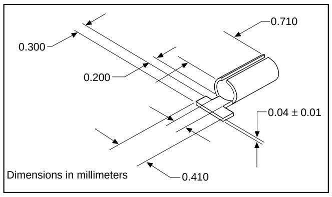
Stress Relief Contacts provide an elegant yet simple solution to relieving stress at the interface of the microcircuit and its connecting coaxial conductor. These contacts simply slide onto the K100 and K100B standard glass bead pins.

Frequency range	DC to 40 GHz
Material	0.025 mm heat-treated BeCu
Plating	Bondable gold

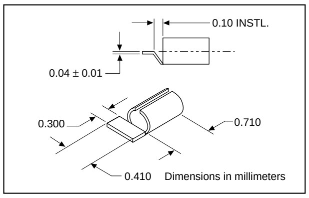
- **K110-1* microstrip and coplanar waveguide**



- **K110-3* microstrip**



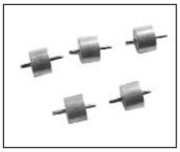
- **K110-2* stripline**



* Use with 01-108 Drill and Tap Set

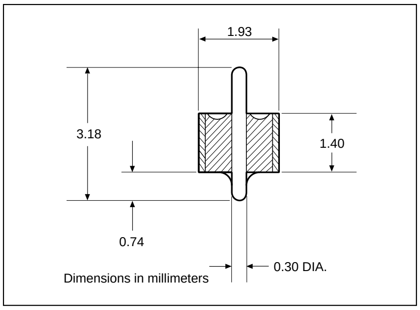
Launchers and cable connectors

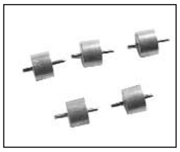
Return loss (launchers only)	15 dB up to 40 GHz
Coupling nut tightening torque	1.36 N-m max
Material	Passivated stainless steel with heat-treated beryllium copper center conductors
Pin depth	0.000 to –0.13 mm for male and female connectors
Temperature range	–55˚ to +125˚C (200˚C available; contact factory)



● **K100**[1,2]

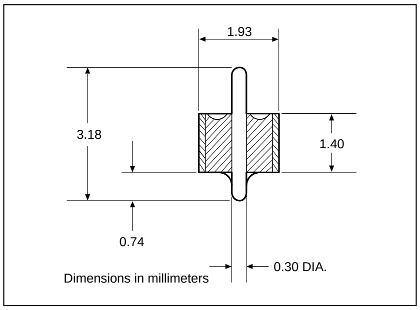
Glass beads for K102, K103 and K104 connectors





● **K100B**[1,2]

High Hermeticity* Glass Beads for K102, K103, and K104 connectors

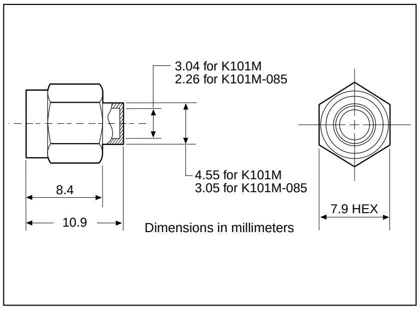


● **K101M**[4]

K male in-line cable connector, DC to 40 GHz for 0.118 cable

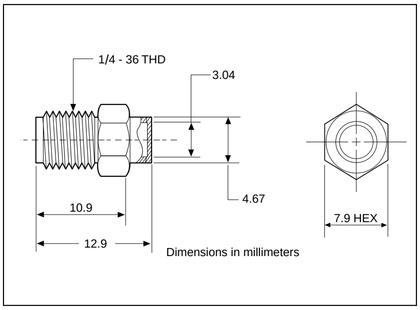
● **K101M-085**

for 0.085 cable



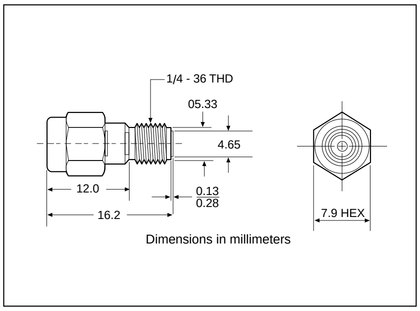
● **K101F**[5]

K female in-line cable connector, DC to 40 GHz for 0.118 cable



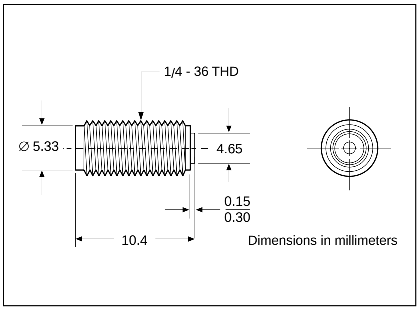
● **K102M**[3]

K male sparkplug launcher connector, DC to 40 GHz



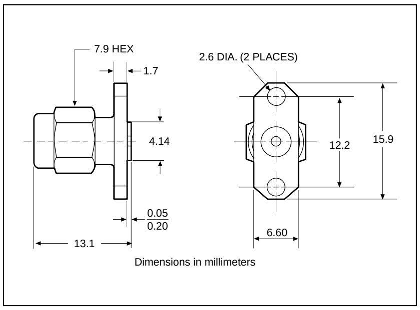
● **K102F**[3]

K female sparkplug launcher connector, DC to 40 GHz



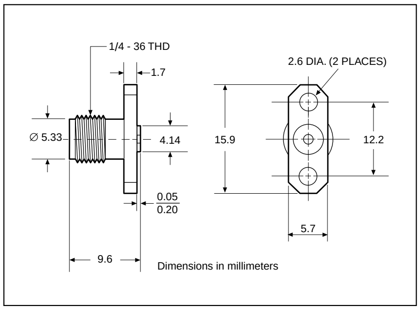
● **K103M**

K male flange launcher, two-hole, DC to 40 GHz



● **K103F**

K female flange launcher, two-hole, DC to 40 GHz



Notes:
1. Use with 01-104 or 01-108 Drill and Tap Sets
2. Use with 01-103 or 01-106 Soldering Fixtures
3. Use with 01-105A Male and Female Sparkplug Torquing Kit
4. Use with 01-107M Cable Sleeve Fixture
5. Use with 01-107F Cable Sleeve Fixture

* Glass Bead Hermeticity Spec: Hermetic to 1 x 10^{-8} std cc He/sec at 1atm differential

● K104M

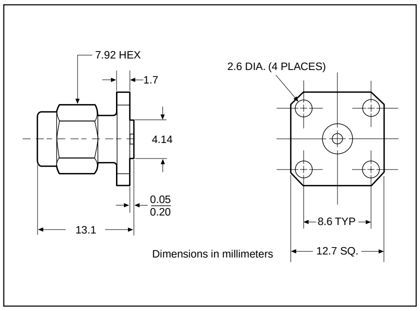
K male flange launcher, four-hole, DC to 40 GHz

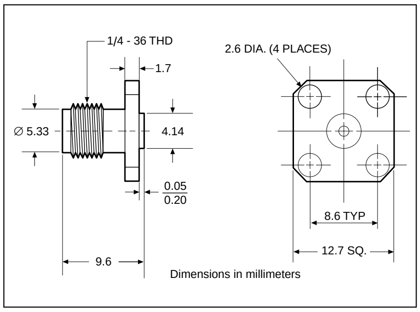
● K104F

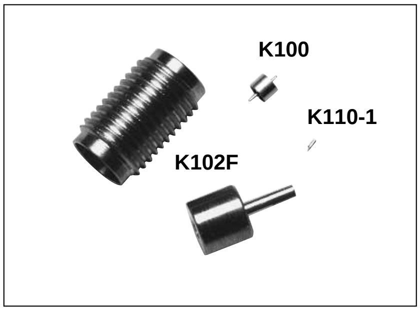
K female flange launcher, four-hole, DC to 40 GHz

● K202F

Combination of K102F, K100, K110-1

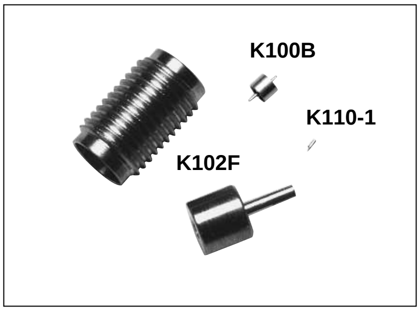






● K202FB

Combination of K102F, K100B, K110-1



Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
01-101A	K Connector® (evaluation kit)
01-103	Soldering fixture for sparkplug launcher glass bead
01-104	Drill and tap set
01-105A	Male and female sparkplug torquing kit
01-106	Soldering fixture for flange launcher glass bead
01-107F	Cable sleeve soldering fixture, female connector
01-107M	Cable sleeve soldering fixture, male connector
01-108	Drill and tap set
01-118	Cable assembling fixture for 0.118-inch semi-rigid coax cable
K110-1	Microstrip stress relief contact
K110-2	Stripline stress relief contact
K110-3	Microstrip stress relief contact
K100	Glass bead for K102/103/104 connector.
K100B	Hermetic glass bead for K102/103/104 connector.
K101M	K(m) in-line cable connector, DC to 40 GHz for K118 cable
K101M-085	K(m) in-line cable connector, DC to 40 GHz for V085 cable
K101F	K(f) in-line cable connector, DC to 40 GHz
K102M	K(m) sparkplug launcher connector, DC to 40 GHz
K102F	K(f) sparkplug launcher connector, DC to 40 GHz
K103M	K(m) flange launcher connector, DC to 40 GHz, 2 mounting holes
K103F	K(f) flange launcher connector, DC to 40 GHz, 2 mounting holes
K104M	K(m) flange launcher connector, DC to 40 GHz, 4 mounting holes
K104F	K(f) flange launcher connector, DC to 40 GHz, 4 mounting holes
K118	Coaxial cable, 1.5 m of 3.00 mm semi-rigid cable for K101 series connector
K202F	Combination of K100, K102F, and K110-1
K202FB	Combination of K100B, K102F, and K110-1

CONNECTORS

V Connector®

DC to 65 GHz

The V Connector® is a reliable 1.85 mm device that operates up to 65 GHz. It is compatible with 2.4 mm connectors and is assembled using procedures that are similar to those used on K Connectors. It is well suited to applications in components, systems, or instrumentation.

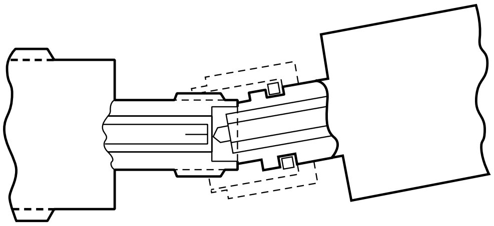
V Connector® features

- Excellent performance up to 65 GHz
- Low VSWR
- Superior reliability
- Low Loss

Exceptional reliability and repeatability

Microwave connector reliability is affected by insertion force, outer conductor strength, stress relief while mating, and mating alignment. The V Connector exhibits exceptional performance in all of these areas.

For proper seating, the V Connector requires only half the insertion force of a 2.4 mm connector. The reduced wear on the center conductor equates to greater reliability. All V Connectors, including the cable connectors, incorporate another feature that eliminates a major cause of connector failure; misalignment of the male pin with respect to the female. To solve the problem, the V Connector male pin is deliberately made sufficiently short to prevent damage to the female connector by misalignment. With this arrangement, the outer housing must be properly aligned prior to the mating of the center conductors. Thus a proper, non-destructive alignment before mating is ensured.

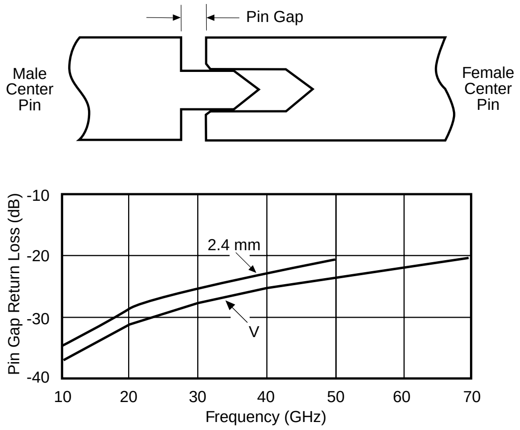


V Connector®

Shortened male pin eliminates damage to female V Connector®

The effect of pin gap on a connection is often overlooked, but is the dominant source of error in many connection systems. Pin gap is the short length of smaller diameter created when a connector pair is mated. Pin gap causes a discontinuity at the connector interface. The V Connector has considerably less susceptibility to pin gap than 2.4 mm connectors.

Many connector manufacturers specify connector performance assuming no pin gap, an unrealistic assumption. V Connectors are specified assuming pin gap to be at its maximum tolerance, to provide you the assurance of real-world specifications.



Effect of pin gap

Launcher design

At the heart of the V Connector product line are the launchers. As their name implies, the launchers “launch” (make the transition) from a microwave circuit (microstrip, suspended substrate, stripline, or coplanar waveguide) to a coaxial connector and an outside transmission line. The key to making the transition without compromising electrical and mechanical objectives is the glass bead in the launcher assembly.

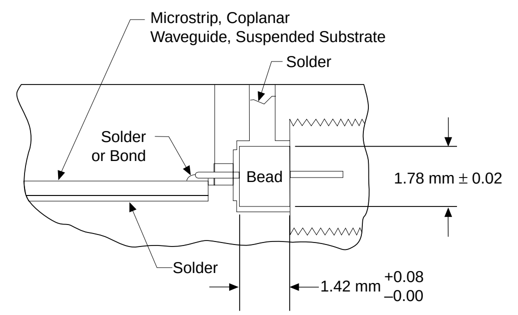
Low-reflection glass bead

The V Connector’s standard glass bead has a unique 0.23 mm center conductor and readily connects to fragile devices. The bead is appropriate for most applications employing Duroid and ceramic (Alumina) microstrip, such as the 0.25 mm wide center conductor on a 0.25 mm thick Alumina substrate. Applications using suspended substrate geometry are equally well satisfied. The bead is constructed of Corning 7070 glass and has a gold-plated center conductor and a gold-plated Kovar® collar.

The outstanding design of the bead is largely accountable for the excellent performance of the V Connector launchers. In addition, the design provides for soldering the bead to achieve a hermetic seal. A 310°C maximum soldering temperature is recommended. The V Connector launchers can be removed for repair without removal of the glass bead. This ensures that during removal the critical microcircuit-to-glass bead interface is not disturbed, that hermeticity is preserved, and that the microcircuit will not be subjected to the additional stress caused by heating to soldering temperature. Hardware locking compound such as removable Loctite® should be used to further secure the launcher in its housing.

Complete family

Anritsu's family of V Connector products is large and growing. Virtually every interface need can be satisfied by one or more of the items offered. As a convenience to the design engineer, each item is completely specified with both guaranteed and typical performance. There are four different models of V Connector launchers. Two types of sparkplug (screw-in) launchers are available; the V102F female version and the V102M male version. Both screw into the housing that encloses the microwave circuit. And, like all Anritsu launchers, they can be easily removed for replacement or repair without unsoldering the glass bead and its interface to the microwave circuit.



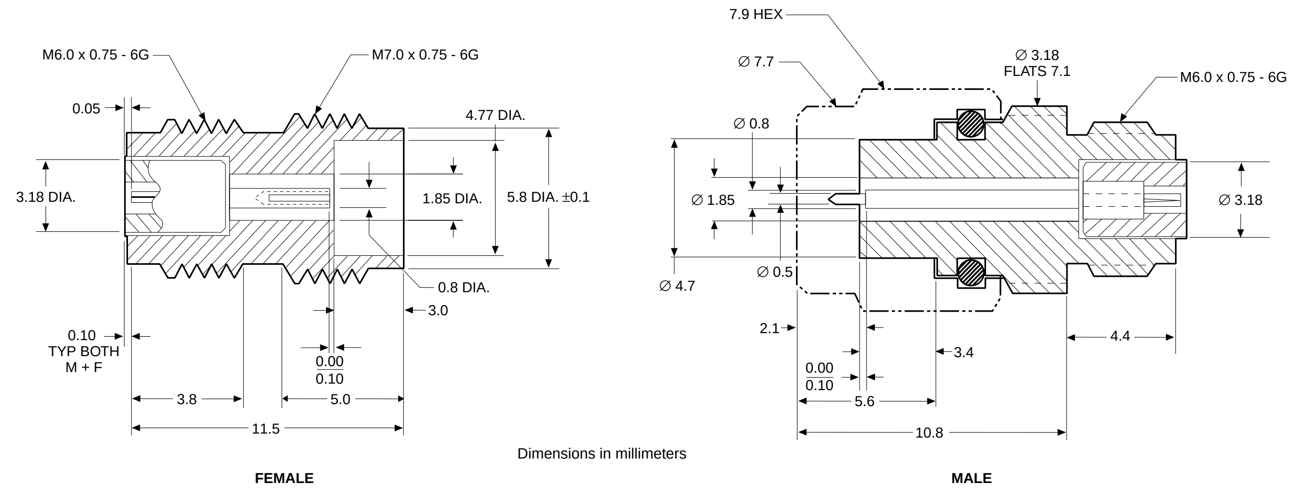
Transition from microcircuit to outside transmission line

When the housing that encloses the microwave circuit is not thick enough to support a threaded, screw-in launcher, flush-mounted (flange) launchers are required. Models with two mounting holes are available in both male and female versions, V103M and V103F. The mounting hole spacing is identical to that of similar SMA flange launchers. The glass bead interface, of course, is the same design used for the sparkplug launcher.

Cable connectors

To complement high performance V085 cable, both male and female cable connectors are available. Typical return loss at 60 GHz for finished cables exceeds 16 dB (1.35 SWR).

The V Connector coaxial cable connectors use a 2.16 mm cable with a microporous Teflon dielectric and a copper center conductor. The cable assemblies use the center conductor of the coax as the male pin. This is similar to the UT-141 SMA-type assembly and 2.4 mm cable assemblies. The microporous Teflon dielectric has maximum phase stability and minimum insertion loss. This type of cable assembly allows for easy assembly and maximum RF performance; however, since the male pin is copper, the cable assemblies are not suitable for repeated connections. In applications where the cable will be subject to more than 100 connections, we recommend that a connector saver be used.



V Connector® interface dimensions

Evaluation kit

- **01-301 V Connector® evaluation kit**

Kit contains one V120MM-25CM male/male cable assembly, two V102F female sparkplug launcher connector assemblies, two V103F female flange launcher connector assemblies, two V101M male in-line cable connector assemblies, five V100 glass beads, one 01-304 drill and tap set, one 01-302 test fixture, two 01-303 soldering fixtures.

Tools and fixtures

- **01-303 soldering fixture**

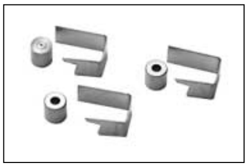
For sparkplug launcher glass beads, package of 10.

- **01-304 drill and tap set**

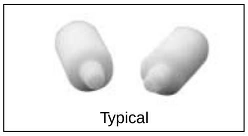
For precision machining of concentric holes for mounting V Connector® in microwave housing (drill part No. 783-568, tap part No. 783-569).

- **01-105A K and V Connector® male and female sparkplug torquing kit**

- **01-306 soldering fixture**
For flange launcher glass bead, package of 5.



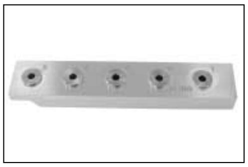
- **01-307M or 01-307F cable sleeve soldering fixture**
For V101M male and V101F female cable connectors, package of 10.



Typical

- **01-308 drill and tap set**
For precision machining of concentric holes for mounting V Connector® in microwave housing in applications where stress-relief contacts are used.

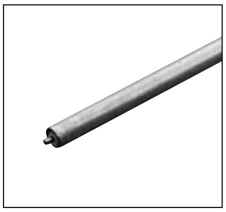
- **01-309 V Connector® cable assembling fixture**
For 0.085 semi-rigid cable.

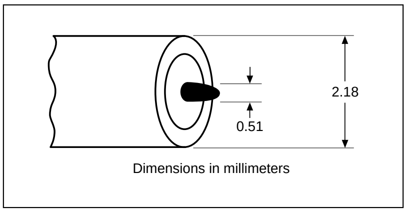


Semirigid coaxial cable

Type	Semi-rigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor
Impedance	50 ±2 Ω
Dielectric type	Microporous Teflon, 0.14 cm diameter
Dielectric constant	1.687
Relative velocity	0.77
Outside diameter	2.16 mm
Center conductor diameter	0.51 mm
Minimum bend radius	0.65 cm
Attenuation	2.3 dB/m at 10 GHz 3.6 dB/m at 20 GHz 4.3 dB/m at 30 GHz 5.2 dB/m at 40 GHz 7.2 dB/m at 60 GHz

- **V085 semirigid coaxial cable**
1.5 m length of 2.16 mm semi-rigid cable for V101 series connector

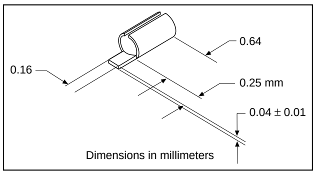




Stress relief contacts

Stress Relief Contacts provide an elegant yet simple solution to relieving stress at the interface of the microcircuit and its connecting coaxial conductor. These contacts simply slide onto the standard glass bead pins and can be soldered, bonded or parallel gap welded to a circuit trace.

Frequency range	DC to 67 GHz
Material	0.025 mm heat-treated BeCu
Plating	Bondable gold
Packaging	Lots of 25

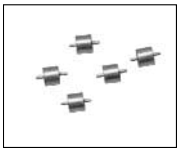


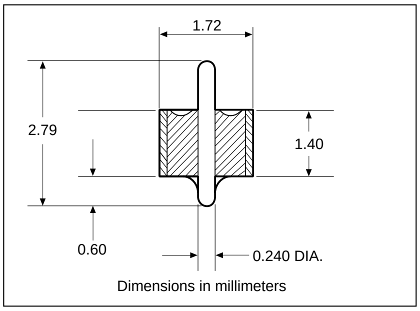
- **V110-1 microstrip and coplanar waveguide**

When using the V110-1, use 01-308 drill and tap set to make the required concentric holes.

Launchers and cable connectors

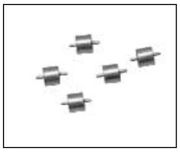
Return loss (launchers only)	13 dB up to 60 GHz typical
Coupling nut tightening torque	1.36 N-m typical
Material	Passivated stainless steel with heat-treated beryllium copper center conductors
Pin depth	0.000 to –0.130 mm for male and female connectors
Temperature range	–55˚ to +125˚C

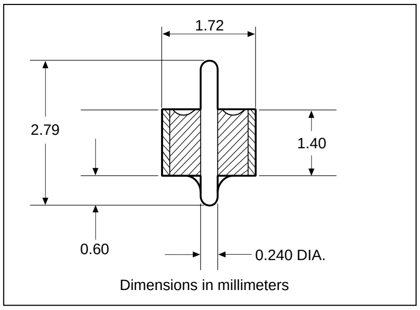




- **V100**^{1,2}

Glass beads for V102 and V103 connectors (package of 5)





- **V100B**^{1,2}

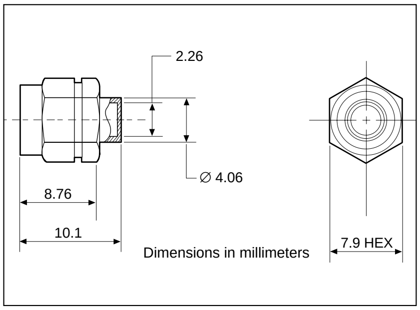
High Hermeticity* Glass Beads for V102, and V103 connectors (package of 5)

* Glass Bead Hermeticity Spec: Hermetic to 1 x 10^{-8} std cc He/sec at 1atm differential

Notes:
1. Use with 01-303 or 01-306 Soldering Fixtures
2. Use with 01-304 or 01-308 Drill and Tap Sets

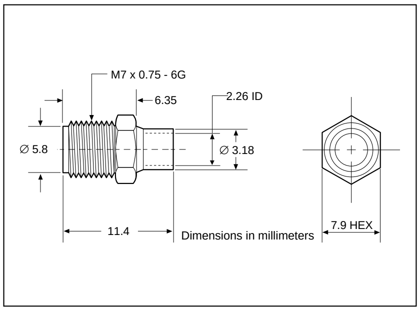
● V101M[2,4]

V male in-line cable connector, DC to 65 GHz for V085 cable



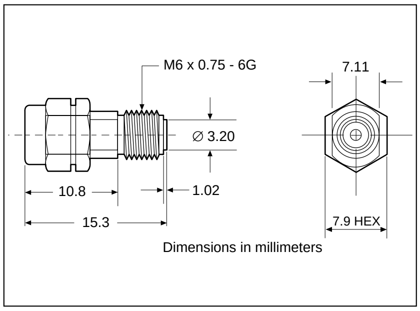
● V101F[3,4]

V female in-line cable connector, DC to 65 GHz for V085 cable



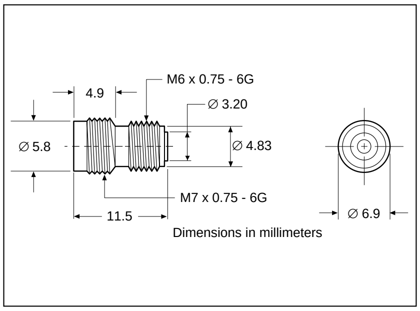
● V102M[1]

V male sparkplug launcher connector, DC to 65 GHz



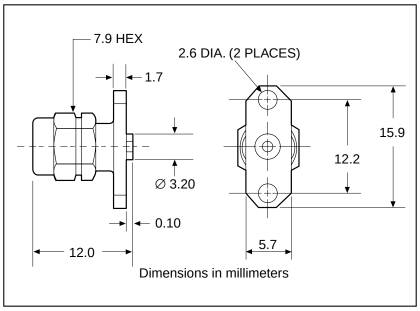
● V102F[1]

V female sparkplug launcher connector, DC to 65 GHz



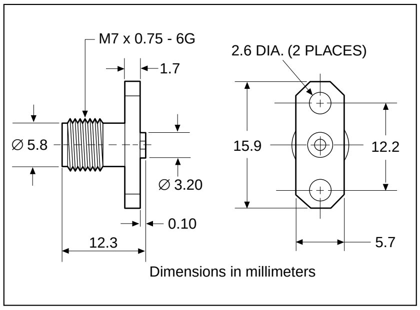
● V103M

V male flange launcher, two-hole, DC to 65 GHz



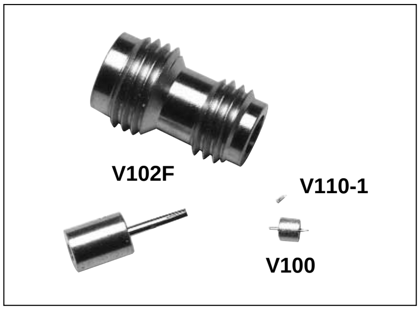
● V103F

V female flange launcher, two-hole, DC to 65 GHz



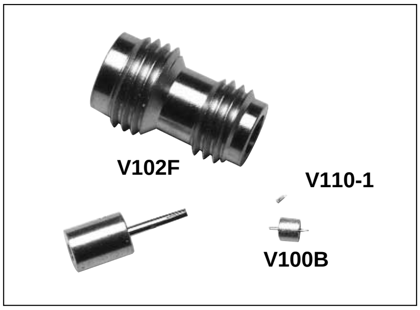
● V202F

Combination of V102F, V100, V110-1



● V202FB

Combination of V102F, V100B, V110-1



Notes:
1. Use with 01-105A Male and Female Sparkplug Torquing Kit
2. Use with 01-307M Cable Sleeve Fixture
3. Use with 01-307F Cable Sleeve Fixture
4. Use with 01-309 Cable Assembling Fixture

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
01-105A	Male and female sparkplug torquing kit
01-301	V Connector® (evaluation kit)
01-303	Soldering fixture for sparkplug launcher glass bead
01-304	Drill and tap set
01-306	Soldering fixture for flange launcher glass bead
01-307M	Cable sleeve soldering fixture, male connector
01-307F	Cable sleeve soldering fixture, female connector
01-308	Drill and tap set
01-309	Cable assembly fixture
V085	Coaxial cable, 152 cm (5 feet) length of 2.16 mm semi-rigid cable
V100	Glass bead for V102/103 connectors.
V100B	Hermetic glass beads for V102/103 connectors.
V101M	V(m) in-line cable connector, DC to 65 GHz
V101F	V(f) in-line cable connector, DC to 65 GHz
V102M	V(m) sparkplug launcher connector, DC to 65 GHz
V102F	V(f) sparkplug launcher connector, DC to 65 GHz
V103M	V(m) flange launcher connector, DC to 65 GHz, 2 mounting holes
V103F	V(f) flange launcher connector, DC to 65 GHz, 2 mounting holes
V110-1	Microstrip stress relief contact
V202F	Combination of V100, V102F, and V110-1
V202FB	Combination of V100B, V102F, and V110-1

CONNECTORS

Integrated V Connector®

DC to 65 GHz

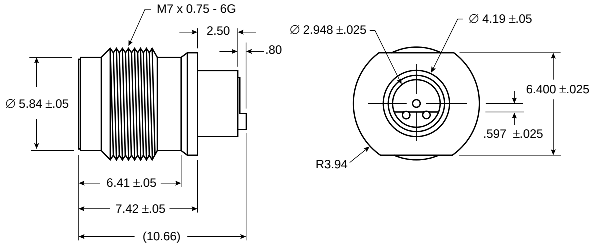
V115FMS10

V115FMS75

V115FCPW

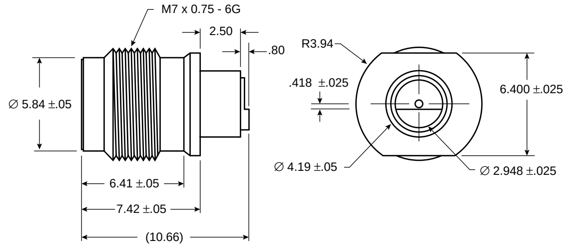
V116F

The Integrated V Connector® family is a group of female connectors which have the launcher and the glass bead integrated into one piece. All compensation steps for matching to Microstrip or Coplanar Waveguide (CPW) are included in the solder-in hermetic* connectors, ensuring that they deliver excellent performance. The integrated V connectors come in two easy-to-install styles: the solder-in version, which is the V115F group, and the V116F screw-in version, which allows more versatility of microcircuit launch design. In addition, the V116F can be soldered-in for hermeticity. These connectors, except for the CPW version, are designed to be used with the V110-1 Stress Relief Contacts. The Integrated V connectors are compatible with other V Connectors.



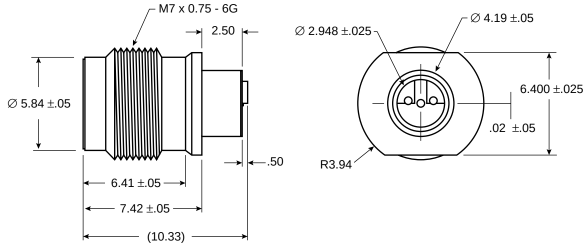
V115FMS10*

Integrated V Female solder-in connector, with ground lip, DC to 65 GHz. Compensated for Microstrip. For use with 0.25 mm (10 mil) substrates.



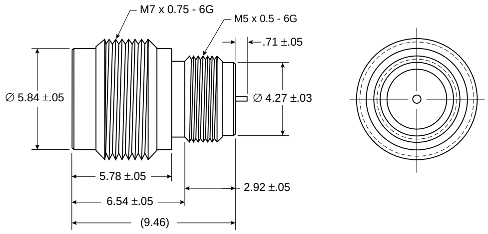
V115FMS75*

Integrated V Female solder-in connector, with ground lip, DC to 65 GHz. Compensated for Microstrip. For use with 0.19 mm (7.5 mil) substrates.



V115FCPW*

Integrated V Female solder-in connector, with ground lip, DC to 65 GHz. Compensated for Coplanar Waveguide.



V116F*

Integrated V Female Sparkplug (screw-in) connector, DC to 65GHz.

∗ Hermeticity specification: 1 x10^{-8} std cc He/sec at 1 atm differential.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
V115FMS10	Integrated V(f) solder-in connector for use with 0.25 mm (10 mil) substrates
V115FMS75	Integrated V(f) solder-in connector for use with 0.19 mm (7.5 mil) substrates
V115FCPW	Integrated V(f) solder-in connector for Coplanar Waveguide
V116F	Integrated V(f) sparkplug connector

CONNECTORS

VP™ Connector Family

DC to 65 GHz

The new VP Connector family, with shrouds and adapters, is well suited for applications in components, systems and instrumentation to 65 GHz. Anritsu's family of VP Connectors satisfy virtually every interface and provide excellent and reliable performance.

Features

- Superior RF Performance to 65 GHz
- Hermetic Connection
- Sliding Contact Connection to Microstrip
- Ground lip for handling substrates on carriers
- Testing capabilities using VP-VF Adapter
- Auto alignment capabilities on VP-VF Adapters

VP Bullet

The VP Bullet is a VP-VP adapter, designed to connect two modules with shrouds, back to back. The VP Bullet exhibits exceptional performance due to it's unique design concept. The VP Bullet is designed with six slots in the outer conductor and four slots in the center conductor. The increase in the number of slots in the outer conductor reduces the insertion and extraction force to less than one half of the force required for conventional SMP connectors and thus reduces wear and tear. In the lab VP Bullets have been tested to 1000 insertions with no degradation in performance. Anritsu guarantees at least 500 connections. In addition, the VP Bullet provides a positive stop so that fingers cannot be damaged during insertion.

VP Shroud Design

Anritsu VP Shrouds are based on the design concept first used in Anritsu's Integrated V Connector®. VP Shrouds use the standard V glass bead and the critical compensation steps required to install the glass bead in the housing are a part of the hermetic shroud design. Since Anritsu controls the critical internal dimensions, consistent performance is assured. Additionally, the ground lip allows the substrate ground to be attached directly to the connector, eliminating the long ground path common to other connector families. This short ground path improves return loss performance, especially at the high end of the frequency range.

VP Shrouds, except for the CPW version, are designed to be used with the Anritsu V110-1 Stress Relief Contact (sliding contact). The CPW backside interface is a pin overlap design, so the center pin is directly connected to the transmission line and the substrate ground is directly attached to the ground lip.

Cable Connector

The VP cable connector uses standard semi-rigid 2.16 mm cable just like the V cable connectors. One can install a standard V cable connector on the opposite end and make the testing of modules much easier. The VP cable connector has a flange to ensure a good rigid connection to the module. The cable connectors can also be utilized for connecting two modules back to back.

VP-VF Adapters

VP-VF Adapters are specifically designed for testing the modules using the Precision V Connector. The VP-VF Adapter can be replaced with a VP Bullet or VP cable connector.

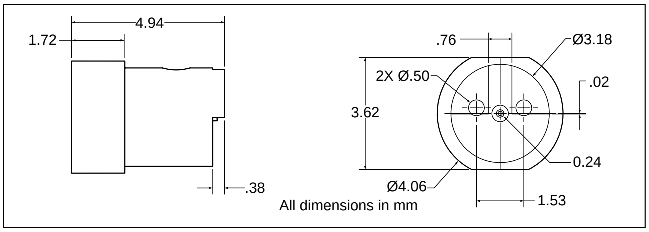
Model 01-501
Bullet insertion and removal tool

Model 01-502
Torque screwdriver adapter

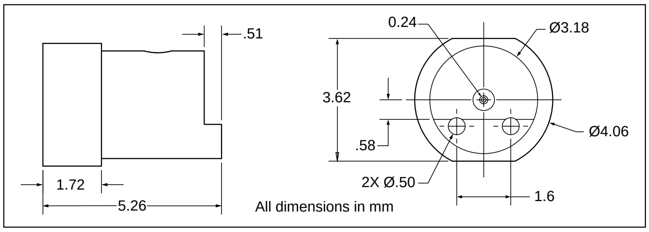
Specifications

Impedance	50 Ω
Frequency	DC to 65 GHz
Insertion loss	$0.05 \sqrt{f}$ (GHz)
VSWR	1.43:1 to 65 GHz typical
Insulation resistance	> 1200 MΩ
Center conductor contact resistance	6 mΩ typical
Force to engage	4.2 N typical (1 lbf typical)
Force to disengage	7 N typical (1.5 lbf typical)
Center contact retension	83 N typical (18 lbf typical)
Radial misalignment	0.25 mm (0.010”)
Axial misalignment	0 – 0.15 mm (0 to 0.006”)
Hermeticity	1 x 10^{-8} std cc He/sec at 1 atmosphere differential for all shrouds

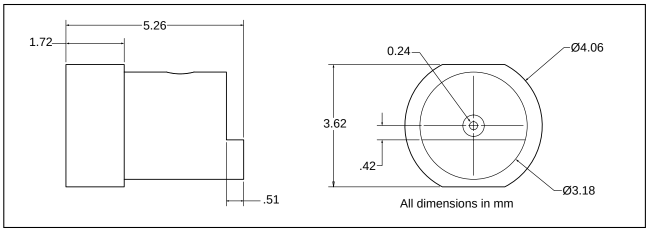
VP100BCPW
Solder-in CPW
hermetic shroud



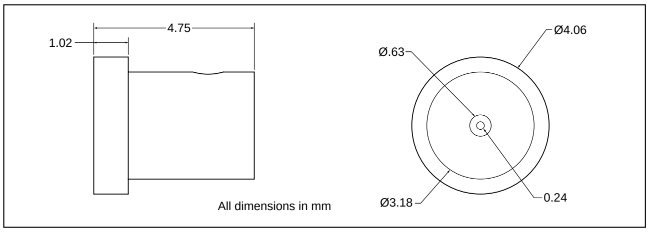
VP100BMS10
Solder-in
10 mil microstrip
hermetic shroud

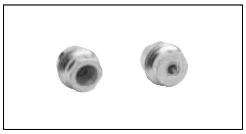


VP100BMS75
Solder-in
7.5 mil microstrip
hermetic shroud

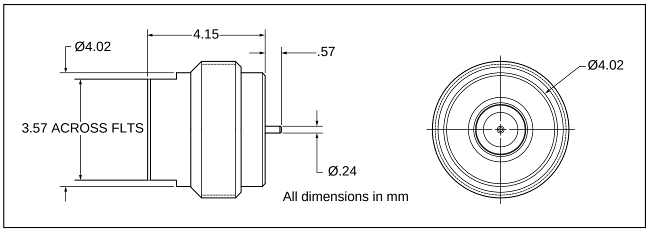


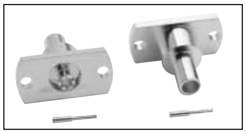
VP100BNL
No lip
hermetic shroud



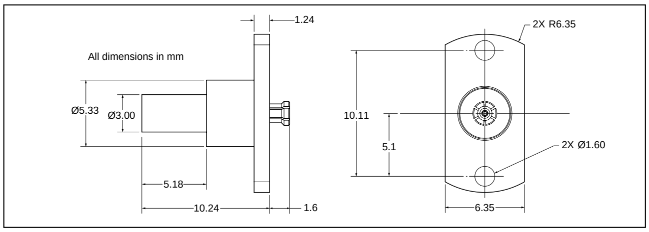


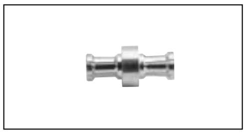
VP100B
Screw in
hermetic shroud



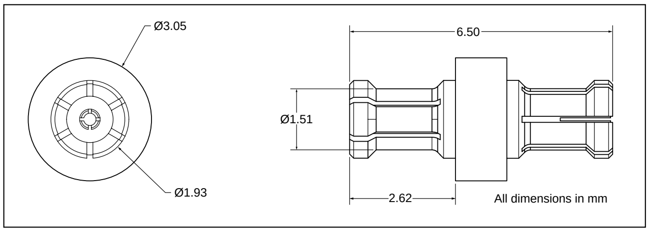


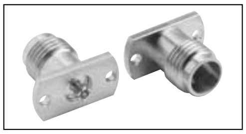
VP101F
VP cable adapter



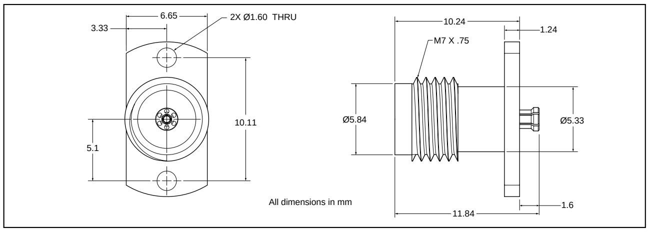


VP102F
VP bullet





VP103F
VP-VF adapter



Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
VP100BCPW	Solder-in CPW hermetic shroud
VP100BMS10	Solder-in 10 mil microstrip hermetic shroud
VP100BMS75	Solder-in 7.5 mil microstrip hermetic shroud
VP100BNL	No lip hermetic shroud
VP100B	Screw in hermetic shroud
VP101F	VP cable adapter
VP102F	VP bullet
VP103F	VP-VF adapter
Model 01-501	Bullet insertion and removal tool
Model 01-502	Torque screwdriver adapter

CONNECTOR TOOLS

01-201, 01-204

01-201

01-204

Anritsu provides two connector tools that make connecting and disconnecting tiny connectors more easily and surely accomplished. These tools are featured below.

Features

- 01-201 Torque wrench: 0.9 N-M (8 in-lbs) for standard SMA and 3.5 mm connectors, and for the Anritsu K Connector® and V Connector®.
- 01-204 Handy stainless steel connector wrench for standard SMA, 3.5 mm, and 2.4 mm connectors, and for the Anristu K Connector® and V Connector®.

Ordering information

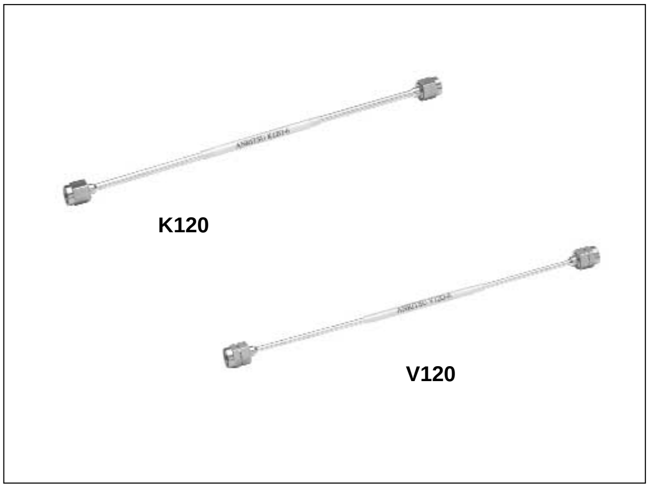
Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
01-201	5/16 torque wrench, 0.9 N-M (8 in-lbs), for SMA, 3.5 mm, K Connector® and V Connector®
01-204	Anritsu stainless steel connector wrench

RF CABLES

K120, V120 Series

DC to 67 GHz



Anritsu produces precision RF cables with characteristics as shown in the tables below. Contact the Microwave Measurements Division for low loss, low VSWR cable bending services.

Semi-rigid RF cable features

- DC to 67 GHz frequency range
- Type N, K Connector®, and V Connector®
- K Connector® compatibility with SMA and 3.5 mm
- V Connector® compatibility with 2.4 mm

Specifications

Model	Frequency range (GHz)	Impedance (Ω)	Length	Connectors
N120-6	DC to 18	50	15 cm	N(m) - N(m)
NS120MF-6	DC to 18	50	15 cm	N(m) - SMA(f)
K120MM	DC to 40	50	See table	K(m) - K(m)
K120MF	DC to 40	50	See table	K(m) - K(f)
K120FF	DC to 40	50	See table	K(f) - K(f)
V120MM	DC to 67	50	See table	V(m) - V(m)
V120MF	DC to 67	50	See table	V(m) - V(f)
V120FF	DC to 67	50	See table	V(f) - V(f)

Temperature range: –55°C to +125°C

Semirigid coaxial cable specifications for K Connectors

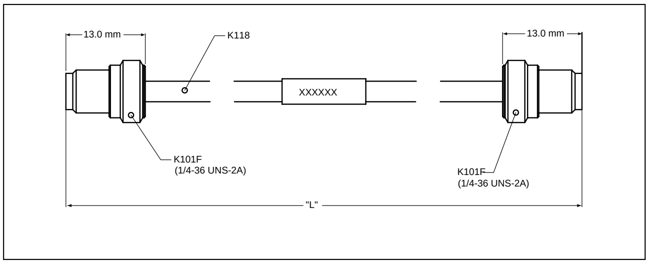
Type	Semirigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor
Impedance	50 ±2 Ω
Dielectric type	Microporous Teflon, 0.24 cm diameter
Dielectric constant	1.687
Relative velocity	0.77
Outside diameter	3.00 mm
Center conductor diameter	0.81 mm
Minimum bend radius	0.65 cm
Attenuation	1.6 dB/m at 10 GHz, 2.3 dB/m at 20 GHz, 3.3 dB/m at 30 GHz, 4.7 dB/m at 40 GHz
K118 semirigid coaxial cable	1.52m length of 0.118-inch Semirigid cable for K101 series connector

Semirigid coaxial cable specifications for V Connectors

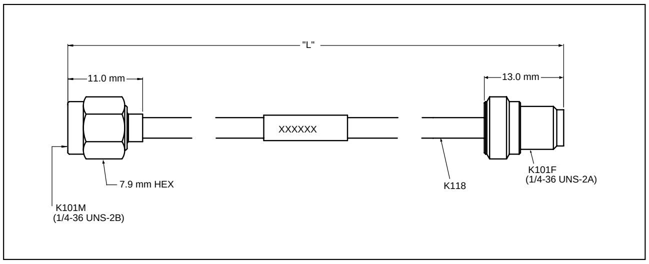
Type	Semirigid coaxial, tin-plated copper outer conductor, silver-plated copper center conductor
Impedance	50 ±2 Ω
Dielectric type	Microporous Teflon, 0.14 cm diameter
Dielectric constant	1.687
Relative velocity	0.77
Outside diameter	2.18 mm
Center conductor diameter	0.51 mm
Minimum bend radius	0.65 cm
Attenuation	2.3 dB/m at 10 GHz, 3.6 dB/m at 20 GHz, 4.3 dB/m at 30 GHz, 5.2 dB/m at 40 GHz, 7.2 dB/m at 60 GHz

Cable assembly part number reference

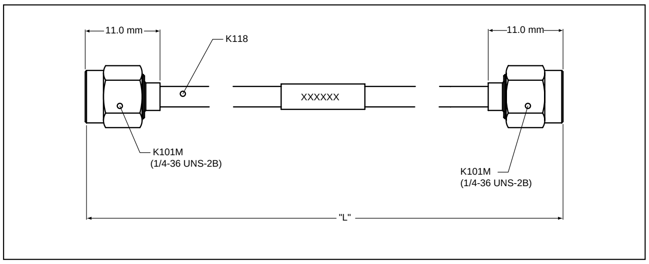
Length	Metric cable asemblies					
cm	K120MM	K120MF	K120FF	V120MM	V120MF	V120FF
5	K120MM-5CM	K120MF-5CM	K120FF-5CM	V120MM-5CM	V120MF-5CM	V120FF-5CM
10	K120MM-10CM	K120MF-10CM	K120FF-10CM	V120MM-10CM	V120MF-10CM	V120FF-10CM
15	K120MM-15CM	K120MF-15CM	K120FF-15CM	V120MM-15CM	V120MF-15CM	V120FF-15CM
20	K120MM-20CM	K120MF-20CM	K120FF-20CM	V120MM-20CM	V120MF-20CM	V120FF-20CM
25	K120MM-25CM	K120MF-25CM	K120FF-25CM	V120MM-25CM	V120MF-25CM	V120FF-25CM
30	K120MM-30CM	K120MF-30CM	K120FF-30CM	V120MM-30CM	V120MF-30CM	V120FF-30CM
35	K120MM-35CM	K120MF-35CM	K120FF-35CM	V120MM-35CM	V120MF-35CM	V120FF-35CM
40	K120MM-40CM	K120MF-40CM	K120FF-40CM	V120MM-40CM	V120MF-40CM	V120FF-40CM
45	K120MM-45CM	K120MF-45CM	K120FF-45CM	V120MM-45CM	V120MF-45CM	V120FF-45CM
50	K120MM-50CM	K120MF-50CM	K120FF-50CM	V120MM-50CM	V120MF-50CM	V120FF-50CM
60	K120MM-60CM	K120MF-60CM	K120FF-60CM	V120MM-60CM	V120MF-60CM	V120FF-60CM
70	K120MM-70CM	K120MF-70CM	K120FF-70CM	V120MM-70CM	V120MF-70CM	V120FF-70CM
80	K120MM-80CM	K120MF-80CM	K120FF-80CM	V120MM-80CM	V120MF-80CM	V120FF-80CM
90	K120MM-90CM	K120MF-90CM	K120FF-90CM	V120MM-90CM	V120MF-90CM	V120FF-90CM
100	K120MM-150CM	K120MF-100CM	K120FF-100CM	V120MM-100CM	V120MF-100CM	V120FF-100CM
125	K120MM-125CM	K120MF-125CM	K120FF-125CM	V120MM-125CM	V120MF-125CM	V120FF-125CM
150	K120MM-150CM	K120MF-150CM	K120FF-150CM	V120MM-150CM	V120MF-150CM	V120FF-150CM



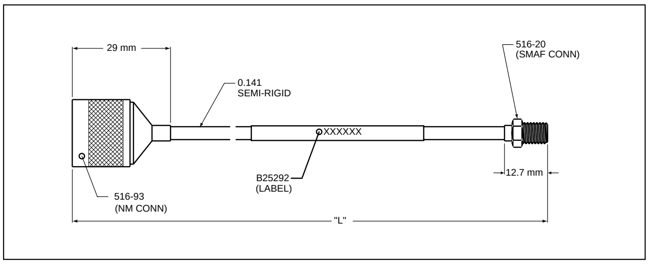
K120FF outline



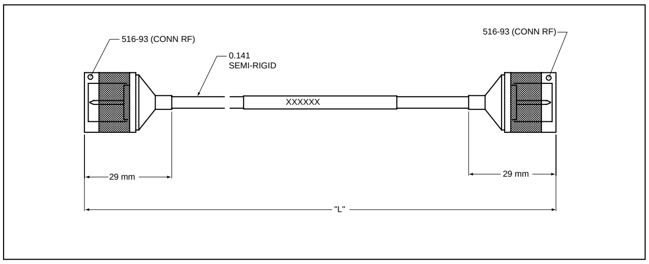
K120MF outline



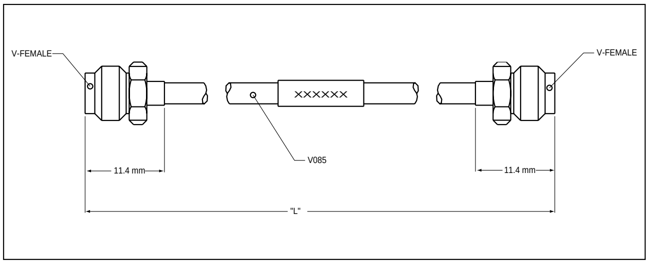
K120MM outline



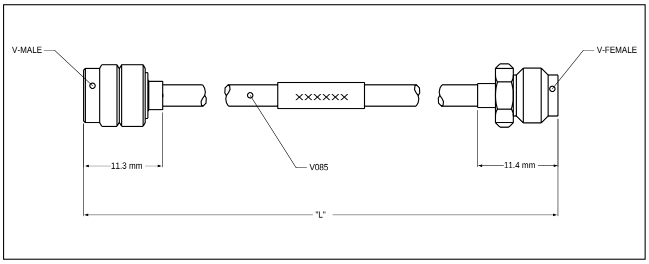
N120-6 outline



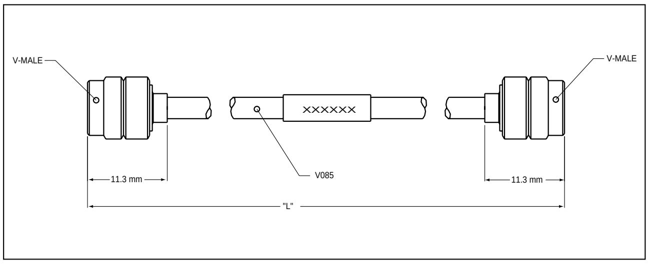
NS120MF-6 outline



V120FF outline



V120MF outline



V120MM outline

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Cable, semi-rigid
N120-6	0.01 to 18 GHz, 50 Ω, 15 cm, N(m) to N(m)
NS120MF-6	0.01 to 18 GHz, 50 Ω, 15 cm, N(m) to SMA(f)
K120MM-5CM	DC to 40 GHz, 50 Ω, 5 cm, K(m) to K(m)
K120MM-10CM	DC to 40 GHz, 50 Ω, 10 cm, K(m) to K(m)
K120MM-15CM	DC to 40 GHz, 50 Ω, 15 cm, K(m) to K(m)
K120MM-20CM	DC to 40 GHz, 50 Ω, 20 cm, K(m) to K(m)
K120MM-25CM	DC to 40 GHz, 50 Ω, 25 cm, K(m) to K(m)
K120MM-30CM	DC to 40 GHz, 50 Ω, 30 cm, K(m) to K(m)
K120MM-35CM	DC to 40 GHz, 50 Ω, 35 cm, K(m) to K(m)
K120MM-40CM	DC to 40 GHz, 50 Ω, 40 cm, K(m) to K(m)
K120MM-45CM	DC to 40 GHz, 50 Ω, 45 cm, K(m) to K(m)
K120MM-50CM	DC to 40 GHz, 50 Ω, 50 cm, K(m) to K(m)
K120MM-60CM	DC to 40 GHz, 50 Ω, 60 cm, K(m) to K(m)
K120MM-70CM	DC to 40 GHz, 50 Ω, 70 cm, K(m) to K(m)
K120MM-80CM	DC to 40 GHz, 50 Ω, 80 cm, K(m) to K(m)
K120MM-90CM	DC to 40 GHz, 50 Ω, 90 cm, K(m) to K(m)
K120MM-100CM	DC to 40 GHz, 50 Ω, 100 cm, K(m) to K(m)
K120MM-125CM	DC to 40 GHz, 50 Ω, 125 cm, K(m) to K(m)
K120MM-150CM	DC to 40 GHz, 50 Ω, 150 cm, K(m) to K(m)
K120MF-5CM	DC to 40 GHz, 50 Ω, 5 cm, K(m) to K(f)
K120MF-10CM	DC to 40 GHz, 50 Ω, 10 cm, K(m) to K(f)
K120MF-15CM	DC to 40 GHz, 50 Ω, 15 cm, K(m) to K(f)
K120MF-20CM	DC to 40 GHz, 50 Ω, 20 cm, K(m) to K(f)
K120MF-25CM	DC to 40 GHz, 50 Ω, 25 cm, K(m) to K(f)
K120MF-30CM	DC to 40 GHz, 50 Ω, 30 cm, K(m) to K(f)
K120MF-35CM	DC to 40 GHz, 50 Ω, 35 cm, K(m) to K(f)
K120MF-40CM	DC to 40 GHz, 50 Ω, 40 cm, K(m) to K(f)
K120MF-45CM	DC to 40 GHz, 50 Ω, 45 cm, K(m) to K(f)
K120MF-50CM	DC to 40 GHz, 50 Ω, 50 cm, K(m) to K(f)
K120MF-60CM	DC to 40 GHz, 50 Ω, 60 cm, K(m) to K(f)
K120MF-70CM	DC to 40 GHz, 50 Ω, 70 cm, K(m) to K(f)
K120MF-80CM	DC to 40 GHz, 50 Ω, 80 cm, K(m) to K(f)
K120MF-90CM	DC to 40 GHz, 50 Ω, 90 cm, K(m) to K(f)
K120MF-100CM	DC to 40 GHz, 50 Ω, 100 cm, K(m) to K(f)
K120MF-125CM	DC to 40 GHz, 50 Ω, 125 cm, K(m) to K(f)
K120MF-150CM	DC to 40 GHz, 50 Ω, 150 cm, K(m) to K(f)
K120FF-5CM	DC to 40 GHz, 50 Ω, 5 cm, K(f) to K(f)
K120FF-10CM	DC to 40 GHz, 50 Ω, 10 cm, K(f) to K(f)
K120FF-15CM	DC to 40 GHz, 50 Ω, 15 cm, K(f) to K(f)
K120FF-20CM	DC to 40 GHz, 50 Ω, 20 cm, K(f) to K(f)
K120FF-25CM	DC to 40 GHz, 50 Ω, 25 cm, K(f) to K(f)
K120FF-30CM	DC to 40 GHz, 50 Ω, 30 cm, K(f) to K(f)
K120FF-35CM	DC to 40 GHz, 50 Ω, 35 cm, K(f) to K(f)
K120FF-40CM	DC to 40 GHz, 50 Ω, 40 cm, K(f) to K(f)
K120FF-45CM	DC to 40 GHz, 50 Ω, 45 cm, K(f) to K(f)
K120FF-50CM	DC to 40 GHz, 50 Ω, 50 cm, K(f) to K(f)
K120FF-60CM	DC to 40 GHz, 50 Ω, 60 cm, K(f) to K(f)
K120FF-70CM	DC to 40 GHz, 50 Ω, 70 cm, K(f) to K(f)
K120FF-80CM	DC to 40 GHz, 50 Ω, 80 cm, K(f) to K(f)
K120FF-90CM	DC to 40 GHz, 50 Ω, 90 cm, K(f) to K(f)
K120FF-100CM	DC to 40 GHz, 50 Ω, 100 cm, K(f) to K(f)
K120FF-125CM	DC to 40 GHz, 50 Ω, 125 cm, K(f) to K(f)
K120FF-150CM	DC to 40 GHz, 50 Ω, 150 cm, K(f) to K(f)

Model/Order No.	Name
V120MM-5CM	DC to 65 GHz, 50 Ω, 5 cm, V(m) to V(m)
V120MM-10CM	DC to 65 GHz, 50 Ω, 10 cm, V(m) to V(m)
V120MM-15CM	DC to 65 GHz, 50 Ω, 15 cm, V(m) to V(m)
V120MM-20CM	DC to 65 GHz, 50 Ω, 20 cm, V(m) to V(m)
V120MM-25CM	DC to 65 GHz, 50 Ω, 25 cm, V(m) to V(m)
V120MM-30CM	DC to 65 GHz, 50 Ω, 30 cm, V(m) to V(m)
V120MM-35CM	DC to 65 GHz, 50 Ω, 35 cm, V(m) to V(m)
V120MM-40CM	DC to 65 GHz, 50 Ω, 40 cm, V(m) to V(m)
V120MM-45CM	DC to 65 GHz, 50 Ω, 45 cm, V(m) to V(m)
V120MM-50CM	DC to 65 GHz, 50 Ω, 50 cm, V(m) to V(m)
V120MM-60CM	DC to 65 GHz, 50 Ω, 60 cm, V(m) to V(m)
V120MM-70CM	DC to 65 GHz, 50 Ω, 70 cm, V(m) to V(m)
V120MM-80CM	DC to 65 GHz, 50 Ω, 80 cm, V(m) to V(m)
V120MM-90CM	DC to 65 GHz, 50 Ω, 90 cm, V(m) to V(m)
V120MM-100CM	DC to 65 GHz, 50 Ω, 100 cm, V(m) to V(m)
V120MM-125CM	DC to 65 GHz, 50 Ω, 125 cm, V(m) to V(m)
V120MM-150CM	DC to 65 GHz, 50 Ω, 150 cm, V(m) to V(m)
V120MF-5CM	DC to 65 GHz, 50 Ω, 5 cm, V(m) to V(f)
V120MF-10CM	DC to 65 GHz, 50 Ω, 10 cm, V(m) to V(f)
V120MF-15CM	DC to 65 GHz, 50 Ω, 15 cm, V(m) to V(f)
V120MF-20CM	DC to 65 GHz, 50 Ω, 20 cm, V(m) to V(f)
V120MF-25CM	DC to 65 GHz, 50 Ω, 25 cm, V(m) to V(f)
V120MF-30CM	DC to 65 GHz, 50 Ω, 30 cm, V(m) to V(f)
V120MF-35CM	DC to 65 GHz, 50 Ω, 35 cm, V(m) to V(f)
V120MF-40CM	DC to 65 GHz, 50 Ω, 40 cm, V(m) to V(f)
V120MF-45CM	DC to 65 GHz, 50 Ω, 45 cm, V(m) to V(f)
V120MF-50CM	DC to 65 GHz, 50 Ω, 50 cm, V(m) to V(f)
V120MF-60CM	DC to 65 GHz, 50 Ω, 60 cm, V(m) to V(f)
V120MF-70CM	DC to 65 GHz, 50 Ω, 70 cm, V(m) to V(f)
V120MF-80CM	DC to 65 GHz, 50 Ω, 80 cm, V(m) to V(f)
V120MF-90CM	DC to 65 GHz, 50 Ω, 90 cm, V(m) to V(f)
V120MF-100CM	DC to 65 GHz, 50 Ω, 100 cm, V(m) to V(f)
V120MF-125CM	DC to 65 GHz, 50 Ω, 125 cm, V(m) to V(f)
V120MF-150CM	DC to 65 GHz, 50 Ω, 150 cm, V(m) to V(f)
V120FF-5CM	DC to 65 GHz, 50 Ω, 5 cm, V(f) to V(f)
V120FF-10CM	DC to 65 GHz, 50 Ω, 10 cm, V(f) to V(f)
V120FF-15CM	DC to 65 GHz, 50 Ω, 15 cm, V(f) to V(f)
V120FF-20CM	DC to 65 GHz, 50 Ω, 20 cm, V(f) to V(f)
V120FF-25CM	DC to 65 GHz, 50 Ω, 25 cm, V(f) to V(f)
V120FF-30CM	DC to 65 GHz, 50 Ω, 30 cm, V(f) to V(f)
V120FF-35CM	DC to 65 GHz, 50 Ω, 35 cm, V(f) to V(f)
V120FF-40CM	DC to 65 GHz, 50 Ω, 40 cm, V(f) to V(f)
V120FF-45CM	DC to 65 GHz, 50 Ω, 45 cm, V(f) to V(f)
V120FF-50CM	DC to 65 GHz, 50 Ω, 50 cm, V(f) to V(f)
V120FF-60CM	DC to 65 GHz, 50 Ω, 60 cm, V(f) to V(f)
V120FF-70CM	DC to 65 GHz, 50 Ω, 70 cm, V(f) to V(f)
V120FF-80CM	DC to 65 GHz, 50 Ω, 80 cm, V(f) to V(f)
V120FF-90CM	DC to 65 GHz, 50 Ω, 90 cm, V(f) to V(f)
V120FF-100CM	DC to 65 GHz, 50 Ω, 100 cm, V(f) to V(f)
V120FF-125CM	DC to 65 GHz, 50 Ω, 125 cm, V(f) to V(f)
V120FF-150CM	DC to 65 GHz, 50 Ω, 150 cm, V(f) to V(f)

COAXIAL ADAPTERS

K, V, K to V

DC to 65 GHz

K222B

K224B

V230

K230B

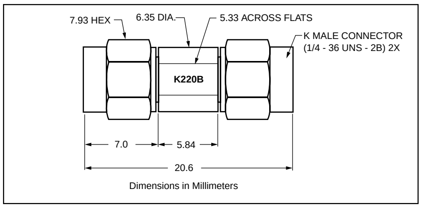
The K220 and 34V Series of precision adapters enable accurate measurements with K or V connectors. Every adapter is fully specified and 100% tested to ensure low reflections and optimum performance over the DC to 60 GHz range.

Precision K and V adapter features

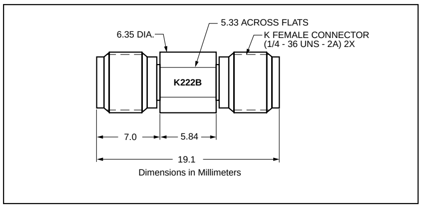
- K Connector® DC to 40 GHz frequency range
- V Connector® DC to 65 GHz frequency range
- Low SWR and insertion loss

Specifications

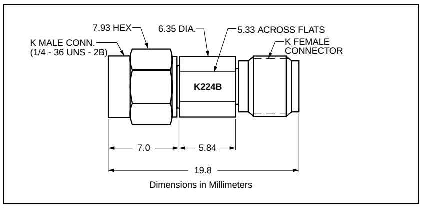
Model	Frequency range (GHz)	Connectors	SWR
K220B K222B K224B	DC to 40	K(m) to K(m) K(f) to K(f) K(f) to K(m)	1.12
34VK50 34VKF50	DC to 40	V(m) to K(m) V(m) to K(f)	1.3
34VFK50 34VFKF50	DC to 40	V(f) to K(m) V(f) to K(f)	1.3
34VV50 34VFVF50 34VVF50	DC to 65	V(m) to V(m) V(f) to V(f) V(m) to V(f)	1.5



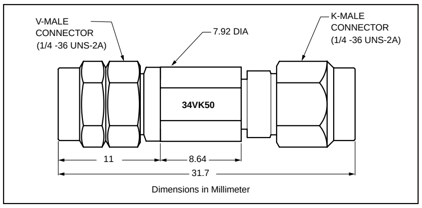
K220B Outline



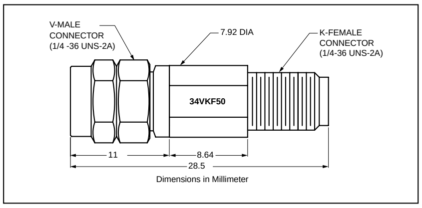
K222B Outline



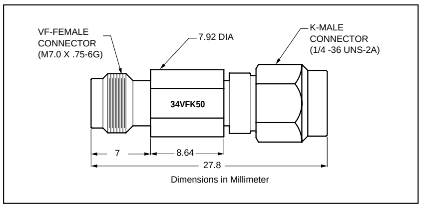
K224B Outline



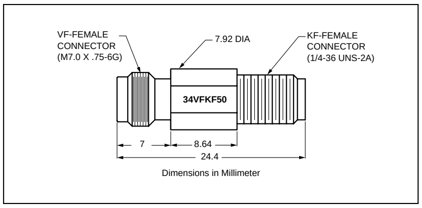
34VK50 Outline



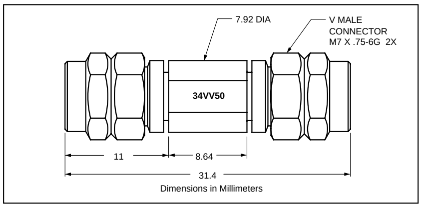
34VKF50 Outline



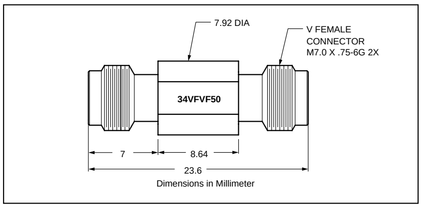
34VFK50 Outline



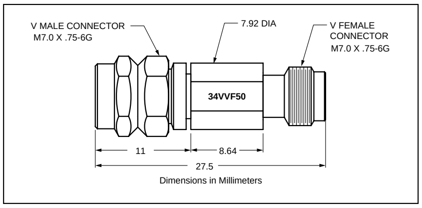
34VFKF50 Outline



34VV50 Outline



34VFVF50 Outline



34VVF50 Outline

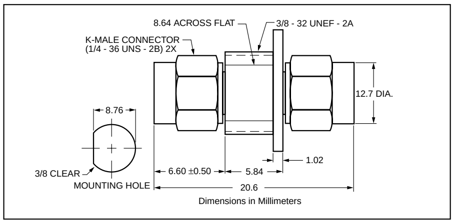
The K230 Series is the panel-mount version of the K220 Series Adapters. These units mount in a standard 9.5 mm “D” hole.

K and V panel adapter features

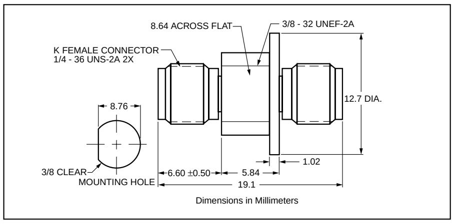
- Precision, panel-mounted feedthru adapter
- Broad, DC to 65 GHz frequency range

K panel adapter specifications

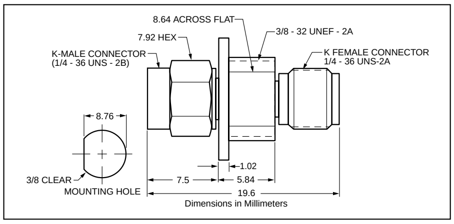
Model	Frequency range (GHz)	Connectors	SWR
K230B	DC to 40	K(m) to K(m)	1.12
K232B		K(f) to K(f)	
K234B		K(f) to K(m)	



K230B outline



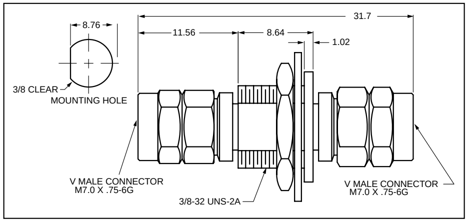
K232B outline



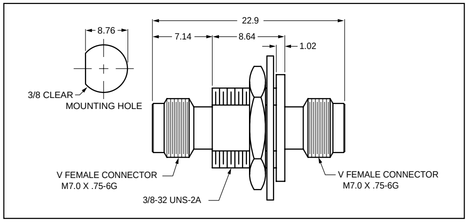
K234B outline

V panel adapter specifications

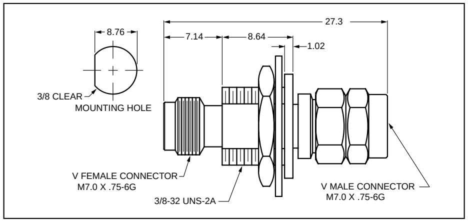
Model	Frequency range (GHz)	Connectors	SWR
K230	DC to 65	V(m) to V(m)	1.5
K232		V(f) to V(f)	
K234		V(f) to V(m)	



V230 Outline



V232 Outline



V234 outline

Ordering information

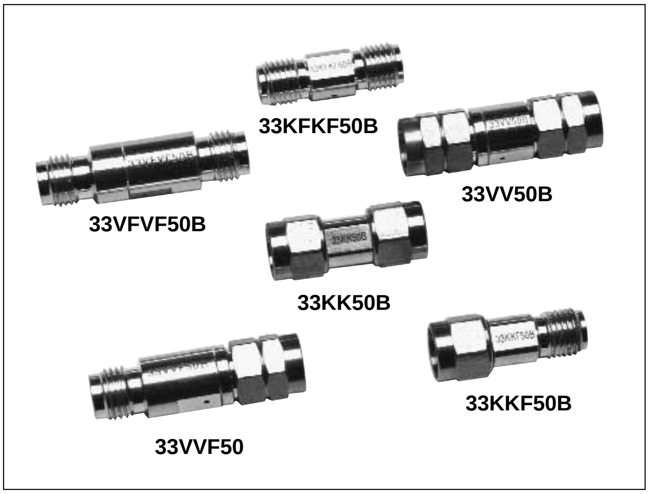
Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Precision adapter
34VK50	DC to 40 GHz, V(m) to K(m)
34VKF50	DC to 40 GHz, V(m) to K(f)
34VFK50	DC to 40 GHz, V(f) to K(m)
34VFKF50	DC to 40 GHz, V(f) to K(f)
34VV50	DC to 60 GHz, V(m) to V(m)
34VFVF50	DC to 60 GHz, V(f) to V(f)
34VVF50	DC to 60 GHz, V(m) to V(f)
K220B	DC to 40 GHz, K(m) to K(m)
K222B	DC to 40 GHz, K(f) to K(f)
K224B	DC to 40 GHz, K(f) to K(m)
K230B	DC to 40 GHz, Panel mount, 50 Ω K(m)-K(m)
K232B	DC to 40 GHz, Panel mount, 50 Ω K(f)-K(f)
K234B	DC to 40 GHz, Panel mount, 50 Ω K(m)-K(f)
V230	DC to 65 GHz, Panel mount, 50 Ω V(m)-V(m)
V232	DC to 65 GHz, Panel mount, 50 Ω V(f)-V(f)
V234	DC to 65 GHz, Panel mount, 50 Ω V(f)-V(m)

CALIBRATION GRADE ADAPTERS

33 Series

DC to 65 GHz



The 33 Series of precision adapters enable accurate measurements with Anritsu V Connector® and K Connector® interfaces. Every adapter is fully specified and 100% tested to ensure low reflections and optimum phase performance over a broad frequency range.

Features

- Low SWR and insertion loss
- DC to 65 GHz, with V Connector® interface
- DC to 40 GHz, with K Connector® interface
- 50 Ω impedance

Specifications

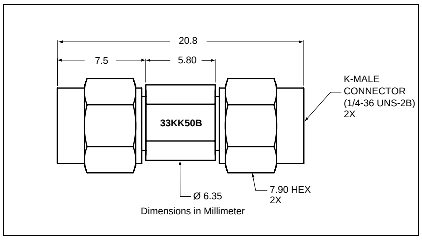
Model	Frequency range (GHz)	Impedance (Ω)	Connectors	SWR
33KK50B	DC to 40	50	K(m)-K(m)	1.1
33KKF50B	DC to 40	50	K(m)-K(f)	1.1
33KFKF50B	DC to 40	50	K(f)-K(f)	1.1
33VV50B	DC to 65	50	V(m)-V(m)	1.22
33VVF50B	DC to 65	50	V(m)-V(f)	1.33
33VFVF50B	DC to 65	50	V(f)-V(f)	1.33

Temperature range: –55°C to +125°C

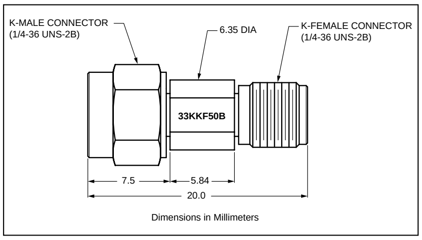
Ordering information

Please specify model/order number, name, and quantity when ordering.

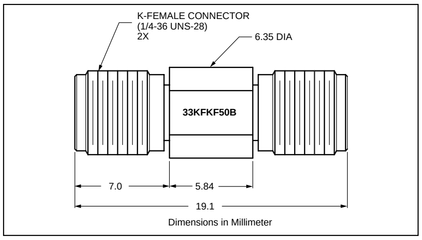
Model/Order No.	Name
	Calibration grade adapter
33KFKF50B	DC to 40 GHz, 50 Ω, K(f)-K(f)
33KK50B	DC to 40 GHz, 50 Ω, K(m)-K(m)
33KKF50B	DC to 40 GHz, 50 Ω, K(m)-K(f)
33VFVF50B	DC to 65 GHz, 50 Ω, V(f)-V(f)
33VV50B	DC to 65 GHz, 50 Ω, V(m)-V(m)
33VVF50B	DC to 65 GHz, 50 Ω, V(m)-V(f)



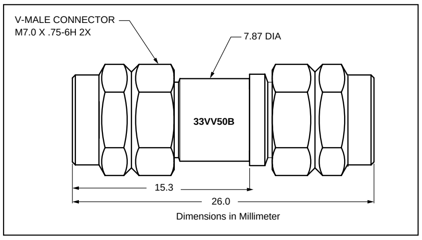
33KK50B Outline



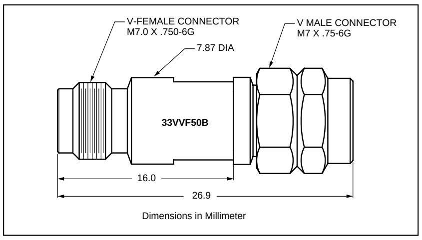
33KKF50B Outline



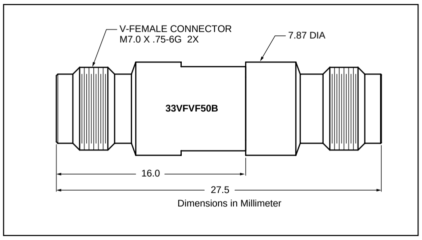
33KFKF50B Outline



33VV50B Outline



33VVF50B Outline



33VFVF50B Outline

INSTRUMENTATION GRADE ADAPTERS

34 Series

34ASF50

34RKRK50

34NN50A

34RSN50

The 34 Series of precision adapters enable accurate measurements with GPC-7, Type N, or WSMA interfaces. Every adapter is fully specified and 100% tested to ensure low reflections and optimum phase performance over a broad frequency range.

Precision adapter features

- Low SWR and insertion loss
- GPC-7, Type N, and WSMA connectors
- Convenient transition with minimal effect on signal
- 50 Ω or 75 Ω impedance

34 Series specifications

Model	Frequency range (GHz)	Impedance (Ω)	Connectors	SWR	Dimensions L(cm) x dia(cm)
34NN75B 34NFNF75B	DC to 3	75	N(m) to N(m) N(f) to N(f)	1.1	6.0 x 2.2 4.7 x 1.6
34AN50 34ANF50	DC to 18	50	GPC-7 to N(m) GPC-7 to N(f)	1.02	4.2 x 2.2 4.2 x 2.2
34AS50 34ASF50	DC to 18	50	GPC-7 to WSMA(m) GPC-7 to WSMA(f)	1.033	3.8 x 2.2 3.8 x 2.2
34NN50A 34NFNF50	DC to 18	50	N(m) to N(m) N(f) to N(f)	1.1	6.0 x 2.2 4.7 x 1.6
34NK50 34NKF50 34NFK50 34NFKF50	DC to 18	50	N(m) to K(m) N(m) to K(f) N(f) to K(m) N(f) to K(f)	1.12	3.8 x 2.2 3.8 x 2.2 3.8 x 1.6 3.8 x 1.6
34SFSF50	DC to 26.5	50	WSMA(f) to WSMA(f)	1.11 to 18.5 GHz 1.18 to 26.5 GHz	1.6 x 0.8

The 34R Series precision adapters provide a rugged, rigid connection between Anritsu instruments with WSMA, K Connector®, or V Connector® outputs and Anritsu SWR Autotesters and SWR Bridges or other instruments.

The adapters have an outside diameter equal to that of a Type N connector, adding mechanical strength to the test setup and making installation convenient and fast.

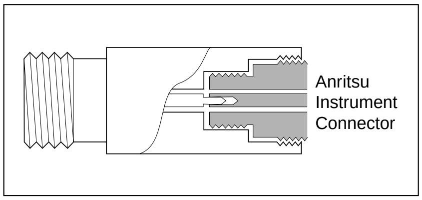
Ruggedized adapter features

- Enhanced reliability of microwave test setup
- Easy-to-grasp Type N outside diameter
- Rigid test connections for improved test data repeatability

34R Series specifications

Model	Frequency range (GHz)	Connectors	SWR	Dimensions L(cm) x dia(cm)
34RSN50	DC to 18	RS(m) to N(m)	1.40	5.1 x 2.2
34RKNF50	DC to 18	RK(m) to N(f)	1.40	5.1 x 1.7
34RVNF50	DC to 18	RV(m) to N(f)	1.40	5.1 x 1.7
34RKRK50	DC to 40	RK(m) to RK(m)	2.00	5.8 x 1.7
34RVRK50	DC to 40	RV(m) to RK(m)	2.00	5.8 x 1.7
34RVRV50	DC to 60	RV(m) to RV(m)	2.30	5.8 x 1.7

Impedance: 50 Ω
Temperature range: 0°C to +75°C



34R Series
Adapter

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Precision adapter
34NN75B	DC to 3 GHz, 75 Ω, N(m)-N(m)
34NFNF75B	DC to 3 GHz, 75 Ω, N(f)-N(f)
34AN50	DC to 18 GHz, 50 Ω, GPC-7-N(m)
34ANF50	DC to 18 GHz, 50 Ω, GPC-7-N(f)
34AS50	DC to 18 GHz, 50 Ω, GPC-7-WSMA(m)
34ASF50	DC to 18 GHz, 50 Ω, GPC-7-WSMA(f)
34NN50A	DC to 18 GHz, 50 Ω, N(m)-N(m)
34NFNF50	DC to 18 GHz, 50 Ω, N (f)-N(f)
34NK50	DC to 18 GHz, 50 Ω, N (m)-K(m)
34NKF50	DC to 18 GHz, 50 Ω, N(m)-K(f)
34NFK50	DC to 18 GHz, 50 Ω, N (f)-K(m)
34NFKF50	DC to 18 GHz, 50 Ω, N(f)-K(f)
34SFSF50	DC to 26.5 GHz, 50 Ω, WSMA(f)-WSMA(f)

INSTRUMENTATION GRADE ADAPTERS

35WR Series

18 to 65 GHz

35WR42K

35WR19K

35WR22V

35WR19V

The 35 Series precision adapters transform standard or double-ridge waveguide to coaxial K Connector® and V Connector® interfaces, thus enabling convenient millimeter wave coaxial measurements.

Features

- 18 to 65 GHz frequency coverage
- K Connector® compatibility with SMA and 3.5 mm
- V Connector® compatibility with 2.4 mm
- Standard and double-ridge designs

Specifications

Model	Frequency range (GHz)	Connectors	W/G flange UG-(_) U	SWR
35WRD180K 35WRD180KF	18 to 40	WRD180 to K(m) WRD180 to K(f)	N/A	1.25
935WR42K 35WR42KF	18 to 26.5	WR42 to K(m) WR42 to K(f)	595	1.25
35WR28K 35WR28KF	26.5 to 40	WR28 to K(m) WR28 to K(f)	599	1.25
35WR22K 35WR22KF	33 to 50	WR22 to K(m) WR22 to K(f)	383	1.30
35WR22V 35WR22VF	33 to 50	WR22 to V(m) WR22 to V(f)	383	1.30
35WR19K 35WR19KF	40 to 50 Usable to 54	WR19 to K(m) WR19 to K(f)	383	1.30
35WR19V 35WR19VF	40 to 60	WR19 to V(m) WR19 to V(f)	383	1.30
35WR15V 35WR15VF	50 to 65	WR15 to V(m) WR15 to V(f)	385	1.38

Impedance: 50 Ω
Maximum input power: 1 W
Temperature range: –55°C to +125°C

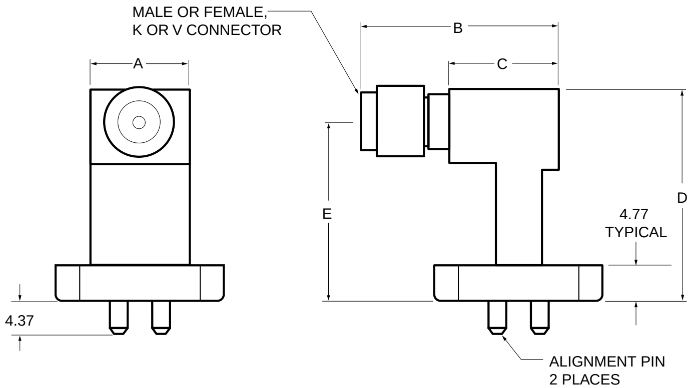
Outline drawings for the 35 Series Waveguide-to-Coaxial Adapters, 18 to 65 GHz, are shown on the following two pages.

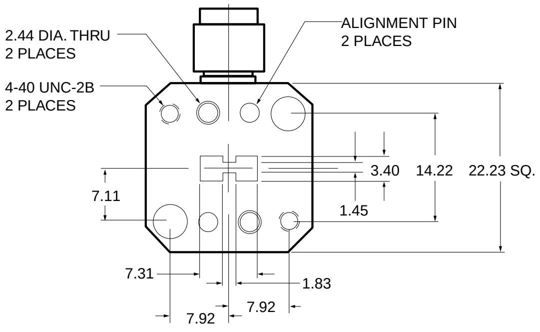
Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Precision waveguide to coax adapter
35WRD180K	18 to 40 GHz, WRD180 (double ridge waveguide) to K(m)
35WRD180KF	18 to 40 GHz, WRD180 (double ridge waveguide) to K(f)
35WR42K	18 to 26.5 GHz, WR42-K(m)
35WR42KF	18 to 26.5 GHz, WR42-K(f)
35WR28K	26.5 to 40 GHz, WR28-K(m)
35WR28KF	26.5 to 40 GHz, WR28-K(f)
35WR22K	33 to 50 GHz, WR22-K(m)
35WR22KF	33 to 50 GHz, WR22-K(f)
35WR22V	33 to 50 GHz, WR22-V(m)
35WR22VF	33 to 50 GHz, WR22-V(f)
35WR19K	40 to 50 GHz (usable to 54 GHz), WR19-K(m)
35WR19KF	40 to 50 GHz (usable to 54 GHz), WR19-K(f)
35WR19V	40 to 60 GHz, WR19-V(m)
35WR19VF	40 to 60 GHz, WR19-V(f)
35WR15V	50 to 65 GHz (usable to 67 GHz), WR15-V(m)
35WR15VF	50 to 65 GHz (usable to 67 GHz), WR15-V(f)

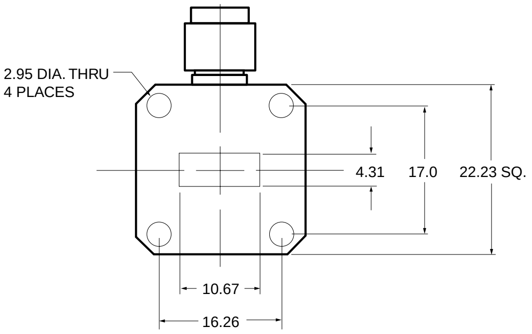
Outline drawings



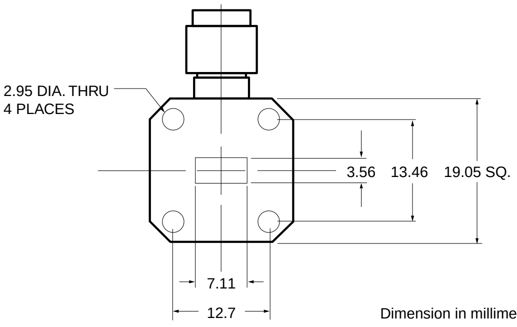


35WRD180K, 35WRD180KF

Model	Dimensions (mm)				
	A	B	C	D	E
35WRD180K	13.20	27.9	14.43	28.40	23.80
35WR180DKF	13.20	22.9	14.43	28.40	23.80
35WR42K	13.20	27.9	14.43	28.14	23.93
35WR42KF	13.20	22.9	14.43	28.14	23.93
35WR28K	10.67	27.9	14.86	28.78	23.93
35WR28KF	10.67	22.9	14.86	28.78	23.88



35WR42K, 35WR42KF

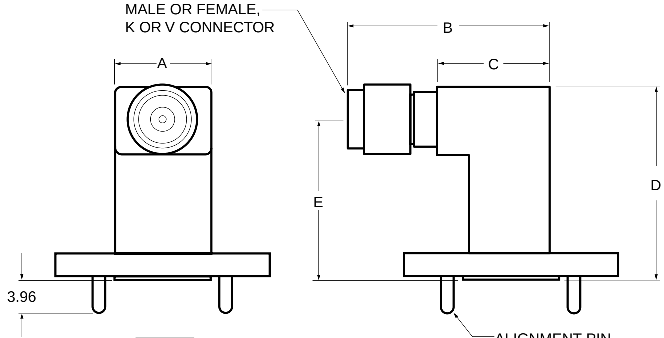


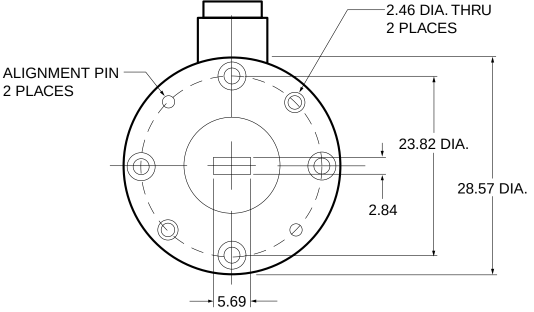
35WR28K, 35WR28KF

Dimension in millimeters

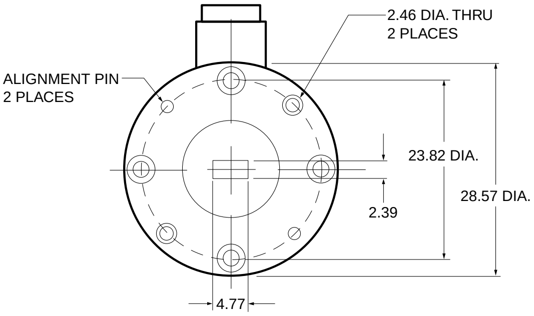
35WRD180K, 35WRD180KF, 35WR42K, 35WR42KF, 35WR28K, 35WR28KF outlines

Outline drawings

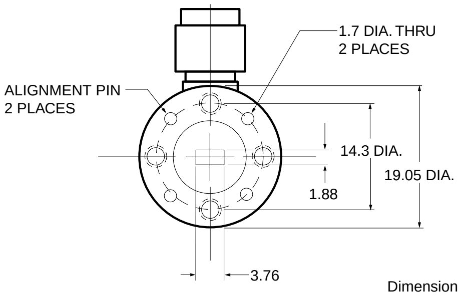




35WR22K, 35WR22KF,
35WR22V, 35WR22VF



35WR19K, 35WR19KF,
35WR19V, 35WR19VF



35WR15V, 35WR15VF

Dimension in millimeters

Model	Dimensions (mm)				
	A	B	C	D	E
35WR22K	12.70	26.9	14.73	25.76	21.44
35WR22KF	12.70	21.6	14.73	25.76	21.44
35WR22V	12.70	26.9	14.73	25.76	21.44
35WR22VF	12.70	21.6	14.73	25.76	21.44
35WR19K	12.70	26.9	14.73	25.76	21.44
35WR19KF	12.70	21.6	14.73	25.76	21.44
35WR19V	12.70	27.9	14.73	25.76	21.44
35WR19VF	12.70	22.6	14.73	25.76	21.44
35WR15V	12.70	24.4	12.19	26.97	21.62
35WR15VF	12.70	20.3	12.19	26.97	21.62

35WR22K, 35WR22KF, 35WR22V, 35WR22VF, 35WR19K, 35WR19KF, 35WR19V, 35WR19VF, 35WR15V, and 35WR15VF outlines

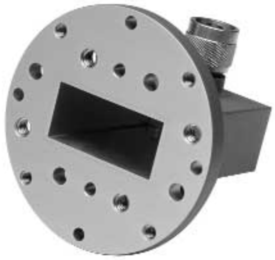
INSTRUMENTATION GRADE ADAPTERS

35U, 35C Series

3.3 to 26.5 GHz

35UM40N

35UM84N



35UA187N

35UA42K

The 35U and 35C Series precision adapters transform standard waveguide to coaxial N and K Connector® interfaces, thus enabling convenient microwave coaxial measurements.

Features

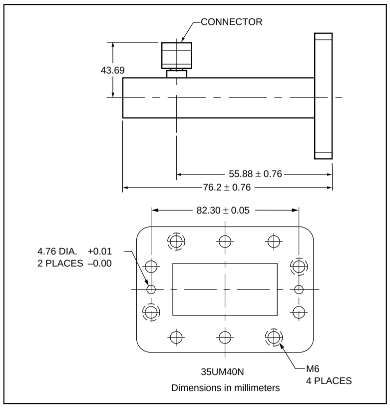
- 3.3 to 26.5 GHz frequency coverage
- N connector compatibility
- K Connector® compatibility with SMA and 3.5 mm

Specifications

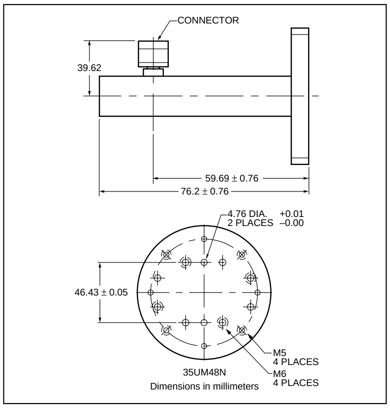
Model	Frequency range (GHz)	Connectors	W/G flange UG-(_) U	SWR
35UM40N	3.3 to 4.9	WR229 to N(m) WG11A to N(m)	PDR40	1.08
35UM48N	3.9 to 5.8	WR187 to N(m) WG12 to N(m)	CAR48, PAR48, UAR48, PDR48	1.08
35UM58N	4.9 to 7.0	WR159 to N(m) WG13 to N(m)	CAR58, PAR58, UAR58, PDR58	1.08
35UM70N	5.8 to 8.2	WR137 to N(m) WG14 to N(m)	CAR70, PAR70, UAR70, PDR70	1.08
35UM84N	7.0 to 10	WR112 to N(m) WG15 to N(m)	CBR84, UBR84, PBR84, PDR84	1.08
35UM100N	8.2 to 12.4	WR90 to N(m) WG16 to N(m)	CBR100, UBR100, PBR100, PDR100	1.08
35UM120N	10 to 15	WR75 to N(m) WG17 to N(m)	CBR120, UBR120, PBR120, PDR120	1.08
35UM140N	12.4 to 18	WR62 to N(m) WG18 to N(m)	CBR140, UBR140, PBR140, PDR140	1.08
35UM220K	17 to 26.5	WR42 to K(m) WG20 to K(m)	CBR220, UBR220, PBR220, PDR220	1.20
35UA229N	3.3 to 4.9	WR229 to N(m) WG11A to N(m)	CPR229F, CPR229G, UG-1350/U, UG-1351/U, UG-1726/U, UG-1727/U	1.08
35UA187N	3.9 to 5.8	WR187 to N(m) WG12 to N(m)	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U	1.08
35UA159N	4.9 to 7.0	WR159 to N(m) WG13 to N(m)	CPR159F, CPR159G, UG-1354/U, UG-1355/U, UG-1730/U, UG-1731/U	1.08
35UA137N	5.8 to 8.2	WR137 to N(m) WG14 to N(m)	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U	1.08
35UA112N	7.0 to 10	WR112 to N(m) WG15 to N(m)	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U	1.08
35UA90N	8.2 to 12.4	WR90 to N(m) WG16 to N(m)	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135B/U, UG-136/U	1.08
35UA75N	10 to 15	WR75 to N(m) WG17 to N(m)	WR75	1.08
35UA62N	12.4 to 18	WR62 to N(m) WG18 to N(m)	UG-541A/U, UG-419A/U UG-1665/U, UG-1666/U	1.08
35UA42K	17 to 26.5	WR42 to K(m) WG20 to K(m)	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U	1.20
35CMR229N	3.3 to 4.9	WR229 to N(m)	CMR229	1.08
35CMR187N	3.9 to 5.8	WR187 to N(m) WG12 to N(m)	CMR187, UG-1475/U, UG-148/U	1.08
35CMR159N	4.9 to 7.0	WR159 to N(m) WG13 to N(m)	CMR159	1.08
35CMR137N	5.8 to 8.2	WR137 to N(m) WG14 to N(m)	CMR137, UG-1476/U 1UG-1481/U	1.08
35CMR112N	7.0 to 10	WR112 to N(m) WG15 to N(m)	CMR112, UG-1477/U UG-1482/U	1.08
35CMR90N	8.2 to 12.4	WR90 to N(m) WG16 to N(m)	CMR90, UG-1478/U UG-1483/U	1.08
35UER40N	3.3 to 4.9	WR229 to N(m) WG11A to N(m)	UER40	1.08
35UER48N	3.9 to 5.8	WR187 to N(m) WG12 to N(m)	UER48	1.08
35UER58N	4.9 to 7.0	WR159 to N(m) WG13 to N(m)	UER58	1.08
35UER70N	5.8 to 8.2	WR137 to N(m) WG14 to N(m)	UER70	1.08
35UER84N	7 to 10	WR112 to N(m) WG15 to N(m)	UER84	1.08
35UER100N	8.2 to 12.4	WR90 to N(m) WG16 to N(m)	UER100	1.08

Impedance: 50 Ω

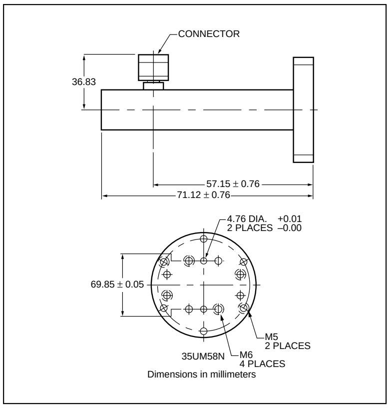
Outline drawings



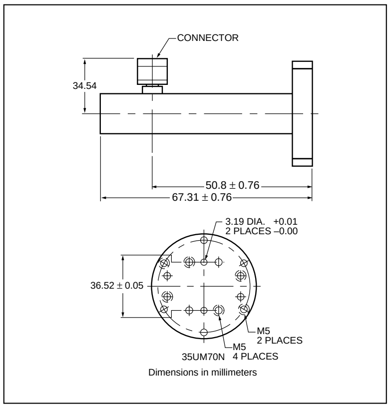
35UM40N outline



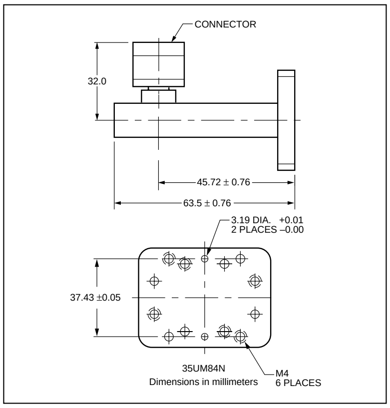
35UM48N outline



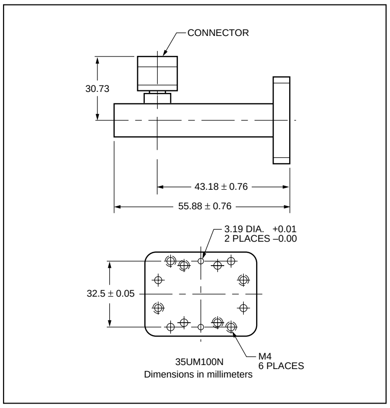
35UM58N outline



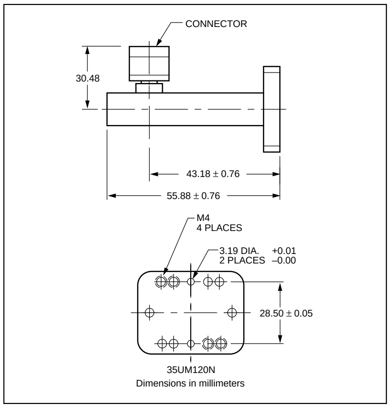
35UM70N outline



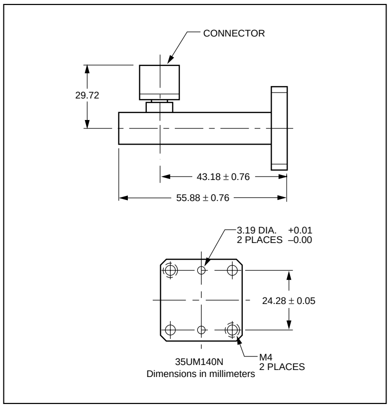
35UM84N outline



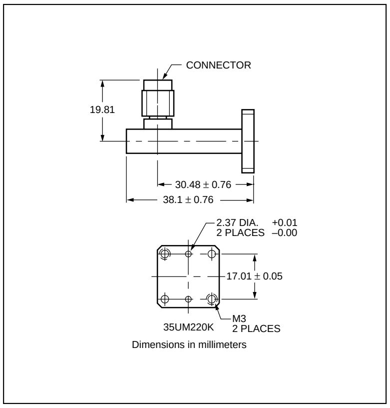
35UM100N outline



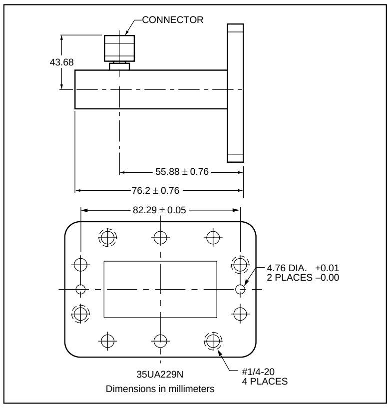
35UM120N outline



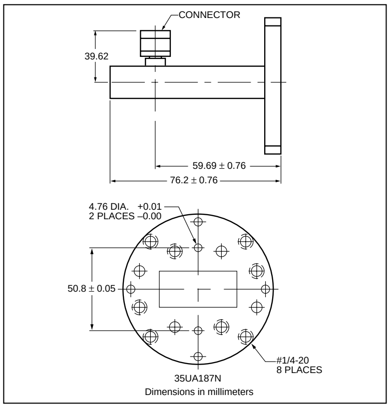
35UM140N outline



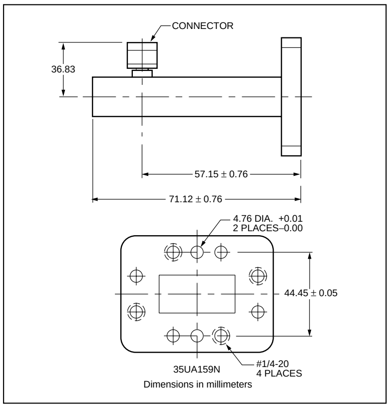
35UM220K outline



35UA229N outline

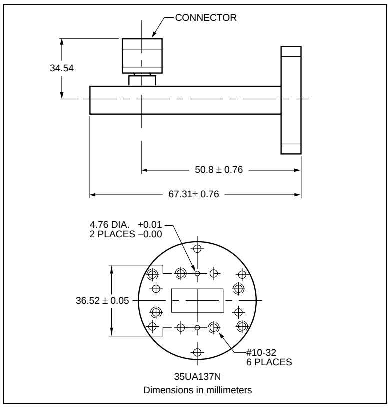


35UA187N outline

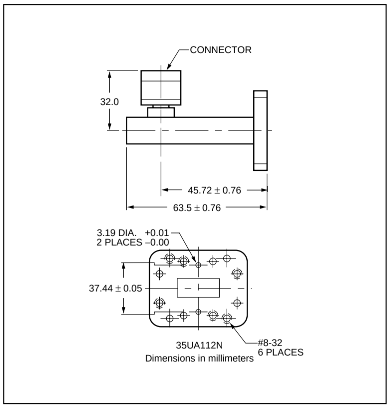


35UA159N outline

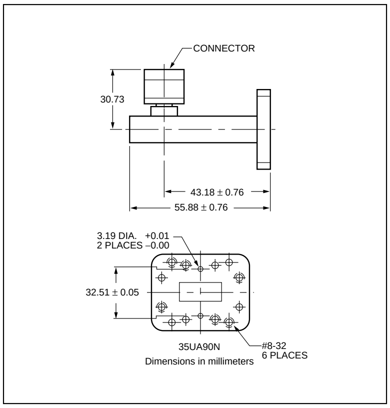
Outline drawings



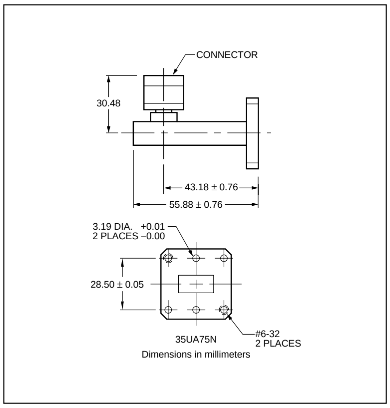
35UA137N outline



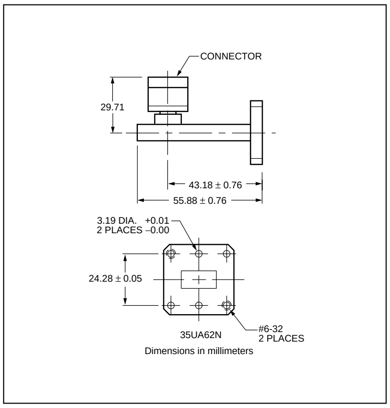
35UA112N outline



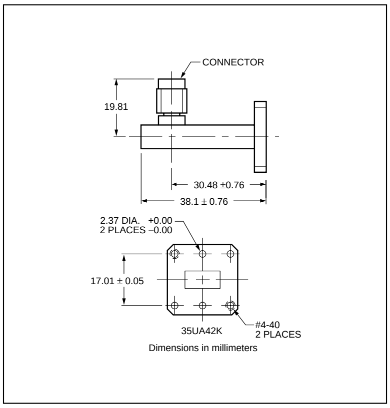
35UA90N outline



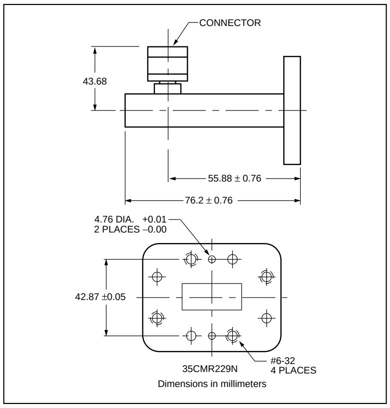
35UA75N outline



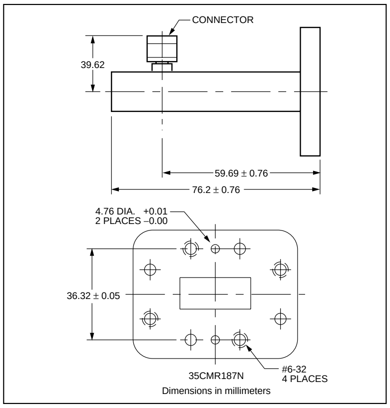
35UA62N outline



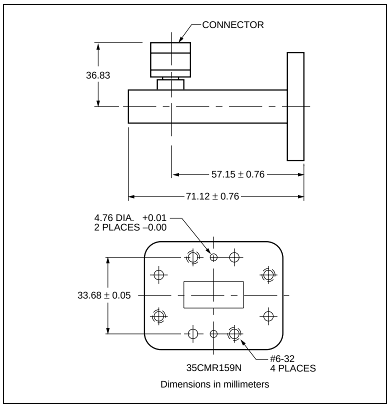
35UA42K outline



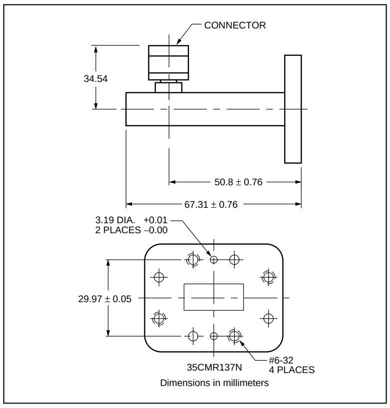
35CMR229N outline



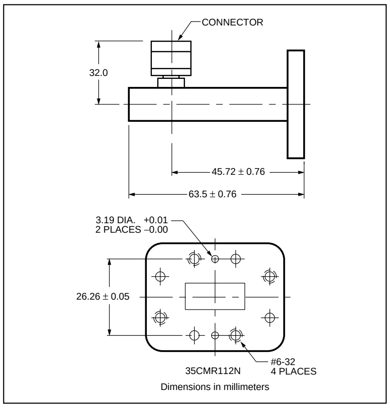
35CMR187N outline



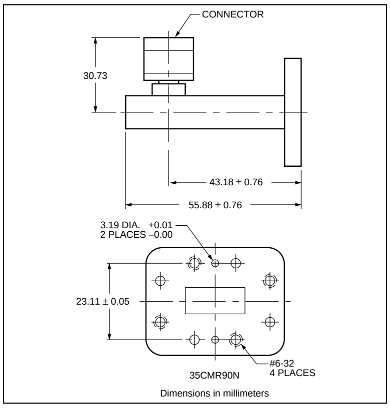
35CMR159N outline



35CMR137N outline

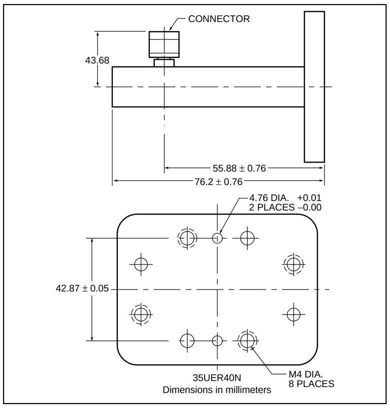


35CMR112N outline

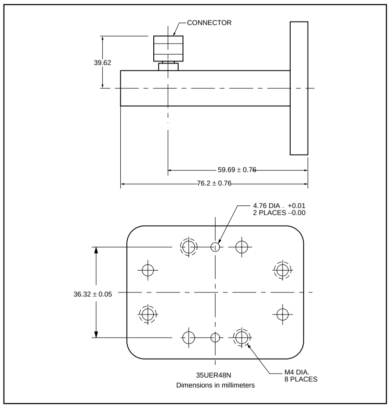


35CMR90N outline

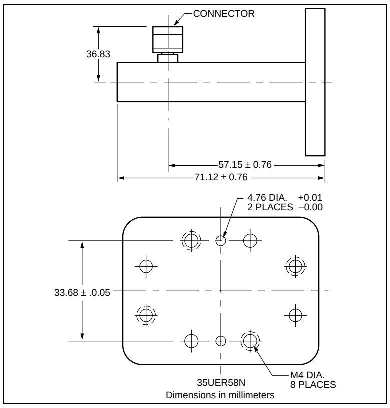
Outline drawings



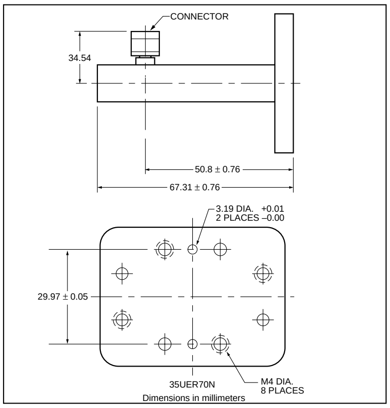
35UER40N outline



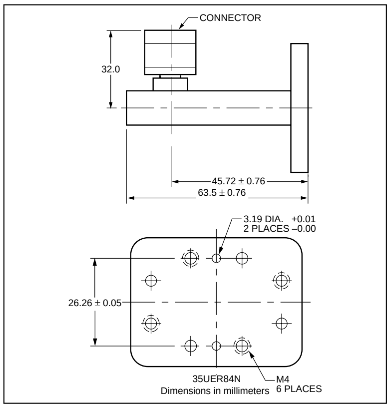
35UER48N outline



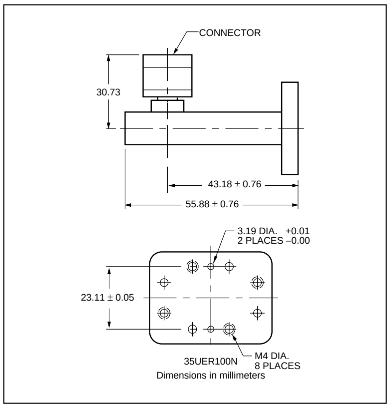
35UER58N outline



35UER70N outline



35UER84N outline



35UER100N outline

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Coaxial adapter
35UM40N	N(m), metric, 3.30 to 4.90 GHz
35UM48N	N(m), metric, 3.95 to 5.85 GHz
35UM58N	N(m), metric, 4.90 to 7.05 GHz
35UM70N	N(m), metric, 5.85 to 8.20 GHz
35UM84N	N(m), metric, 7.05 to 10.00 GHz
35UM100N	N(m), metric, 8.20 to 12.40 GHz
35UM120N	N(m), metric, 10.00 to 15.00 GHz
35UM140N	N(m), metric, 12.40 to 18.0 GHz
35UM220K	K(m), metric, 17.00 to 26.5 GHz
35UA229N	N(m), US, 3.30 to 4.90 GHz
35UA187N	N(m), US, 3.95 to 5.85 GHz
35UA159N	N(m), US, 4.90 to 7.05 GHz
35UA137N	N(m), US, 5.85 to 8.20 GHz
35UA112N	N(m), US, 7.05 to 10.00 GHz
35UA90N	N(m), US, 8.20 to 12.40 GHz
35UA75N	N(m), US, 10.00 to 15.00 GHz
35UA62N	N(m), US, 12.40 to 18.0 GHz
35UA42K	K(m), US, 17.00 to 26.5 GHz
35CMR229N	N(m), CMR, 3.30 to 4.90 GHz
35CMR187N	N(m), CMR, 3.95 to 5.85 GHz
35CMR159N	N(m), CMR, 4.90 to 7.05 GHz
35CMR137N	N(m), CMR, 5.85 to 8.20 GHz
35CMR112N	N(m), CMR, 7.05 to 10.00 GHz
35CMR90N	N(m), CMR, 8.20 to 12.40 GHz
35UER40N	N(m), UER, 3.30 to 4.90 GHz
35UER48N	N(m), UER, 3.95 to 5.85 GHz
35UER58N	N(m), UER, 4.90 to 7.05 GHz
35UER70N	N(m), UER, 5.85 to 8.20 GHz
35UER84N	N(m), UER, 7.05 to 10.00 GHz
35UER100N	N(m), UER, 8.20 to 12.40 GHz

COAXIAL TERMINATIONS
26, 28, 29 Series
DC to 65 GHz

26NF75

28N50-2

28K50

28KF50

28V50B

29A50-20

These precision, metrology-grade terminations are used in measurement systems that need to achieve the smallest possible reflections. Their excellent match makes them ideal as a reference for fault location measurements on scalar network analyzers.

Precision termination features

- Accurate reference for SWR measurements
- Precise termination for test instrument or device under test

Precision termination specifications

Model	Frequency range (GHz)	Test port connector	Input impedance (Ω)	SWR (F in GHz)	Dimensions L(cm) x dia(cm)
26N75A 26NF75A	DC to 3	N(m) N(f)	75	1.013 Max.	5.2 x 2.2 4.8 x 1.6
28A50-1	DC to 18	GPC-7	50	1.02 Max.	5.2 x 2.2
28N50-2 28NF50-2	DC to 18	N(m) N(f)	50	1.02 Max.	5.2 x 2.2 4.8 x 1.6
28N50-3 28NF50-3	DC to 8	N(m) N(f)	50	1.03 Max.	5.2 x 2.2 4.8 x 1.6
28S50-1 28SF50-1	DC to 26.5	WSMA(m) WSMA(f)	50	1.020 to 18.5 GHz 1.153 to 26.5 GHz	3.7 x 1.2 3.7 x 1.2
28K50 28KF50	DC to 40	K(m) K(f)	50	1.040 to 18.5 GHz 1.070 to 26.5 GHz 1.135 to 40 GHz	3.7 x 1.2 3.7 x 1.2
28V50B 28VF50B	DC to 65	V(m) V(f)	50	1.018 to 6 GHz 1.058 to 26.5 GHz 1.074 to 40 GHz 1.12 to 60 GHz 1.25 to 65 GHz	3.7 x 1.2 3.7 x 1.2

Maximum Input Power: 0.5 W

When used with Anritsu airlines, the 29 Series Offset Terminations permit measurements down to 1.006 SWR to 18 GHz, 1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz.

Offset termination features

- 50 Ω Offset Terminations for precise measurement of low SWR or high directivity
- Measurements down to 1.006 SWR to 18 GHz, 1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz

Offset termination specifications

Model	Frequency range (GHz)	Test port connector	Return loss (dB)	Dimensions L(cm) x dia(cm)
29A50-20	DC to 18	GPC-7	20 ±0.5 to 1 GHz 20 ±1.0 to 4 GHz 20 ±1.5 to 18 GHz	5.2 x 2.2
29S50-20	DC to 26.5	WSMA(m)	20 ±1.5 to 18.5 GHz 20 ±2.5 to 26.5 GHz	3.7 x 1.2
29SF50-20	DC to 26.5	WSMA(f)	20 ±1.5 to 18.5 GHz 20 ±2.5 to 26.5 GHz	3.7 x 1.2
29K50-15	DC to 40	K(m)	15 ±1.5 to 18.5 GHz 15 ±2.5 to 26.5 GHz 15 ±3.5 to 40 GHz	3.7 x 1.2
29KF50-15	DC to 40	K(f)	15 ±1.5 to 18.5 GHz 15 ±2.5 to 26.5 GHz 15 ±3.5 to 40 GHz	3.7 x 1.2

Temperature range: +25°C ±5°C

Ordering information

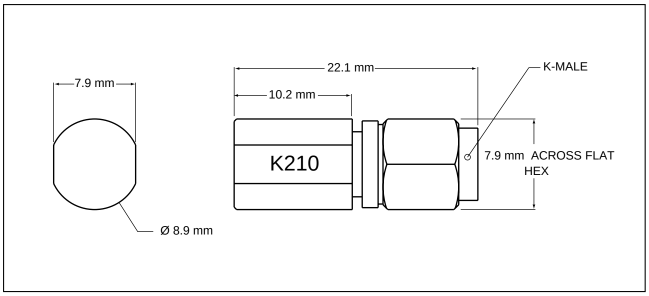
Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Precision termination
26N75A	DC to 3 GHz, 75 Ω, N(m)
26NF75A	DC to 3 GHz, 75 Ω, N(f)
28A50-1	DC to 18 GHz, 50 Ω, GPC-7, Max. SWR=1.02
28N50-2	DC to 18 GHz, 40 dB, 50 Ω, N(m)
28NF50-2	DC to 18 GHz, 40 dB, 50 Ω, N(f)
28N50-3	DC to 8 GHz, 50 Ω, N(m)
28NF50-3	DC to 8.6 GHz, 50 Ω, N(f)
28S50-1	DC to 26.5 GHz, 50 Ω, WSMA(m) (selected for higher accuracy)
28SF50-1	DC to 26.5 GHz, 50 Ω, WSMA(f) (selected for higher accuracy)
28K50	DC to 40 GHz, 50 Ω, K(m)
28KF50	DC to 40 GHz, 50 Ω, K(f)
28V50B	DC to 65 GHz, V(m)
28VF50B	DC to 65 GHz, V(f)
	Offset termination
29A50-20	DC to 18 GHz, 50 Ω, GPC-7, 20 dB return loss
29S50-20	DC to 26.5 GHz, 50 Ω, WSMA(m), 20 dB return loss
29SF50-20	DC to 26.5 GHz, 50 Ω, WSMA(f), 20 dB return loss
29K50-15	DC to 40 GHz, 50 Ω, K(m), 15 dB return loss
29KF50-15	DC to 40 GHz, 50 Ω, K(f), 15 dB R return loss

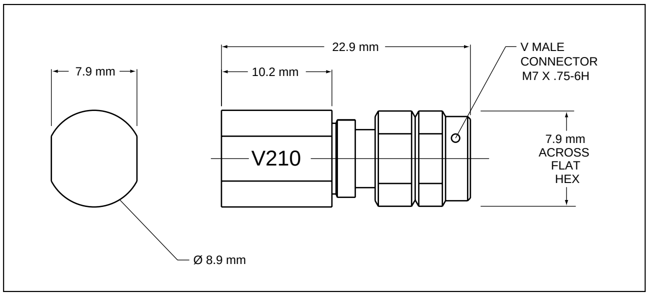
COAXIAL TERMINATIONS

K210, V210

DC to 40 GHz, DC to 60 GHz



K210 outline



V210 outline

These economy-grade 50 Ω terminations provide good return loss for use when a small amount of reflection won't be an issue. These terminations are intended for use as circuit terminators; they are not intended for use as calibration standards.

Features

- Good return loss
- Economical
- Maximum Input power 0.5 W

Specifications

Model	Frequency range	Return loss	Connector
K210	DC to 40 GHz	26 dB to 18 GHz 19 dB to 40 GHz	K(m)
V210	DC to 60 GHz	23 dB to 18 GHz 18 dB 18 to 26.5 GHz 16 dB 26.5 to 40 GHz 14 dB 40 to 60 GHz	V(m)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
K210	50 Ω termination, K(m), 19 dB to 40 GHz
V210	50 Ω termination, V(m), 14 dB to 60 GHz

FIXED ATTENUATORS

41, 43 Series

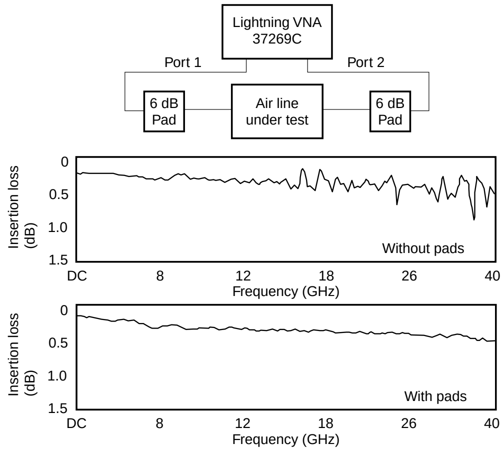
DC to 60 GHz

41V-10

43KC-10

41V-20

43KC-20



Improved Measured Accuracy

Anritsu offers two series of fixed attenuators:

- The Gold Line (Series 41) for precision measurement applications covering DC to 60 GHz
- The Silver Line (Series 43) for use in systems and OEM equipment covering DC to 40 GHz

Both series offer fixed attenuation values of 3, 6, 10, or 20 dB with models that span frequency range of DC to 26.5 GHz, 40 GHz, or 60 GHz.

Features

- 3, 6, 10, or 20 dB Attenuation up to 60 GHz
- Low SWR, 1.28 Up to 40 GHz
- SMA, 3.5 mm, and 2.4 mm compatibility
- Rugged and reliable K Connector® and V Connector®

Advanced performance and reliability

Anritsu attenuators define the standard for fixed attenuator performance and reliability. Performance, however, is not their only distinguishing feature. Attenuators that use the K Connector offer a vast improvement in reliability compared to attenuators with SMA connectors. Attenuators that use the V Connector can be connected directly to 2.4 mm devices.

For applications in metrology and calibration laboratories where precise characterization is essential, the Gold Line models are available in sets consisting of 3, 6, 10, and 20 dB units. Each is provided with attenuation and SWR calibration data. Calibration data is also optionally available for individual units, each of which is serialized.

The reliability of the attenuator connectors is affected by insertion force, outer conductor mating area, and mating alignment. The K Connector® is used because it has excellent performance in all of these areas. For example, a typical female SMA, 3.5 mm center conductor requires up to 27N* of insertion force compared to 2.2N* for the K Connector In addition, the K Connector outer conductor is four times thicker than SMA, resulting in a conservative order-of-magnitude improvement in the number of reliable connections.

To avoid a major cause of connector failure, the K Connector male pin is deliberately made shorter than the SMA pin. Therefore, the outer housing is properly aligned prior to center conductor mating, preventing destructive misalignment.

Gold Line - improved measurement accuracy

Adding Gold Line attenuators to your attenuation measurement setup will improve your measurement accuracy. In the test setup shown, the insertion loss of an air line was measured, first without and then with matching 6 dB pads. The difference in the accuracy of the two measurements is striking. By attenuating reflections and re-reflections that occur at the input and output of the air line, the pads reduce mismatch errors and allow the system to measure more accurately the actual insertion loss.

Silver Line - improved system reliability

Fixed attenuators used in systems or OEM equipment must be small, lightweight, economical, and reliable under severe environmental conditions. The Silver Line meets these requirements. K Connectors ensure well-seated, low-reflection connections that provide consistent operation year after year.

The Series 43 (Silver Line) attenuator's small size, 8 mm dia. x 28.8 mm length, and light weight, 8g, make them an attractive choice for miniaturized, lightweight systems.

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* Force is measured in Newtons (N).

Common specifications

Impedance		50 Ω
Power rating (average)		2W at 20°C; 1W at 85°C
Temperature coefficient		0.001 dB/dB/°C
Connectors	V Connector®	Male and female compatible with 2.4 mm
	K Connector®	Male and female, compatible with SMA and 3.5 mm
Material		Passivated stainless steel housing
Size	Length	28.8 mm ±0.5 mm
	Diameter	8 mm
Weight		8 g
Temperature range	Operating	–55°C to +85°C
	Nonoperating	–55°C to +125°C

Specifications

	Model[*1]	Attenuation (dB)	Attenuation Accuracy				SWR				
			DC-18 GHz	18-26.5 GHz	26.5-40 GHz	40-60 GHz	DC-12 GHz	12-18 GHz	18-26.5 GHz	26.5-40 GHz	40-60 GHz
Gold Line	DC to 60 GHz										
	41V-3	3	±0.5	±0.6	±0.9	±1.20	1.15	1.20	1.30	1.50	1.90
	41V-6	6	±0.5	±0.6	±0.9	±1.20	1.15	1.20	1.25	1.40	1.70
	41V-10	10	±0.5	±0.6	±0.9	±1.20	1.15	1.20	1.25	1.40	1.70
	41V-20	20	±0.5	±0.6	±0.9	±1.20	1.15	1.20	1.25	1.40	1.70
	DC to 40 GHz										
	41KC-3	3	±0.4	±0.5	±0.8	-	1.10	1.15	1.23	1.42	-
	41KC-6	6	±0.4	±0.5	±0.8	-	1.10	1.15	1.18	1.28	-
	41KC-10	10	±0.4	±0.5	±0.8	-	1.10	1.15	1.18	1.28	-
	41KC-20	20	±0.4	±0.5	±0.8	-	1.10	1.15	1.18	1.28	-
	DC to 26.5 GHz										
	41KB-3	3	±0.4	±0.5	-	-	1.10	1.15	1.23	-	-
	41KB-6	6	±0.4	±0.5	-	-	1.10	1.15	1.18	-	-
	41KB-10	10	±0.4	±0.5	-	-	1.10	1.15	1.18	-	-
	41KB-20	20	±0.4	±0.5	-	-	1.10	1.15	1.18	-	-
Silver Line	Model	Attenuation[*2] (dB)	Attenuation Accuracy				SWR				
			DC-18 GHz	18-26.5 GHz	26.5-40 GHz	40-60 GHz	DC-12 GHz	12-18 GHz	18-26.5 GHz	26.5-40 GHz	40-60 GHz
	DC to 40 GHz										
	43KC-3	3	±0.5	±0.6	±0.9	-	1.15	1.20	1.30	1.50	-
	43KC-6	6	±0.5	±0.6	±0.9	-	1.15	1.20	1.30	1.40	-
	43KC-10	10	±0.5	±0.6	±0.9	-	1.15	1.20	1.30	1.40	-
	43KC-20	20	±0.5	±0.6	±0.9	-	1.15	1.20	1.30	1.40	-
	DC to 26.5 GHz										
	43KB-3	3	±0.5	±0.6	-	-	1.15	1.20	1.30	-	-
	43KB-6	6	±0.5	±0.6	-	-	1.15	1.20	1.30	-	-
	43KB-10	10	±0.5	±0.6	-	-	1.15	1.20	1.30	-	-
	43KB-20	20	±0.5	±0.6	-	-	1.15	1.20	1.30	-	-

*1: For traceability, all Gold Line attenuators are serialized.
*2: ±1 dB from DC to 26.5 GHz; ±1.3 dB from > 26.5 to 40 GHz, including frequency response and DC offset.

Ordering information

Please specify model/order number, name, and quantity when ordering.
Single fixed attenuators may be ordered from the table above.

Model/Order No.	Name
	Precision Fixed Attenuator
41KB-3, 6, 10, or 20	DC to 26.5 GHz, 50 Ω, K(m)-K(f)
41KC-3, 6, 10, or 20	DC to 40 GHz, 50 Ω, K(m)-K(f)
41V-3, 6, 10, or 20	DC to 60 GHz, 50 Ω, V(m)-V(f)
	Precision Fixed Attenuator Set
41KB-S[*1]	41KB Series
41KC-S[*1]	41KC Series
41V-S[*1]	41V Series
	Fixed Attenuator
43KB-3, 6, 10, or 20	DC to 26.5 GHz, 50 Ω, K(m)-K(f)
43KC-3, 6, 10, or 20	DC to 40 GHz, 50 Ω, K(m)-K(f)
	Option
Option C[*2]	Calibration Data

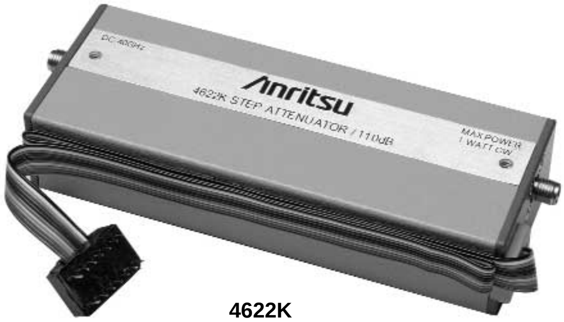
*1: A set of 3, 6, 10, and 20 dB Gold line (Series 41). Attenuators are supplied in a handsome hardwood case. Calibration data are included for each unit.
*2: Attenuation and SWR test data are provided for input and output ports at 500 MHz frequency intervals.

STEP ATTENUATORS

4400, 4500, 4600 Series

DC to 40 GHz

4612K



4622K

Anritsu programmable step attenuators bring a substantial increase in the frequency and attenuation range available in one small package. Using the latest technology, these units offer superior performance, reliability, and ease of use to 40 GHz. All are plug-compatible with competitive units.

Features

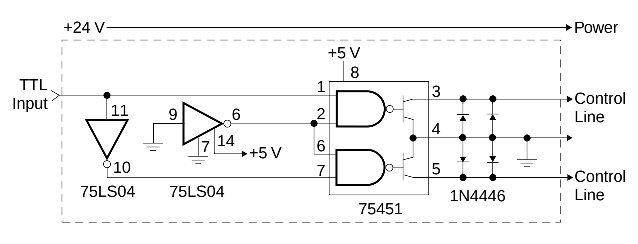
- DC-20 GHz, DC-26.5 GHz, DC-40 GHz
- 70 dB and 110 dB attenuation ranges
- Lowest insertion loss
- Precise repeatability
- Life of 5 million operations
- Small, rugged, light weight

Advanced technology-advanced performance

Anritsu has lowered throughline loss by designing the first 40 dB attenuator sections to operate above 18 GHz. Compared with designs that use 30 dB sections, these attenuators have a shorter thru path and fewer switching contacts. As a result, insertion loss is as much as 1.7 dB less than that of units made by other companies. RF input power requirements for systems that use these attenuators can be reduced, saving money, space, and weight.

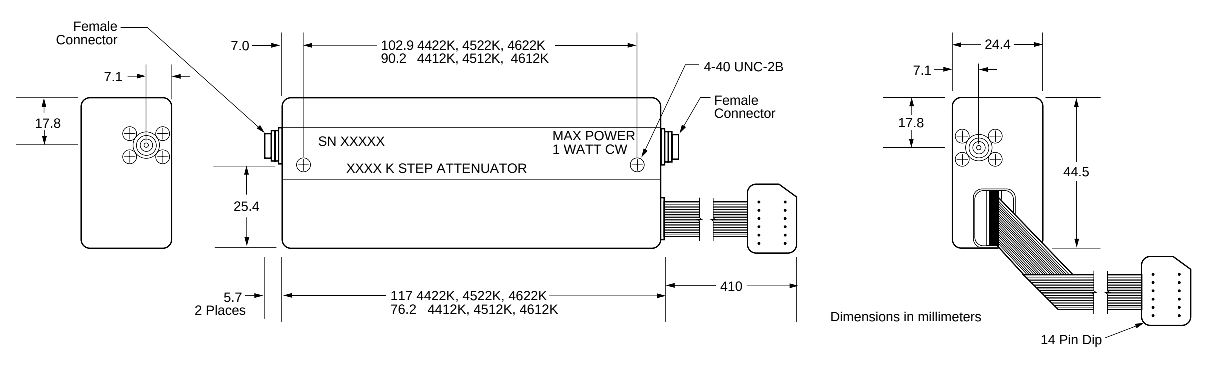
Integrated switching structure

The push rods that switch in the attenuator modules and thrulines are driven by a solenoid actuator. By designing the solenoid as an integral part of the attenuator assembly, switching speeds of 20 ms (including settling time) are achieved. Upon completion of the switching operation, the solenoid is magnetically latched to withstand severe shock and vibration. At the same time, the solenoid current is automatically turned off to save power and to minimize temperature rise. Also integrated in the design is solid state DC switching circuitry that avoids the relatively high failure rate of mechanical DC switches. Each attenuator section is controlled by its own driver circuit, which requires 24 V, 125 mA. A typical external driver circuit for one section is shown in the figure below.



Accuracy enhancing calibration data

Attenuation accuracy can be improved by using optional calibration data taken on an Anritsu vector network analyzer. The calibration data can be used to normalize the effect of frequency response and reflections. The calibration data is traceable to NIST.



4400, 4500, and 4600 series outline

Specifications

Frequency and attenuation ranges

Model	Frequency range	Attenuation range in 10 dB steps	Connectors
4412K 4422K	DC to 20 GHz	0 to 70 dB 0 to 110 dB	K(f)
4512K 4522K	DC to 26.5 GHz	0 to 70 dB 0 to 110 dB	K(f)
4612K 4622K	DC to 40 GHz	0 to 70 dB 0 to 110 dB	K(f)

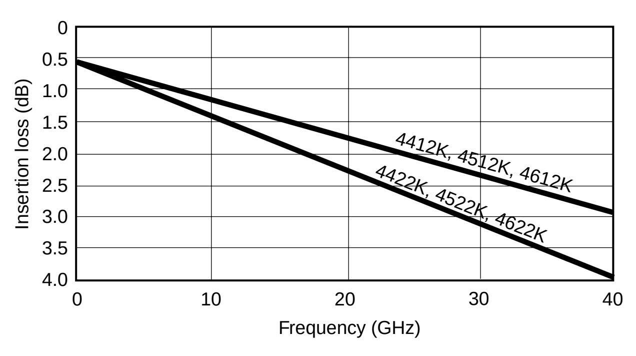
Attenuator accuracy (± dB)

Frequency (GHz)	Attenuation (dB)							
	10	20	30	40	50	60	70	80-110
DC to 8	0.3	0.5	0.6	0.7	0.8	1.0	1.1	1.4
>8 to 12	0.4	0.5	0.7	0.9	1.0	1.3	1.5	2.0
>12 to 20	0.5	0.6	0.8	1.1	1.2	1.4	1.7	2.2
>20 to 26.5	0.7	0.8	1.0	1.5	1.6	1.9	2.3	2.8
>26.5 to 40	0.9	1.0	1.2	1.7	1.9	2.3	2.6	3.2

Electrical

Switching speed (maximum)	20 ms
Operating voltage	20 to 30 Volts
Switching control current	125 mA at 24 V nominal per section 3 sections in 4412K, 4512K, 4612K 4 sections in 4422K, 4522K, 4622K
Solenoid coil impedance	190 Ω
Solenoid coil inductance	65 mH
RF input power (maximum)	1 W average, 100 W peak for 10 µs
RF power sensitivity	0.001 dB/W
Life (minimum operations per section)	5 million
Repeatability (typical after 1 million operations)	±0.03 dB to 18 GHz ±0.05 dB to 26.5 GHz ±0.08 dB to 40 GHz

Insertion loss (maximum)



Impedance match

Frequency (GHz)	Return loss (dB)	SWR
DC to 8	19	1.25
>8 to 12	14	1.5
>12 to 20	12.7	1.6
>20 to 26.5	11	1.8
>26.5 to 40	9	2.1

Mechanical

Weight	4412K, 4512K, 4612K: 170g 4422K, 4522K, 4622K: 213g
Mounting position	Any
RF connectors	K Connectors, female, in-line
Programming connector	14 pin DIP
Programming cable length	406 mm

Environment

Temperature	Operating:	0°C to +70°C
	Non-operating:	–55°C to +85°C
Altitude	Operating:	4.6 km (440 mm Hg)
	Non-operating:	15 km
Shock	Operating:	10 g, 6 ms, on 6 sides, 3 blows
	Non-operating:	500 g, 1.8 ms, in 6 directions
Humidity		0 to 95% relative humidity
EMC		Mil-Std-461, Method RE02, VDE 0871, CISPR#2

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
4412K	Step Attenuator, DC to 20 GHz, 70 dB
4512K	Step Attenuator, DC to 26.5 GHz, 70 dB
4612K	Step Attenuator, DC to 40 GHz, 70 dB
4422K	Step Attenuator, DC to 20 GHz, 110 dB
4522K	Step Attenuator, DC to 26.5 GHz, 110 dB
4622K	Step Attenuator, DC to 40 GHz, 110 dB
	Options
Option C*	Calibration Data (4412K, 4512K, 4612K)

* Calibration data is taken every 100 MHz from DC to 900 MHz and every 500 MHz from 1 GHz to 40 GHz.

SWR BRIDGES

61 Series, 87 Series

5 to 2500 MHz **2 to 18 GHz**

61N50

The 61 series RF SWR Bridges are precision directional devices designed to make very accurate measurements of SWR. All models contain a built-in reference termination and preserve phase and amplitude of the reflected signal.

Features

- 5 to 2500 MHz frequency coverage
- 40 dB directivity
- Built-in reference termination
- Type N test port connectors

Specifications

Model	Frequency range (MHz)	Test port connector	Directivity (dB)	Impedance (Ohms)	Accuracy*
61N50	5-2500	Type N(m)	40	50	$0.01 + 0.09\rho^2$
61NF50	5-2500	Type N(f)	40	50	$0.01 + 0.09\rho^2$

Insertion loss	6.5 dB nominal from input to test port
Maximum input power	0.5 W
Input and output connector	Type N(f)
Dimensions	6.7 x 5.1 x 2.54 cm (excluding connectors)
Weight	340 g

*Includes the effects of test port reflections and directivity.
ρ is the measured reflection coefficient.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
61N50 61NF50	SWR Bridge, 5 to 2500 MHz, Type N(m), 40 dB directivity SWR Bridge, 5 to 2500 MHz, Type N(f), 40 dB directivity

87A50

The 87 Series SWR Bridges are precision, high directivity measurement components, ideal for SWR and return loss measurements. Models include a built-in termination, and they are provided with an overall accuracy equation. These SWR bridges can be used for making very low-level SWR measurements by amplifying the RF output prior to detection. Since both the phase and amplitude of the reflected signal are preserved in the RF output, these components can also be used to make accurate phase comparisons in a network analyzer system.

Features

- Broadband 2 to 18 GHz frequency range
- High 38 dB directivity
- Precise GPC-7 test port connector
- Built-in reference termination

Specifications

Model	Directivity (dB)	Accuracy*1		
		2 to 3 GHz	3 to 4 GHz	4 to 18 GHz
87A50	35	$0.018 + 0.32\rho^2$	$0.018 + 0.23\rho^2$	$0.018 + 0.015\rho^2$
87A50-1	38	$0.013 + 0.32\rho^2$	$0.013 + 0.23\rho^2$	$0.013 + 0.015\rho^2$

Frequency range	2 to 18 GHz
Insertion loss	6.5 dB nominal*2
Maximum input power	0.5 W
Test port connector	GPC-7
Input and output connector	Type N(f)
Dimensions	7.3 x 5.2 x 2.9 cm plus connectors
Weight	340 g

*1: Where ρ is the measured reflection coefficient.
*2: Typically 9 dB at 18 GHz from input to test port.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
87A50 87A50-1	SWR Bridge, 2 to 18 GHz, GPC-7, 35 dB directivity SWR Bridge, 2 to 18 GHz, GPC-7, 38 dB directivity

Temperature range: +25°C ±5°C

SWR AUTOTESTERS

97 Series and 560-97, 560-98 Series

10 MHz to 50 GHz

The Series 97, 560-97 and 560-98 SWR Autotesters integrate a high directivity bridge, a detector, a low reflection test port, and a precision reference termination. The 560-97 and -98 Series units are broadband microwave measurement components that are used with the Model 56100A Scalar Network Analyzer and with Series 54100A Scalar Measurement System for making fixed-frequency and swept-frequency return loss (SWR) measurements. Return loss measurements are used over a wide range of radio and microwave frequencies to check the performance of systems, subsystems, and microwave components such as amplifiers, directional couplers, attenuators, filters, splitters, and terminations.

560-97, 98 Series SWR autotester features

- Up to 40 dB directivity
- 10 MHz to 50 GHz range
- Test port connectors to fit most measurement applications; avoids use of adapters

97 Series SWR autotester features

- High 40 dB directivity
- Low test port reflections
- Broadband 10 MHz to 18 GHz frequency range
- Small package including bridges, termination, and detector
- Selection of GPC-7, WSMA, or Type N test port connectors

Specifications

Models	Directivity (dB)	Accuracy*1		Freq. Sensitivity (dB)	Test Port Connection	Physical
97 Series SWR Autotesters, 10 MHz to 18 GHz*2						
97A50	36	10 MHz-8 GHz 0.016 ±0.06ρ^2	8-18 GHz 0.016 ±0.10ρ^2	±1.5 max.	GPC-7	Dimensions: 7.6 x 5 x 2.8 cm plus connectors Weight: 340 g
97A50-1	40	0.010 ±0.06ρ^2	0.010 ±0.10ρ^2	±1.5 max.	GPC-7	
97N50 97NF50	35	0.018 ±0.08ρ^2	0.018 ±0.12ρ^2	±1.5 max.	Type N(m) Type N(f)	
97N50-1 97NF50-1	38	0.013 ±0.08ρ^2	0.013 ±0.12ρ^2	±1.5 max.	Type N(m) Type N(f)	
97S50 97SF50	35	0.018 ±0.08ρ^2	0.018 ±0.12ρ^2	±1.5 max.	WSMA(m) WSMA(f)	
97S50-1 97SF50-1	38	0.013 ±0.08ρ^2	0.013 ±0.12ρ^2	±1.5 max.	WSMA(m) WSMA(f)	
560-97 Series SWR Autotesters, 10 MHz to 18 GHz*2						
560-97A50	36	0.01-8 GHz 0.013 ±0.08ρ^2	8-18 GHz 0.016 ±0.10ρ^2	±1.2	GPC–7	Dimensions*5: 7.6 x 5.1 x 2.8 cm Weight: 340 g
560-97A50-1	40	0.010 ±0.06ρ^2	0.010 ±0.10ρ^2	±1.2	GPC–7	
560-97N50 560-97NF50	35	0.018 ±0.08ρ^2	0.018 ±0.12ρ^2	±1.5	Type N (m) Type N (f)	
560-97N50-1 560-97NF50-1	38	0.013 ±0.08ρ^2	0.013 ±0.12ρ^2	±1.5	Type N (m) Type N (f)	

Continued on next page

Models	Directivity (dB)	Accuracy*1				Freq. Sensitivity (dB)	Test Port Connection	Physical
560-98 Series SWR Autotesters, 10 MHz to 40 GHz*2								
560-98S50 560-98SF50	37 36	0.01-8 GHz	8-18 GHz 0.014 ±0.10ρ^2	18-26.5 GHz 0.016 ±0.13ρ^2	26.5-40 GHz	±2.0	WSMA (m) WSMA (f)	Dimensions*4: 1.9 x 3.8 x 2.9 cm Weight: 198 g
560-98S50-1 560-98SF50-1	40 38	0.010 ±0.07ρ^2	0.010 ±0.10ρ^2	0.013 ±0.13ρ^2		±2.0	WSMA (m) WSMA (f)	
560-98K50 560-98KF50	35 32 30	0.018 ±0.07ρ^2	0.018 ±0.07ρ^2	0.026 ±0.15ρ^2	0.032 ±0.18ρ^2	±3.0	Type K (m) Type K (f)	
560-98 Series SWR Autotesters, 10 MHz to 50 GHz③								
560-98VA50 560-98VFA50	30	0.01-50 GHz 0.032 ±0.11ρ^2				±4.0	Type V (m) Type V (f)	Dimensions*4: 2.2 x 6.6 x 5.3 cm Weight: 198 g
560-97, 560-98 Offset SWR Autotesters, 10 MHz to 40 GHz								
560-97A50-20	20	500 MHz-18 GHz*5 0.0015				±2.5	GPC-7	Dimensions*4: 7.6 x 5.1 x 2.8 cm Weight: 340 g
560-98KF50-15	15	800 MHz-40 GHz*6 0.0100				±4.0	Type K (m)	Dimensions*4: 2.2 x 6.6 x 5.3 cm Weight: 198 g

All Models:
Input Port Impedance: 50 Ω
Insertion Loss (from input to test port): 6.5 dB nominal
Detector Output Polarity: Negative
Output Time Constant: 2 µs
Maximum Power Input: 0.5 W (+27 dBm) (560-98C50A: +24 dBm)
Cable Length: 122 cm (4 ft.)

*1: Where r is the reflection coefficient being measured. Accuracy includes the effects of test port reflections and directivity.
*2: Input Connector: Ruggedized Type K Female
*3: Input Connector: Ruggedized Type V Female
*4: Plus connectors and cable
*5: When used with 18A50 Airline
*6: When used with 19K50 Airline

Temperature: +25°C ±5°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	SWR Autotester
97A50	10 MHz to 18 GHz, GPC-7, 36 dB directivity
97A50-1	10 MHz to 18 GHz, GPC-7, 40 dB directivity
97N50	10 MHz to 18 GHz, N(m), 35 dB directivity
97N50-1	10 MHz to 18 GHz, N(m), 38 dB directivity
97NF50	10 MHz to 18 GHz, N(f), 35 dB directivity
97NF50-1	10 MHz to 18 GHz, N(f), 38 dB directivity
97S50	10 MHz to 18 GHz, WSMA(m), 35 dB directivity
97S50-1	10 MHz to 18 GHz, WSMA(m), 38 dB directivity
97SF50	10 MHz to 18 GHz, WSMA(f), 35 dB directivity
97SF50-1	10 MHz to 18 GHz, WSMA(f), 38 dB directivity
560-97A50	10 MHz-18 GHz, GPC-7, 50 Ω, 36 dB directivity
560-97A50-1	10 MHz-18 GHz, GPC-7, 50 Ω, 40 dB directivity
560-97N50	10 MHz-18 GHz, N(m), 50 Ω, 35 dB directivity
560-97N50-1	10 MHz-18 GHz, N(m), 50 Ω, 38 dB directivity
560-97NF50	10 MHz-18 GHz, N(f), 50 Ω, 35 dB directivity
560-97NF50-1	10 MHz-18 GHz, N(f), 50 Ω, 38 dB directivity
560-98S50	10 MHz-26.5 GHz, WSMA(m), 50 Ω, directivity = 37 dB (<18 GHz), 36 dB (18 GHz)
560-98S50-1	10 MHz-26.5 GHz, WSMA(m), 50 Ω, directivity = 40 dB (< 18 GHz), 38 dB (18 GHz)

Model/Order No.	Name
560-98SF50	10 MHz-26.5 GHz, WSMA(f), 50 Ω, directivity = 37 dB (< 18 GHz), 36 dB (18 GHz)
560-98SF50-1	10 MHz-26.5 GHz, WSMA(f), 50 Ω, directivity = 40 dB (< 18 GHz), 38 dB (18 GHz)
560-98K50	10 MHz-40 GHz, K(m), 50 Ω, directivity = 35 dB (<18 GHz), 32 dB (18 to 26.5 GHz), 30 dB (26.5 GHz)
560-98KF50	10 MHz-40 GHz, K(f), 50 Ω, directivity = 35 dB (<18 GHz), 32 dB (18 to 26.5 GHz), 30 dB (26.5 GHz)
560-98VA50	10 MHz-50 GHz, V(m), 50 Ω, directivity = 36 dB (<20 GHz), 30 dB (20 GHz)
560-98VFA50	10 MHz-50 GHz, V(m), 50 Ω, directivity = 36 dB (<20 GHz), 30 dB (20 GHz)
	Offset SWR Autotester
560-97A50-20	10 MHz to 18 GHz, GPC-7, 20 dB offset reference in bridge
560-98KF50-15	10 MHz to 40 GHz, K(f), 15 dB offset reference in bridge

SWR AUTOTESTERS

5400-6 Series

1 MHz to 3000 MHz

5400-6N50

5400-6NF50

The 5400-6 Series SWR Autotesters integrate a high directivity bridge, a detector, a low reflection test port, a precision reference termination, and a connecting cable. They are used with the Model 56100A Scalar Network Analyzers and with Series 54100A Scalar Measurement Systems for making fixed-frequency and swept-frequency return loss (SWR) measurements. Return loss measurements are used over a wide range of radio and microwave frequencies to check the performance of systems, subsystems, and microwave components such as amplifiers, directional couplers, attenuators, filters, splitters, and terminations.

Features

- 40 dB directivity.
- 1 MHz to 3000 MHz range
- F, N, or BNC type test port connectors

Specifications

Models	Directivity (dB)	Accuracy*1			Test Port Connection	Physical
5400-67FF75*2,5	40	10-1000 MHz $0.010 \pm 0.01\rho^2$			F (f)	Dimensions*4: 2.5 x 5.1 x 7.0 cm Weight: 255 g
5400-6B50B*3 5400-6BF50B*3	40	1-1500 MHz $0.010 \pm 0.01\rho^2$			BNC (m) BNC (f)	
5400-6B75B*3,5 5400-6BF75B*3,5	40	$0.010 \pm 0.10\rho^2$			BNC (m) BNC (f)	
5400-6N50*3 5400-6NF50*3	40	1-1000 MHz $0.010 \pm 0.05\rho^2$	1000-3000 MHz $0.010 \pm 0.05\rho^2$	2000-3000 MHz $0.010 \pm 0.05\rho^2$	Type N (m) Type N (f)	
5400-6N75*3,5 5400-6NF75*3,5	40	$0.010 \pm 0.05\rho^2$	$0.010 \pm 0.05\rho^2$	$0.010 \pm 0.08\rho^2$	Type N (m) Type N (f)	

All Models:
Input Port Impedance: 50 Ω (except as noted)
Insertion Loss (from input to test port): 6.5 dB nominal
Detector Output Polarity: Negative
Output Time Constant: 2 µs
Maximum Power Input: 0.5 watts (+27 dBm)
Cable Length: 122 cm (4 ft.)

*1: Where ρ is the reflection coefficient being measured. Accuracy includes the effects of test port reflections and directivity.
*2: Input Connector: BNC Female
*3: Input Connector: Type N Female
*4: Plus connectors and cable
*5: Impedance 75 Ω

Temperature range: +25°C ±5°C

Ordering information

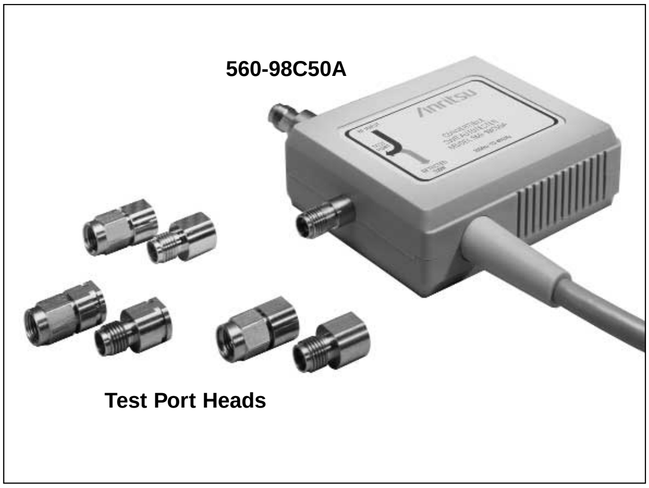
Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	SWR Autotester
5400-6N50	1 to 3000 MHz, Type N(m), 50 Ω 40 dB Directivity
5400-6N75	1 to 3000 MHz, Type N(m), 75 Ω
5400-6NF50	1 to 3000 MHz, Type N(f), 50 Ω
5400-6NF75	1 to 3000 MHz, Type N(f), 75 Ω

CONVERTIBLE SWR AUTOTESTER

560-98C50A and Test Port Heads

10 MHz to 40 GHz



Convertible SWR Autotesters reduce capital equipment and maintenance costs. A single Convertible SWR Autotester accurately measures the Return Loss or SWR of devices with SMA, 3.5 mm, or K Connector®. Six interchangeable test port heads (male and female for each connector standard) are precision tuned to the Convertible SWR Autotester's internal bridge circuit.

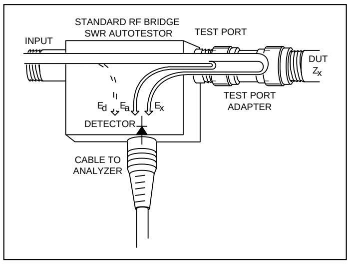
The inexpensive test port heads save repair and calibration costs, because they are interchangeable. Repetitive connect/disconnect cycles will eventually wear out test port connectors – especially when excess torque is applied or the connector's mating surfaces are rotated against each other.

It is common practice today to avoid the subsequent maintenance cost by using adapters or "Connector Savers" on the test port of the directional device (RF Bridge, SWR Autotester, or Directional Coupler). Unfortunately, the adapters attached to a standard RF Bridge cause accuracy problems. Directional devices are tuned for optimum directivity at a specific phase reference point – this position is called the reference plane. Any test port adapter will degrade the effective directivity. The Convertible SWR Autotester's interchangable test port heads eliminate the accuracy problem.

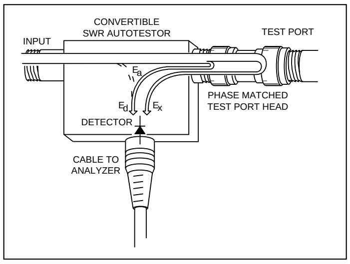
Adapter errors

In a standard RF bridge, measurement error increases when adapters or connector savers are used 1) to change the connector's sex and/or 2) to protect the test port from physical wear. The error effect is represented as a reduction to directivity. Effective Directivity is a measurement error term consisting of the directional device's directivity plus the SWR response of the test port adapter/connector saver.

Effective-Directivity is illustrated in the following illustration. The Directivity Error, E_d, is caused by deviations from ideal within the directional device. The adapter's SWR is represented by E_a. Both E_d and E_a cause errors in the measurement of DUT's return loss, E_x. This error problem is compounded by production practices which use poor quality adapters and neglect calibration/verification cycles.



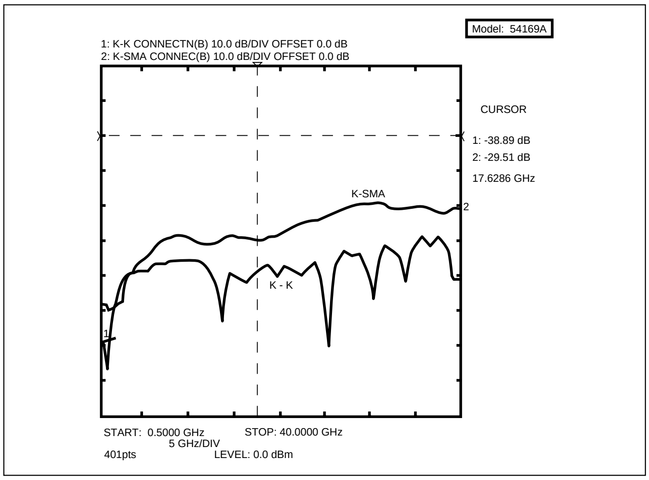
A test port adapter on a standard SWR Autotester or RF Bridge creates an error vector E_a in addition to directivity, E_d.



The directivity response of a Convertible SWR Autotester is tuned to cancel the vector reflection response of the phase matched test port heads.

Accuracy improvement

The Convertible SWR Autotester improves the accuracy of SMA device tests. It is common practice to test SMA devices with either 3.5 mm or K test ports. The 3.5 mm and K Connector® standards offer rugged, instrument grade connections, but they are not designed for proper impedance match to a device that has SMA connectors. SMA, K, and 3.5 mm connectors are mechanically compatible, but lack electrical compatibility. The resulting connector mismatch causes a 10 to 15 dB degradation in measurement directivity.

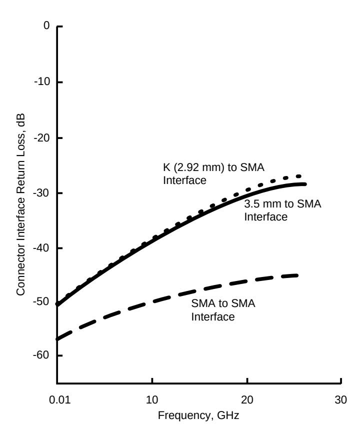


The Directivity of a K - K connector interface is far superior to a mismatched K - SMA connection

The above graph illustrates the degradation to directivity when a K Connector® test port is used to measure a precision SMA device. A 3.5 mm interface causes similar errors. The directivity was measured using the precision return loss mode on a 54100A Series Network Analyzer.

K - SMA or 3.5 mm - SMA interfaces.

Electrically, the Convertible SWR Autotester provides a nearly perfect 50 Ω interface when connected to SMA devices – resulting in a typical 10 dB improvement in effective directivity performance as compared to other SMA compatible connectors.



The Convertible SWR Autotester provides significantly better directivity performance than test components with either K (2.92 mm) or 3.5 mm test port connectors.

SMA connections to either K (2.92 mm) or 3.5 mm connectors are inherently capacitive. Both K and 3.5 mm connectors use air dielectric. The Teflon® or foam polyethylene dielectric common to SMA connectors have different dielectric constants than air. Thus, the coaxial dimensions of the center and outer conductors must also be different to maintain a 50 Ω transmission line impedance. Since the K and 3.5 mm connector standards specify flush pin depths, a non-50 Ω capacitance develops between their relatively thick outer conductors to the center pin of an SMA connected device.

Anritsu's 25S50 and 25SF50 SMA Test Port Heads include an inductive connection to SMA connectors by virtue of a slight air gap at the center pin interface. The air gap negates excess capacitance caused by the 50 Ω dimensional transition from the test port head's air dielectric to the SMA connector's Teflon® dielectric.

SMA connectors are not used as a precision instrumentation connector for three important reasons. First, the dielectric tends to expand and contract slightly with temperature and humidity conditions; thus, it is difficult to adhere to dimensional standards traceability (typically, precision air lines are used as primary or secondary reference standards) over a reasonable range of manufacturing floor conditions. Second, as an inexpensive connector type, many manufacturers have taken liberties in the specification of dimensions, tolerances, dielectric types and metallurgic content. A precision standard for SMA connector design is not recognized by the microwave industry. Finally, SMA designs suffer from reliability problems when subjected to multiple connections. Center pins can back out easily and the thin outer conductor wall is easily crushed when subjected to excessive torque.

The Convertible SWR Autotester solves these problems. Air dielectric is used to eliminate the temperature and humidity variations suffered by Teflon® and other dielectrics. Dimensional tolerances and metallic composition are clearly specified and center pin dimensions are phase matched. Air dielectric also allows use of thicker outer conductors, drastically decreasing potential deformation from excessive torque.

The Convertible SWR Autotester reduces maintenance costs without using error prone test port adapters or connector savers.

Accuracy for SMA device test is also improved because the test port head is properly compensated for operation with standard SMA connector dimensions.

Specifications

Frequency Range	0.01 to 40 GHz
Directivity	>34 dB 0.01 to 20 GHz >32 dB 20.0 to 26.5 GHz >29 dB 26.5 to 40.0 GHz
Test Port Match	>21 dB 0.01 to 20.0 GHz >18 dB 20.0 to 40.0 GHz
Maximum Input Power	+27 dBm
Source Input to Test Port Isolation	7.0 dB to 9.0 dB nominal insertion loss, frequency dependent.
Impedance	50 Ω
Input Connector	K(f), 2.92 mm with ruggedized threads
Compatibility	The 560-98C50 is compatible with the 560, 560A, 561, 5400A, 56100A, 562, 54100A and 54000A analyzers.
Dimensions	Autotester: 7.3 cm x 5.3 cm x 2.3 cm Test Port Heads: 16 mm(L) x 9 mm (dia.)

Temperature range: +25°C ±5°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

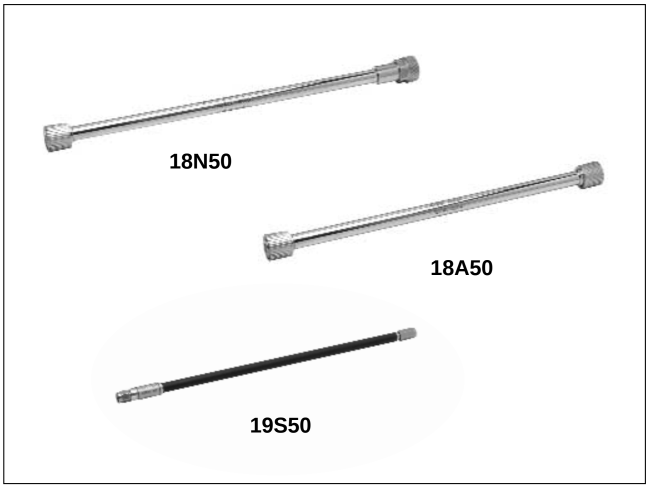
Model/Order No.	Name
560-98C50A*	Convertible SWR Autotester
	Open/Shorts
22K50	Male Open/Short, (Included with 560-98C50A purchase.)
22KF50	Female Open/Short, (Not included with 560-98C50A purchase.)
	Test Port Heads
25S50	Precision Matched WSMA male
25SF50	Precision Matched WSMA female
25L50	Precision Matched 3.5 mm male
25LF50	Precision Matched 3.5 mm female
25K50	Precision Matched K male
25KF50	Precision Matched K female
25SKF50	Precicion Matched Set, WSMA male & female, K male & female
25SLF50	Precicion Matched Set, WSMA male & female, 3.5 mm male & female, K Conntor male & female

* The Convertible SWR Autotester must be used with a test port head.

AIR LINES

18, 19 Series

2 to 40 GHz



The 18 and 19 Series Precision Airlines are the most accurate impedance standards available today, and they are the recognized traceability path for impedance at high frequencies. Anritsu airlines are a critical component when measuring accurate impedances, enabling measurements down to 1.006 SWR to 18 GHz,1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz.

A beadless connector is used at the measurement end to provide a minimum reflection connection. The other end is beaded to keep the center conductor captive, thus fixing the reference plane at the beadless end.

Features

- Virtually lossless gold over silver plating
- Provides impedance traceability to NIST
- Enable measurements down to 1.006 SWR to 18 GHz, 1.01 SWR to 26.5 GHz, and 1.02 SWR to 40 GHz

Specifications

Model	Frequency range (GHz)	Test port connector	Beaded port connector	Dimensions L(cm) x dia(cm)
18A50	2 to 18	GPC-7	GPC-7	30 x 0.7
18N50 18NF50	2 to 18	N(m) N(f)	GPC-7	30 x 0.7
19S50 19SF50	2 to 26.5	WSMA(m) WSMA(f)	WSMA(m)	25 x 0.35
19K50 19KF50	2 to 40	K(m) K(f)	K(m)	15 x 0.29

Temperature range: +25°C ±5°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Precision Air Line
18A50	2 to 18 GHz, 50 Ω, GPC-7
18N50	2 to 18 GHz, 50 Ω, N (m)
18NF50	2 to 18 GHz, 50 Ω, N (f)
19K50	2 to 40 GHz, 50 Ω, K(m)
19KF50	2 to 40 GHz, 50 Ω, K(f)
19S50	2 to 26.5 GHz, 50 Ω, WSMA(m)
19SF50	2 to 26.5 GHz, 50 Ω, WSMA(f)

OPEN/SHORTS
22 Series
DC to 50 GHz


22K50


22KF50

The 22 Series Open/Shorts are used on the test port of an SWR Autotester or SWR bridge to establish a full reflection reference for accurate SWR measurements. When used with scalar network analyzers, the open and short reflections over a swept frequency range can be automatically averaged to enhance measurement accuracy. All models consist of an open on one end and a short on the other.

Features
- Single gold-plated component providing full open and short reflections for accurate SWR measurements
- DC to 50 GHz frequency coverage
- GPC-7, Type N, WSMA, K Connector® and V Connector®
- 50 Ω or 75 Ω impedance

Specifications

Model	Frequency range (GHz)	Test port connector	Characteristic impedance (Ω)	Dimensions L(cm) x dia(cm)
22N75 22NF75	DC to 3	N(m) N(f)	75	6.3 x 1.8 4.9 x 1.6
22N50 22NF50	DC to 18	N(m) N(f)	50	6.3 x 1.8 4.9 x 1.6
22A50	DC to 18	GPC-7	50	3.8 x 1.6
22S50 22SF50	DC to 26.5	WSMA(m) WSMA(f)	50	4.2 x 0.8 3.5 x 0.8
22K50 22KF50	DC to 40	K(m) K(f)	50	4.2 x 0.8 3.5 x 0.8
22V50 22VF50	DC to 50	V(m) V(f)	50	3.6 x 0.8 2.8 x 0.8

Temperature range: +25°C ±5°C

Ordering information
Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Open/Short
22N50	DC to 18 GHz, N(m), 50 Ω
22NF50	DC to 18 GHz, N(f), 50 Ω
22N75	DC to 3 GHz, N(m), 75 Ω
22NF75	DC to 3 GHz, N(f), 75 Ω
22A50	DC to 18 GHz, GPC-7 connector, 50 Ω
22K50	DC to 40 GHz, K(m), 50 Ω
22KF50	DC to 40 GHz, K(f), 50 Ω
22S50	DC to 26.5 GHz, WSMA(m), 50 Ω
22SF50	DC to 26.5 GHz, WSMA(f), 50 Ω
22V50	DC to 50 GHz, V(m), 50 Ω
22VF50	DC to 50 GHz, V(f), 50 Ω

OPEN/SHORTS/LOADS

OSL Series

DC to 4 GHz

22K50

The OSL series open/short/load are used on the test port of hand held spectrum analyzers to establish a full reflection reference for accurate measurements. When used with a Site Master, the open/short and load reflection over a swept frequency range can be automatically averaged to enhance measurement accuracy. The OSL series Open/Short/Load comes in both N (Male) and N (Female) connector configuration and consists of an open on one end, a short on other end, and a Load on the tee section.

Features

- Single Nickel Plated Component providing full open, short and load reflections for accurate measurements.
- DC to 4 GHz frequency coverage
- Type N(Male) and N(Female) connector configurations
- 50 Ω Impedence

Specifications

Model	Frequency range (GHz)	Test port connector	Characteristic impedance (Ω)
OSLN50LF	DC to 4	N(m)	50
OSLNF50LF	DC to 4	N(f)	50

Temperature range: +25°C ±5°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Open/Short/Load
OSLN50LF	DC to 4 GHz, N(m), 50 Ω
OSLNF50LF	DC to 4 GHz, N(f), 50 Ω

MICROWAVE DETECTORS

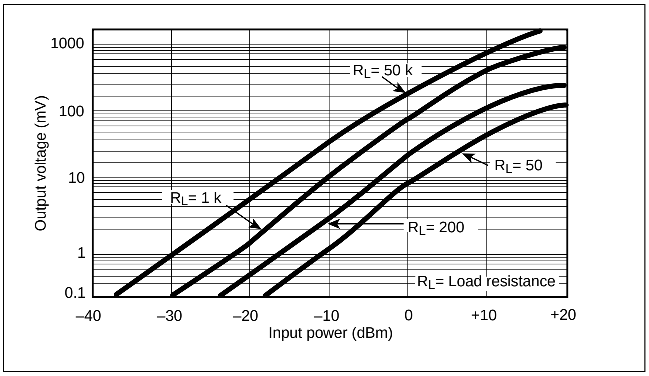
70, 75 Series

100 kHz to 50 GHz

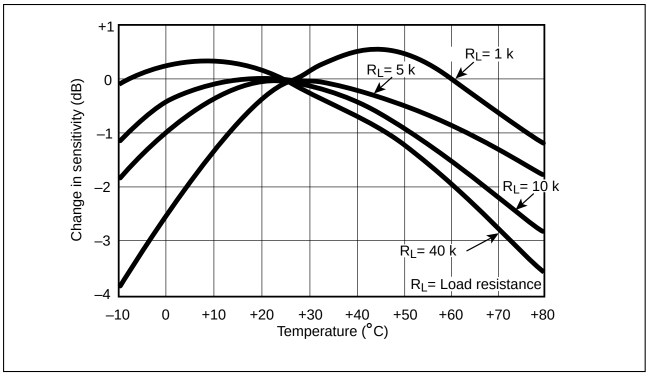
Within the 70 or 75 Series product lines, you will find a model that matches your needs for instrumentation, system, or OEM applications. By using the latest design and microelectronics production technologies, Anritsu low-barrier Schottky-diode detectors outperform others and offer significant cost savings. Input connector types include Type N, and K Connector® (compatible with SMA and 3.5 mm), and V Connector® (compatible with 2.4 mm). In addition to frequency coverage and price, these detectors are distinguished by their low SWR, flat frequency response, and close output-voltage tracking over a wide dynamic range.

Features

- Broadband coverage, 10 MHz to 50 GHz with a Single Detector
- K Connector® compatible with SMA and 3.5 mm
- V Connector® compatible with 2.4 mm
- Lowest SWR: 1.33 to 20 GHz, 1.5 to 40 GHz
- Flat Response: ±0.5 dB to 20 GHz ±1.5 dB to 40 GHz
- Best Value for Instrumentation, system, and OEM applications
- Low price and availability from stock



Typical sensitivity



Typical sensitivity change

Specifications

Model	Frequency range	Flatness (dB)	Connectors		Impedance (Ω)	SWR (Maximum)	Low level sensitivity at –30 dBm (mV/µW)	High level sensitivity at +13 dBm (Volts, Min.)	Input maximum (mW)	Output capacitance (pF)
			In	Out						
70KA50	0.01 to 20 GHz	± 0.6	K(m)	SMC(f)	50	1.33	0.6	1	100	30
70KC50	0.01 to 40 GHz	± 0.5 to 20 GHz ±1.0 to 26.5 GHz ±1.5 to 40 GHz	K(m)	SMC(f)	50	1.33 to 20 GHz 1.50 to 26.5 GHz 1.90 to 40 GHz	0.4	1	100	30
75N50B	0.01 to 18 GHz	± 0.3 to 12.4 GHz ± 0.6 to 18 GHz	N(m)	BNC(f)	50	1.15 to 4.5 GHz 1.30 to 15 GHz 1.39 to 18 GHz	0.35	1	100	30
75KC50	0.01 to 40 GHz	± 0.5 to 20 GHz ±1.0 to 26.5 GHz ±1.5 to 40 GHz	K(m)	BNC(f)	50	1.33 to 20 GHz 1.50 to 26.5 GHz 1.90 to 40 GHz	0.4	1	100	30
75VA50	0.01 to 50 GHz	± 0.5 to 20 GHz ±1.0 to 26.5 GHz ±1.5 to 40 GHz ±3 to 50 GHz	V(m)	BNC(f)	50	1.33 to 20 GHz 1.50 to 26.5 GHz 1.90 to 40 GHz 2.1 to 50 GHz	0.4	1	100	30

Dimensions

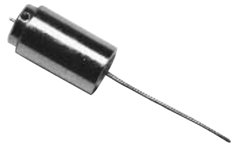
Model	Dimensions L(cm) x dia(cm)
70KA50	4.6 x 1.0
70KC50	4.6 x 1.0
75N50B	6.4 x 1.8
75KC50	4.6 x 1.0
75VA50	4.6 x 1.0

Ordering information

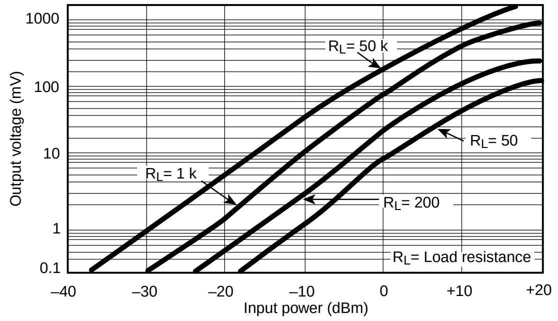
Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Microwave Detector
70KA50	10 MHz to 20 GHz, K(m) input, SMC(f) output, 50 Ω
70KC50	10 MHz to 40 GHz, K(m) input, SMC(f) output, 50 Ω
75KC50	10 MHz to 40 GHz, K(m) input, BNC(f) output, 50 Ω
75N50B	10 MHz to 18.5 GHz, N(m) input, BNC(f) output, 50 Ω
75VA50	10 MHz to 50 GHz, V(m) input, BNC(f) output, 50 Ω
	Options
Option 2 (75KC50)	Matching frequency response of two detectors
Option 3 (75KC50)	Matching frequency response of three detectors

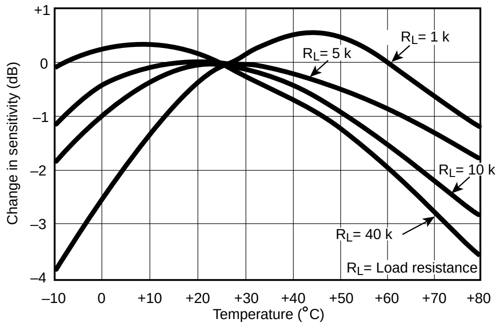
FIELD REPLACEABLE DIODE MODULES



A16176



Typical sensitivity



Typical sensitivity change

Field replaceable diode modules provide field replacements for damaged diodes, virtually eliminating down time. To avoid all degradation in performance when a diode is replaced in the field, all replacement modules include the thin-film matching circuit. Performance after replacement cannot be distinguished from that of a new detector.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Diode module
A16176	70K Series, (≥20 GHz) and 75K Series (≥20 GHz)
A16177	70K Series (≤20 GHz) and 75K Series (≤20 GHz)
A18735	74N50B
B16132	75N50B

MICROWAVE DETECTORS

5400-71, 560-7 Series

1 MHz to 50 GHz

5400-71N50

The Anritsu 560-7 and 5400-71 Series RF Detectors are used with the Model 56100A Scalar Network Analyzer and with Series 54100A Scalar Measurement System for making coaxial transmission loss or gain and power measurements. They are also used with the Site Master™ and Cable Mate™ Series Personal SWR/RL and Fault Location Testers for making power measurements.

Features

- Zero-biased Schottky diodes
- –55 dBm to +16 dBm range

Specifications

Model	Frequency range	Impedance	Return loss	Input connector	Frequency Response
560-7A50	0.01 to 18 GHz	50 Ω	15 dB, <0.04 GHz 22 dB, <8 GHz 17 dB, <18 GHz	GPC-7	±0.5 dB, 18 GHz
560-7N50B	0.01 to 20 GHz	50 Ω	15 dB, <0.04 GHz 22 dB, <8 GHz 17 dB, <18 GHz 14 dB, <20 GHz	N(m)	±0.5 dB, <18 GHz ±1.25 dB, <20 GHz
560-7S50B	0.01 to 20 GHz	50 Ω	15 dB, <0.04 GHz 22 dB, <8 GHz 17 dB, <18 GHz 14 dB, <20 GHz	WSMA(m)	±0.5 dB, <18 GHz ±1.25 dB, <20 GHz
560-7S50-2	0.01 to 26.5 GHz	50 Ω	15 dB, <0.04 GHz 22 dB, <8 GHz 17 dB, <18 GHz 14 dB, <26.5 GHz	WSMA(m)	±0.5 dB, <18 GHz ±1.25 dB, <26.5 GHz
560-7K50	0.01 to 40 GHz	50 Ω	12 dB, <0.04 GHz 22 dB, <8 GHz 7 dB, <18 GHz 15 dB, <26.5 GHz 14 dB, <32 GHz 13 dB, <40 GHz	K(m)	±0.5 dB, <18 GH ±1.25 dB, <26.5 GHz ±2.2 dB, <32 GHz ±2.5 dB, <40 GHz
560-7VA50	0.01 to 50 GHz	50 Ω	12 dB, <0.04 GHz 19 dB, <20 GHz 15 dB, <40 GHz 10 dB, <50 GHz	V(m)	±0.8 dB, <20 GHz ±2.5 dB, <40 GHz ±3.0 dB, <50 GHz
5400-71B50	0.001 to 1.5 GHz	50 Ω	20 dB	BNC(m)	±0.2 dB, <1.5 GHz
5400-71B75	0.001 to 1.5 GHz	75 Ω	20 dB	BNC(m)	±0.2 dB, <1.5 GHz
5400-71N50	0.001 to 3 GHz	50 Ω	26 dB	N(m)	±0.2 dB, <1 GHz ±0.3 dB, <3 GHz
5400-71N75	0.001 to 3 GHz	75 Ω	26 dB, <2 GHz 20 dB, <3 GHz	N(m)	±0.2 dB, <3 GHz ±0.3 dB, <3 GHz
5400-71N75L*	0.005 to 1.2 GHz	75 Ω	24 dB	N(m)	±0.2 dB, <1 GHz ±0.5 dB, <1.2 GHz

* The input of the 5400-71N75L is designed to extend the damage level to 1 W (+30 dBm). Compression begins at 10 dBm <0.05 GHz, 15 dBm <1 GHz, or 20 dBm <1.2 GHz.

Temperature range: 0°C to +70°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Microwave Detector
5400-71N50	1 to 3000 MHz, N(m), 50 Ω
5400-71N75	1 MHz to 3 GHz, N(m), 75 Ω
560-7A50	10 MHz to 18 GHz, GPC-7, 50 Ω
560-7K50	10 MHz to 40 GHz, K(m), 50 Ω

Model/Order No.	Name
560-7N50B	10 MHz to 20 GHz, N(m), 50 Ω
560-7S50-2	10 MHz to 26.5 GHz, WSMA(m), 50 Ω
560-7S50B	10 MHz to 20 GHz, WSMA(m), 50 Ω
560-7VA50	10 MHz to 50 GHz, V(m), 50 Ω

POWER SENSORS

MA2400A/B Series

10 MHz to 50 GHz

The MA2400A/B Series Power Sensors consist of MA247XA Series Power Sensors, MA246XA/B Series Power Sensors, MA248XA Series Universal Power Sensors, MA242XA/B Series Thermal Power Sensors, and MA244XA Series High Accuracy Power Sensors. These units are broadband microwave measurement components. All models except the MA246XA/B Series Power Sensors, are used with the ML2430A Series Power Meters. The MA246XA/B Series Power Sensors are used only with the ML2400A Series Power Meter.

Features

- 10 MHz to 50 GHz range
- N, K, and V type RF connectors
- 90 dB dynamic range provides stable power readings to –70 dBm
- MA244XA Series High Accuracy Power Sensors contain an additional matching circuit to improve return loss performance
- MA242XA/B Series Thermal Power Sensors provide measuring speeds to 4 ms rise and fall times in addition to exceptional return loss performance
- MA246XB power sensors have fast one millisecond rise and fall times needed for CDMA measurements
- MA248XA Universal sensors measure average power of modulated signals such as W-CDMA, multi-tone, etc.
- All MA2400A/B Series Power Sensors contain internal EEPROMs for storage of calibration data as a function of frequency, power, and temperature. This allows the power meter to interpolate and correct readings automatically

Fast thermal sensors

Anritsu's thermal sensors provide excellent power measurement accuracy over 50 dB of dynamic range with more speed than any other thermal sensor available (see figure 1). Thermal sensors use Seebeck elements where the combined effect of a thermal gradient and charge migration between dissimilar metals gives a true reading of average power on any incident waveform. Anritsu thermal sensors have class-leading SWR and a built in EEPROM with calibration factor and linearity correction data. This results in assured accuracy when measuring any signal. Anritsu's fast thermal power sensors improve sensor rise time and fall time to less than 4.0 ms – an order of magnitude faster than previous thermal sensors. Settled power measurements are now 10 times faster, which means reduced test time.

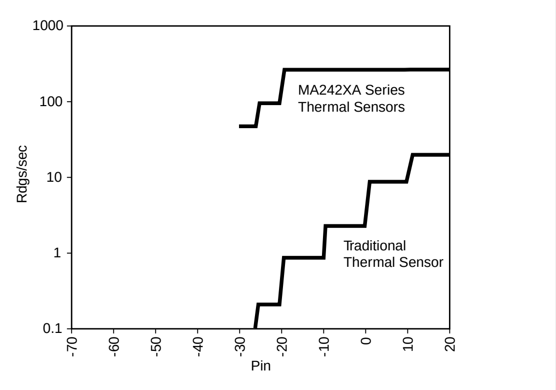


Figure 1 Fast Thermal Sensors

Standard diode sensors

Diode sensors have greater speed, sensitivity, and dynamic range than thermal sensors (see figure 2). All Anritsu diode sensors use a dual diode architecture that gives improved sensitivity and dynamic range over single diode architectures. The MA2470A Series Power Sensors 90 dB dynamic range is both fast and accurate. Linearity is better than 1.8%, typically < 1.0% through 18 GHz.

MA2470A power sensors offer an ideal combination of speed and dynamic range for general purpose power measurements. A single sensor replaces the two sensors that were previously required with sensors limited to 50 dB dynamic range.

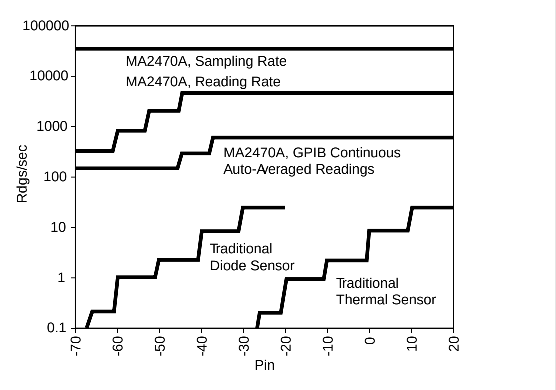


Figure 2 Standard Diode Sensors

High accuracy diode sensors

The Anritsu MA2440A series high-accuracy diode sensors have a built in 3 dB attenuator to minimize input SWR. They are used where the best measurement accuracy is required over a large dynamic range, for example when measuring amplifiers. High accuracy diode sensors have a dynamic range of 87 dB compared to the 90 dB of standard diode sensors.

Fast diode sensors

The MA2460A fast diode sensors from Anritsu have a rise time of 0.6 µs. This, together with a sensor video bandwidth of 1.25 MHz, makes them the ideal solution for power measurements on N-CDMA (IS-95) signals. The MA2460 sensors must be used with the ML2407/08A power meter. This combination of meter and sensor provides fast signal processing and sampling speeds. Average power, peak power and crest factor on N-CDMA signals can be measured and displayed. The MA2460 are dual diode sensors that deliver a greater-than 80 dB dynamic range, which makes them suitable for both open- and closed-loop power-control testing. The sensors internal AC detection circuitry gives a guaranteed noise floor of –60 dBm with typical performance to –70 dBm, even when measuring CDMA signals. Pulses down to 1 µs can also be captured and displayed, thanks to the sensor rise time of 0.6 µs. In profile mode the ML2407A meter can be used to measure average power across narrow pulses, an increasingly common test method for amplifiers in digitally modulated systems.

Universal power sensors

The new MA2480A series Universal Power Sensors will measure any modulated or multi-tone signal, thanks to a patented sensor architecture with three diode pairs (see figure 3). Universal power sensors deliver over 80 dB of dynamic range with speed and accuracy. Average power measurements on WCDMA signals can now be made without the need for special power meters. Universal sensors are also ideal for power measurements on other digitally modulated carriers such as HDTV, DAB or QAM modulated radio links.

Universal power sensors are also ideal for applications where multiple signals are present, such as intermodulation measurements and satellite multi carrier power loading measurements.

Anritsu universal power sensors have a unique additional capability for performing as a standard diode sensor for CW measurements. In this mode the fast response of diode sensors is maintained across the full dynamic range of the sensor, meaning that for the majority of users it is the only sensor that they will ever need – a truly Universal Power Sensor.

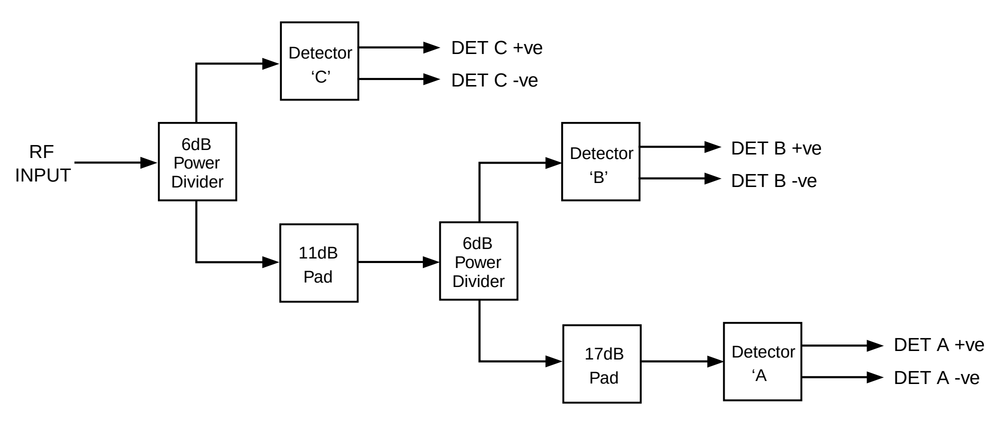


Figure 3 Universal Power Sensor

Specifications

Model	Frequency range	Dynamic range (dBm)	SWR	Rise time*1 (ms)	Sensor linearity	RF connector*2
Standard diode sensors						
MA2472B	10 MHz - 18 GHz	–70 to +20	<1.17; 10 - 150 MHz (MA2472B only) <1.90; 10 - 50 MHz <1.17; 50 - 150 MHz <1.12; 0.15 - 2 GHz <1.22; 2 - 12.4 GHz <1.25; 12.4 - 18 GHz <1.35; 18 - 32 GHz <1.50; 32 - 40 GHz <1.63; 40 - 50 GHz	<0.004	1.8%, <18 GHz 2.5%, <40 GHz 3.5%, <50 GHz	N (m)
MA2473A	10 MHz - 32 GHz					K (m)
MA2474A	10 MHz - 40 GHz					K (m)
MA2475A	10 MHz - 50 GHz					V (m)
Fast thermal sensors						
MA2421B	0.1 MHz - 18 GHz	–30 to +20	<1.10; 0.1 MHz - 2 GHz <1.15; 2 - 12.4 GHz <1.20; 12.4 - 18 GHz	<4.0	1.3%, <18 GHz 1.5%, <40 GHz 1.8%, <50 GHz	N (m)
MA2422B	10 MHz - 18 GHz		<1.90; 10 - 50 MHz <1.17; 50 - 150 MHz <1.10; 0.15 - 2 GHz <1.15; 2 - 12.4 GHz <1.20; 12.4 - 18 GHz <1.25; 18 - 32 GHz <1.30; 32 - 40 GHz <1.40; 40 - 50 GHz			N (m)
MA2423B	10 MHz - 32 GHz					K (m)
MA2424B	10 MHz - 40 GHz					K (m)
MA2425B	10 MHz - 50 GHz					V (m)
High accuracy diode sensors						
MA2442B	10 MHz - 18 GHz	–67 to +20	<1.17; 10 -150 MHz (MA2442B only) <1.90; 10 - 50 MHz <1.17; 50 - 150 MHz <1.08; 0.15 - 2 GHz <1.16; 2 - 12.4 GHz <1.21; 12.4 - 18 GHz <1.29; 18 - 32 GHz <1.44; 32 - 40 GHz <1.50; 40 - 50 GHz	<0.004	1.8%, <18 GHz 2.5%, <40 GHz 3.5%, <50 GHz	N (m)
MA2444A	10 MHz - 40 GHz					K (m)
MA2445A	10 MHz - 50 GHz					V (m)
Fast diode sensors						
MA2468A*3	10 MHz - 6 GHz	–60 to +20	<1.90; 10 - 50 MHz <1.17; 50 - 150 MHz <1.12; 0.15 - 2 GHz <1.22; 2 - 12.4 GHz <1.25; 12.4 - 18 GHz	<0.0006	1.8%	N (m)
MA2469B*3	10 MHz - 18 GHz					
Universal power sensors						
MA2481B	10 MHz - 6 GHz	–60 to +20	< 1.17; 10 - 150 MHz < 1.12; 0.15 - 2 GHz < 1.22; 2 - 12.4 GHz < 1.25; 12.4 - 18 GHz	<0.004 (with option 1 only)	10 MHz to 6GHz 3% -60 to +20 dBm 6 to 18 GHz 3% -60 to 0 dBm 3.5% 0 to +20 dBm (1.8% CW with option 1)	N (m)
MA2482A	10 MHz - 18 GHz					
MA2480/01	Adds fast CW mode to Universal Power Sensors for high speed measurements of CW signal plus TDMA and pulse measurements.					

*1: 0.0 dBm, room temperature.
*2: Each MA2400A/B series sensor incorporates precision RF connectors with hexagon coupling nut for attachment by industry standard torque wrench.
*3: MA2460A/B Fast Diode Sensors must be used with ML2407/08A Power Meters for NCDMA and Fast Pulse measurements.

Temperature range: +25°C ±5°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Thermal Sensor
MA2421A	0.1 MHz to 18 GHz
MA2422B	10 MHz to 18 GHz
MA2423B	10 MHz to 32 GHz
MA2424B	10 MHz to 40 GHz
MA2425B	10 MHz to 50 GHz
	High Accuracy Sensor
MA2442B	10 MHz to 18 GHz
MA2444A	10 MHz to 40 GHz
MA2445A	10 MHz to 50 GHz
	Fast Diode Sensor
MA2468A	10 MHz to 6 GHz
MA2469B	10 MHz to 18 GHz

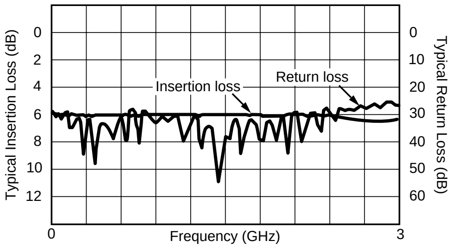
Model/Order No.	Name
	Power Sensor
MA2472B	10 MHz to 18 GHz
MA2473A	10 MHz to 32 GHz
MA2474A	10 MHz to 40 GHz
MA2475A	10 MHz to 50 GHz
MA2481B	Universal Power Sensor, 10 MHz to 6 GHz
MA2482A	Universal Power Sensor, 10 MHz to 18 GHz
MA2480/01	Option 1, Universal Power Sensor CW Option
MA2400/98	Z540/Guide 25 Calibration
MA2400/99	Premium Calibration
MA2497A	Agilent (HP) Sensor adapter
MA2499B	Anritsu Sensor 10 to 12 pin Adapter

POWER DIVIDERS

11 Series

DC to 3000 MHz

11N50B



Insertion loss (typical) /return loss (typical)

These RF power dividers are symmetrical, three-resistor tee designs that can be used in applications where signals from DC to 3000 MHz must be accurately divided. They are available in 50 Ω or 75 Ω and provide excellent amplitude and phase tracking.

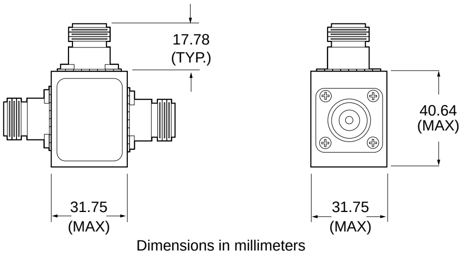
Features

- DC to 3000 MHz frequency range
- Excellent amplitude and phase tracking
- 50 or 75 Ω

Specifications

Model	Frequency range (MHz)	SWR	Insertion loss (dB, max.)	Impedance (Ω)	Connectors	
					Input	Output
11N50B 11N75B	DC to 3000	<1.25	7	50 75	N(f)	N(f)

Maximum Input Power: 1 Watt
Temperature range: 0°C to +70°C



11N50B, 11N75B outline

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
11N50B 11N75B	Power Divider, 1 MHz to 3 GHz, 50 Ω Power Divider, 1 MHz to 3 GHz, 75 Ω

POWER DIVIDERS

K240, V240 Series

DC to 65 GHz

V240C

These microwave power dividers are symmetrical, three-resistor tee designs that can be used in applications where signals from DC to 65 GHz must be accurately divided or combined. K Connector® is compatible with 3.5 mm and SMA; V Connector® is compatible with 2.4 mm. All models have exceptional amplitude and phase tracking characteristics.

Features

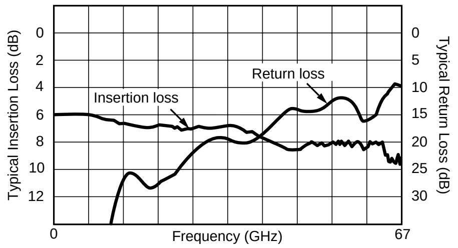
- DC to 65 GHz frequency range
- K Connector® compatibility with SMA/3.5 mm
- V Connector® compatibility with 2.4 mm
- Excellent amplitude and phase tracking

Specifications

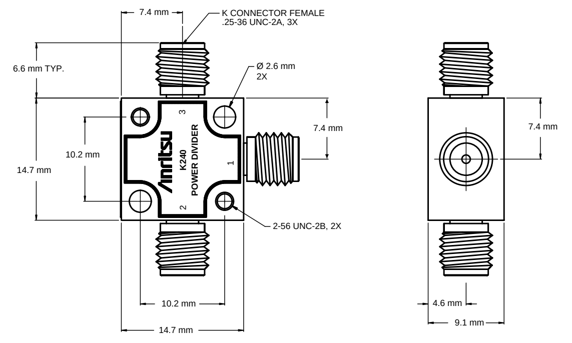
Model	Frequency range (GHz)	Impedance (Ω)	Connectors
K240B	DC to 26.5	50	K(f)
K240C	DC to 40	50	K(f)
V240C	DC to 65	50	V(f)

Frequency range (GHz)	Tracking of outputs		Insertion loss (dB max.)	SWR
	Amplitude	Phase		
DC to 6	± 0.3 dB	±2˚	7	1.22
6 to 18	± 0.3 dB	±3˚	7.5	1.44
18 to 26.5	± 0.6 dB	±4˚	8	1.58
26.5 to 40	± 0.6 dB	±6˚	8.5	1.79
40 to 65	± 1.8 dB	±18˚	10	3.11

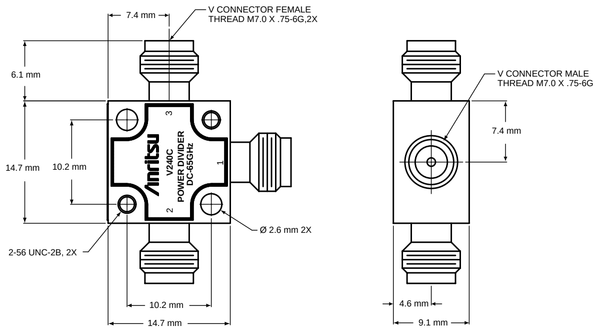
Maximum Input Power: 1W
Temperature range: 0°C to +70°C
Weight: 43g



Insertion loss (typical) /return loss (typical)



K240B, K240C outline



V240C outline

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
K240B	Precision Power Divider, DC to 26.5 GHz
K240C	Precision Power Divider, DC to 40 GHz
V240C	Precision Power Divider, DC to 60 GHz

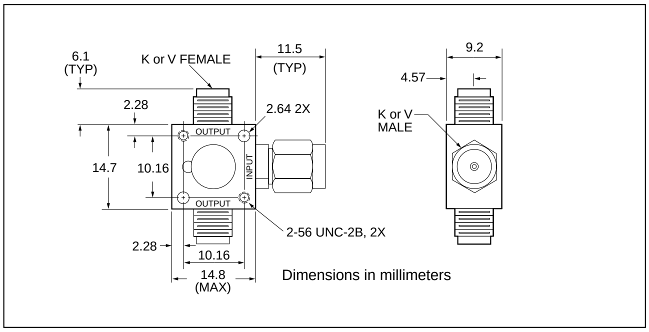
POWER SPLITTERS

K241, V241 Series

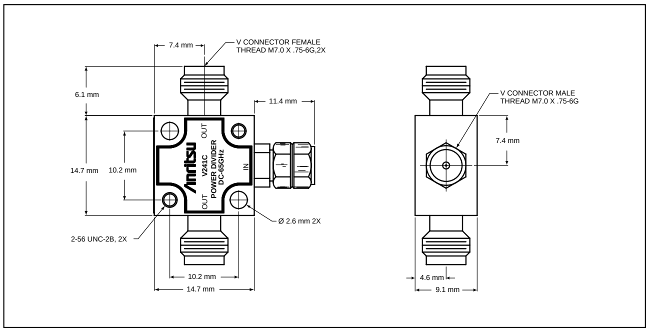
DC to 65 GHz

K241C

V241C



K241B, K241C Outline



V241C Outline

These microwave power splitters are symmetrical, two-resistor designs that can be used in applications where signals from DC to 65 GHz must be accurately divided for ratio measurements. They provide excellent flatness and effective output SWR. K Connectors® are compatible with 3.5 mm and SMA; V Connectors® are compatible with 2.4 mm.

Features

- DC to 65 GHz frequency range
- K Connector® compatibility with SMA/3.5 mm
- V Connector® compatibility with 2.4 mm
- Excellent flatness and effective output SWR

Specifications

Model	Frequency range (GHz)	Impedance (Ω)	Connectors	
			Input	Output
K241B	DC to 26.5	50	K(m)	K(f)
K241C	DC to 40	50	K(m)	K(f)
V241C	DC to 65	50	V(m)	V(f)

Model	Frequency range (GHz)	Flatness (dB)	Input SWR	Effective output SWR	Insertion loss (dB)
K241B	DC to 26.5	2.0	1.45	1.45	7.5
K241C	DC to 26.5	2.0	1.45	1.45	7.5
	26.5 to 40	2.0	1.93	1.70	8.5
V241C	DC to 18	2.0	2.11	2.00	8.5
	18 to 40	2.0	2.33	2.30	9.5
	40 to 65	2.0	2.62	2.60	10.5

Maximum Input Power: 1W
Temperature range: 0°C to +70°C
Weight: 43g

Ordering information

Please specify model/order number, name, and quantity when ordering.

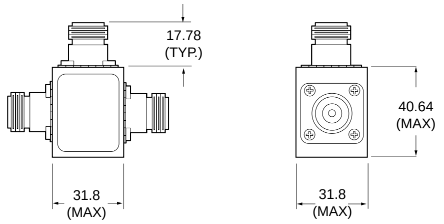
Model/Order No.	Name
K241B	Precision Power Splitter, DC to 26.5 GHz
K241C	Precision Power Splitter, DC to 40 GHz
V241C	Precision Power Splitter, DC to 60 GHz

POWER SPLITTERS

N241 Series

DC to 3000 MHz

N241A50



N241A50, N241A75 outline

These RF power splitters are symmetrical, two resistor designs that can be used in applications where signals from DC to 3000 MHz must be accurately divided for ratio measurements. They are available in 50 or 75 Ω and provide excellent flatness and effective output SWR.

Features

- DC to 3000 MHz frequency range
- Excellent flatness and effective output SWR
- 50 or 75 Ω

Specifications

Model	N241A50	N241A75
Frequency range	DC to 3000 MHz	DC to 3000 MHz
Input SWR	1.3	1.4
Effective output SWR	1.3	1.4
Insertion loss	7.5 dB	7.5 dB
Flatness	±1.5 dB	±1.5 dB
Impedance	50 Ω	75 Ω
Connectors	Input: N(f) Output: N(f)	Input: N(f) Output: N(f)

Maximum Input Power: 1W
Temperature range: 0°C to +70°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
N241A50	Power Splitter, DC to 3000 MHz, 50 Ω
N241A75	Power Splitter, DC to 3000 MHz, 75 Ω

BIAS TEES

K250, V250

100 MHz to 40 GHz 100 MHz to 60 GHz

K250

These bias tees are designed for applications where both DC and RF signals must be applied to a device under test. They are particularly suited for active device measurements. DC voltages of up to 30 volts at 0.5 amps may be applied to test devices with negligible effect on RF performance. Low RF throughline loss (<1 dB) and low return loss ensure negligible effect on measurements up to 60 GHz. An RF input DC block isolates the input port from the applied bias voltage.

Features

- Broadband, 0.1 to 60 GHz coverage
- Low SWR, low insertion loss
- K Connector® and V Connector® availability

Specifications

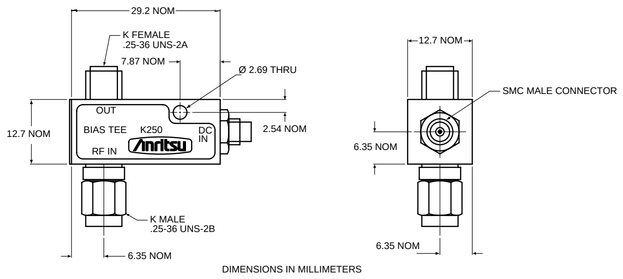
Model	K250	V250
Frequency range	0.1 to 40 GHz[*1]	0.1 to 60 GHz[*1]
Insertion loss	1.2 dB typ.	2.2 dB typ.
Return loss	15 dB min. to 20 GHz 10 dB min. to 40 GHz	13 dB min. to 20 GHz 9 dB min. to 40 GHz 8 dB min. to 60 GHz
RF power	1W max.	1 W max.
DC voltage	30V max.	30 V max.
DC current	0.5A	0.5 A
DC port isolation	20 dB at 0.1 GHz 40 dB above 0.5 GHz	20 dB at 0.1 GHz 40 dB above 0.5 GHz
RF connectors	Input: K(m) Output: K(f)	Input: V(m) Output: V(f)
DC connectors	SMC(m)	SMC(m)

*1. Usable between 0.04 and 0.1 GHz with degraded performance.

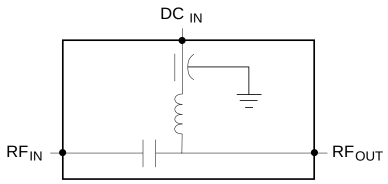
Temperature range: 0°C to +70°C

Specifications

Temperature	0 to 60°C
Mounting position	Any
Weight	57g



Outline drawing (K and V models)



Schematic diagram (K and V models)

Ordering information

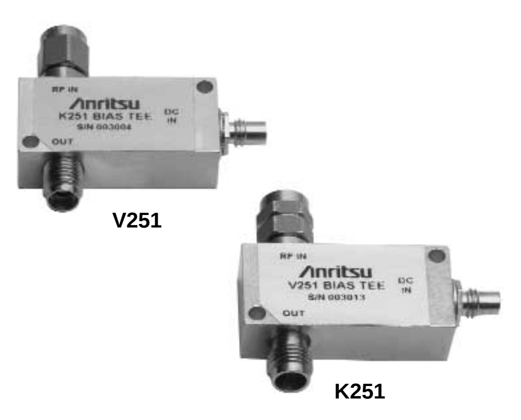
Please specify model/order number, name, and quantity when ordering.

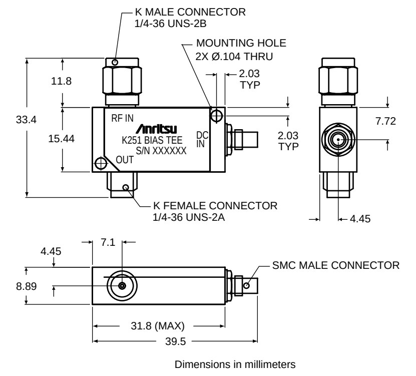
Model/Order No.	Name
K250	Precision Bias Tee, 100 MHz to 40 GHz
V250	Precision Bias Tee, 100 MHz to 60 GHz

ULTRA-WIDEBAND BIAS TEES

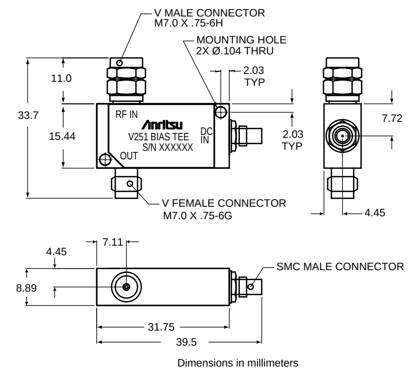
K251, V251

50 kHz to 40 GHz **100 kHz to 65 GHz**





K251 outline drawing



V251 outline drawing

These ultra-wide bandwidth bias tees have been optimized for optical communications and other high-speed pulse, data or microwave applications. Designed to simultaneously apply both DC and RF drive signals to a device via a single input port, these bias tees feature fast rise times, excellent low frequency response, minimum insertion loss and flat group delay. Precision K Connector® and V Connector® interfaces assure excellent impedance match across the wide bandwidths available. A one year warranty is provided.

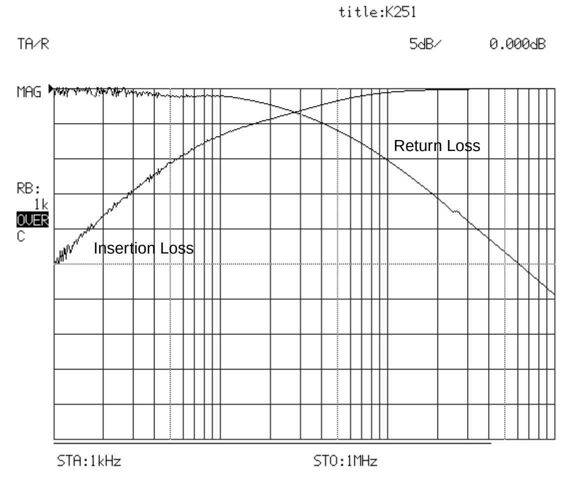
Features

- Ideal for Optical Communications Applications
- Low Insertion Loss
- Risetime: <5 ps typical (V251), <7 ps typical (K251)

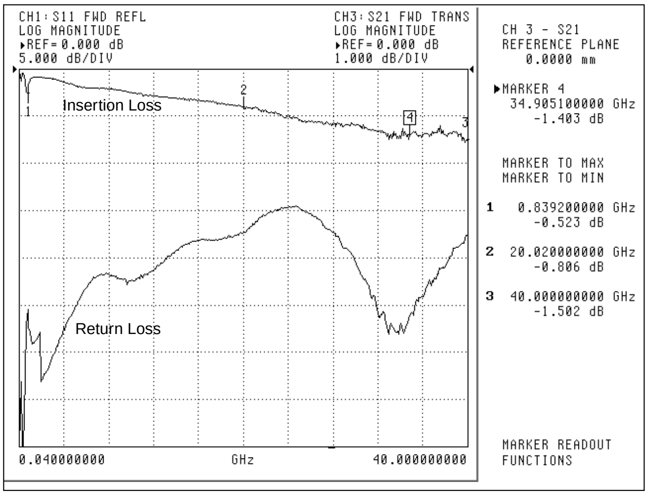
Specifications

Model	Frequency range	Insertion loss	Return loss	Rise time	Group delay	Max DC current	Max DC voltage	Max RF power	Connectors
K251	50 kHz to 40 GHz	<2 dB typical	See Plot	<7 ps typical	110 ±2 ps typical	100 mA	16 VDC	1 W	RF In: K(m) RF Out: K(f) Bias: SMC(m)
V251	100 kHz to 65 GHz	<2.5 dB typical	See Plot	<5 ps typical	113 ±2 ps typical	100 mA	16 VDC	1 W	RF In: V(m) RF Out: V(f) Bias: SMC(m)

Specifications apply over the full DC Bias current range and over the temperature range of 0°C to +70°C.

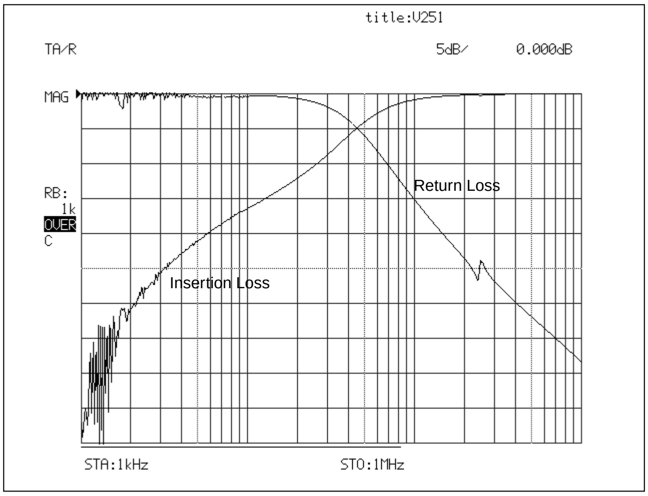


Typical Low Frequency Insertion Loss and Return Loss measured on K251 over the range of 1kHz to 1 MHz.

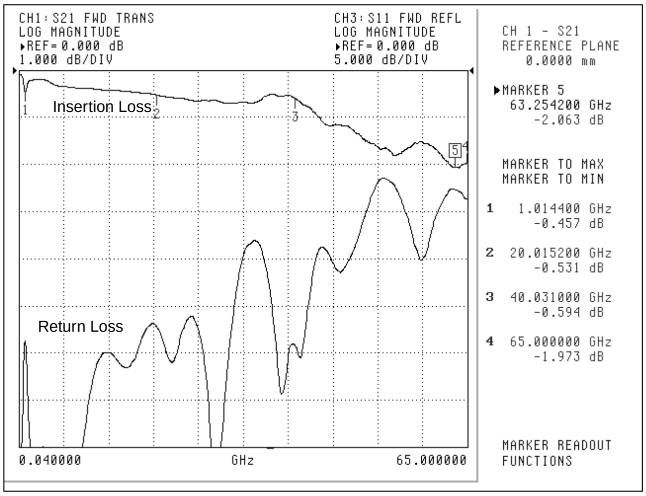


Typical Insertion Loss and Return Loss measured on K251 over the range of 40 MHz to 40 GHz.

For product ordering information, see pages 3 – 6



Typical Low Frequency Insertion Loss measured on V251 over the range of 1 kHz to 1 MHz.



CH 1 - S21
REFERENCE PLANE
0.0000 mm

▸MARKER 5
63.254200 GHz
-2.063 dB

MARKER TO MAX
MARKER TO MIN

1 1.014400 GHz
-0.457 dB

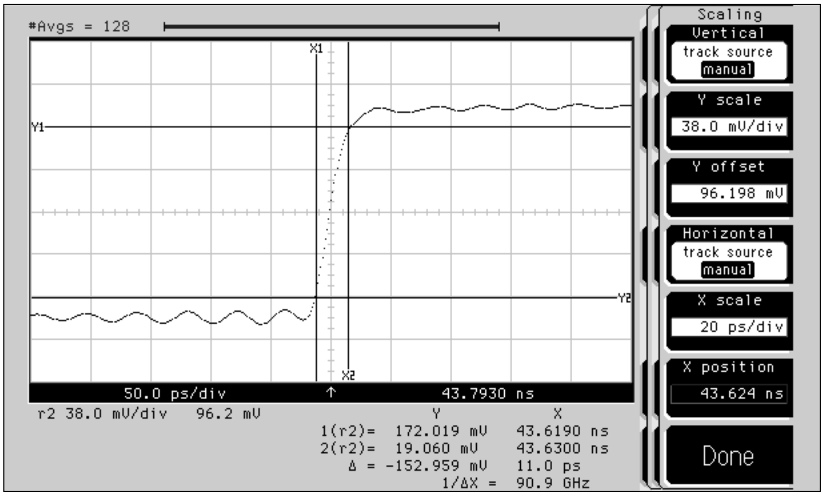
2 20.015200 GHz
-0.531 dB

3 40.031000 GHz
-0.594 dB

4 65.000000 GHz
-1.973 dB

MARKER READOUT
FUNCTIONS

Insertion Loss and Return Loss measured on V251 over the range of 40 MHz to 65 GHz.



#Avgs = 128

50.0 ps/div ↑ 43.7930 ns

r2 38.0 mV/div 96.2 mV

	Y	X
1(r2)=	172.019 mV	43.6190 ns
2(r2)=	19.060 mV	43.6300 ns
Δ =	-152.959 mV	11.0 ps
	1/ΔX =	90.9 GHz

Scaling
Vertical
track source
manual
Y scale
38.0 mV/div
Y offset
96.198 mV
Horizontal
track source
manual
X scale
20 ps/div
X position
43.624 ns

Typical Uncorrected Pulse Response for V251. Absolute risetime for the Bias Tee is derived from this measured data by applying the RSS method to compensate for the risetime of the input pulse.

$$\sqrt{T_{BT}^2 + T_{PG}^2} = T\ meas.$$

T meas. = uncorrected risetime
T_{BT} = *absolute Bias Tee risetime*
T_{PG} = *risetime of input pulse*

$$T_{BT} = \sqrt{T_{meas}^2 - T_{PG}^2}$$

Ordering information

Please specify model/order number, name, and quantity when ordering.

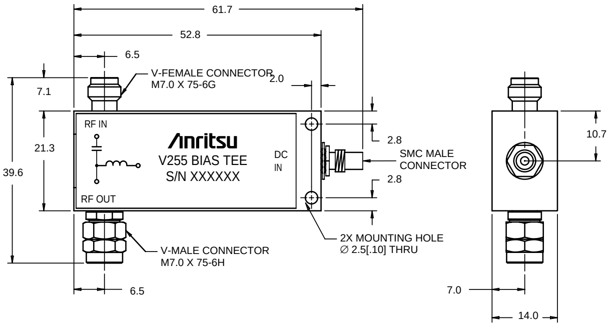
Model/Order No.	Name
K251	Precision Bias Tee, 50 kHz to 40 GHz
V251	Precision Bias Tee, 100 kHz to 65 GHz

ULTRA-WIDEBAND BIAS TEE, HIGH CURRENT

V255

50 kHz to 65 GHz

V255



V255 outline drawing

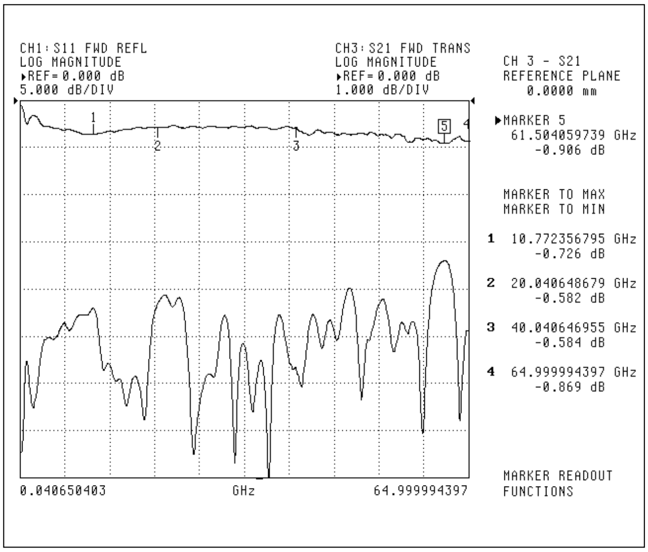
The V255 Gen II Ultra Wideband Bias Tee is designed to meet the high electrical performance requirements of passive components in optical communication networks. This bias tee is ideal for use in 40 Gbps systems because of low insertion loss, excellent return loss and broad bandwidth. Its fast rise time and flat group delay performance allows extremely accurate measurements within a laboratory environment. The V255 Bias Tee comes with a standard V Connector® that assures excellent impedance match across the available wide bandwidth. The DC signal can be applied or extracted from the bias tee through an SMC connector at the third port. As with our other bias tees, the V255 also has a one-year warranty.

Features

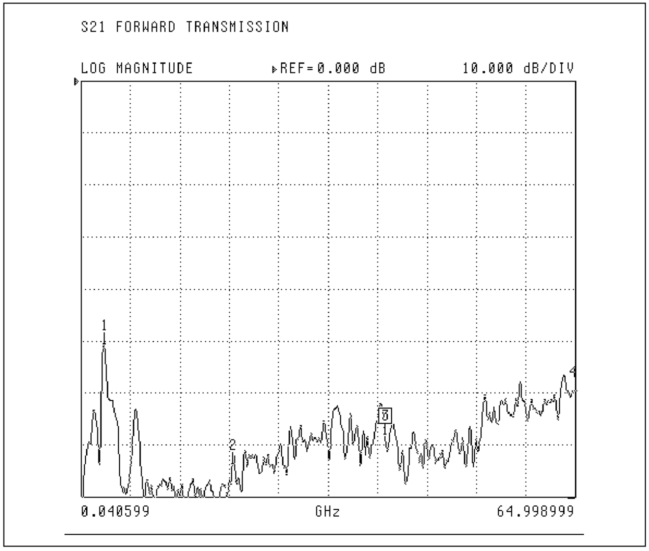
- Ideal for Optical Communication applications.
- Very low Insertion Loss
- Rise Time 3 ps typical
- High Current Capacity
- High Isolation between Input Port and DC Port

Specifications

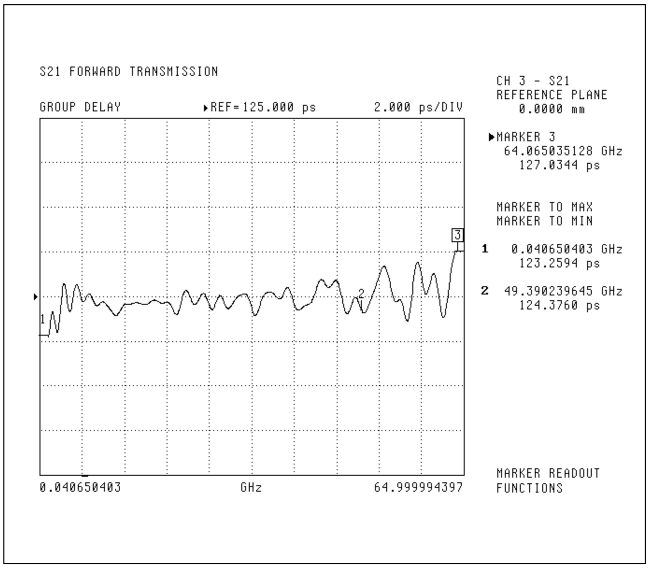
Model	Frequency range	Insertion loss	Return loss	DC voltage	DC current	Isolation	Rise Time	Group delay	Operating temp.
V255	50 kHz to 65 GHz 30 kHz to 65 GHz typ.	1.5 dB to 65 GHz typ.	12 dB to 65 GHz typ.	10 V max.	400 mA max.	–50 dB min.	3 ps typ.	125 ±2 ps typ.	0°C to 80°C



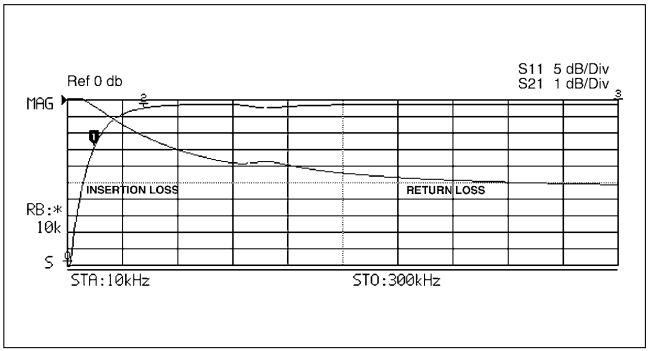
Typical High Frequency Insertion Loss and Return Loss measured on V255 over the range of 65 GHz



Typical Isolation between Data I/P and DC Port



Typical Group Delay Performance measured on V255



Typical Low Frequency Insertion Loss and Return Loss measured on V255 Bias Tee over the range of 10 kHz to 300 kHz

Ordering information

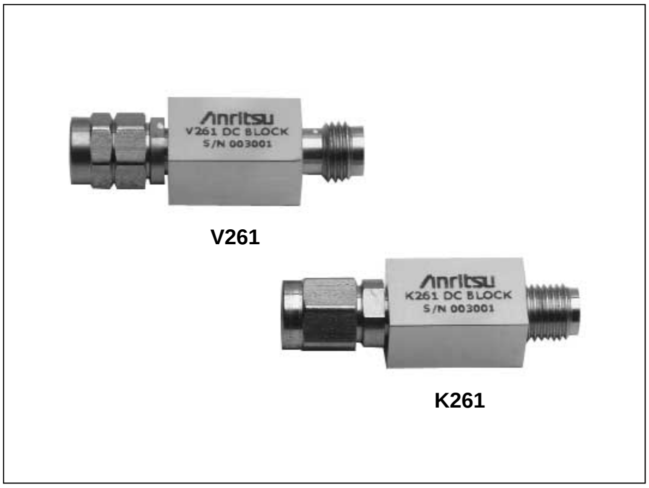
Please specify model/order number, name, and quantity when ordering.

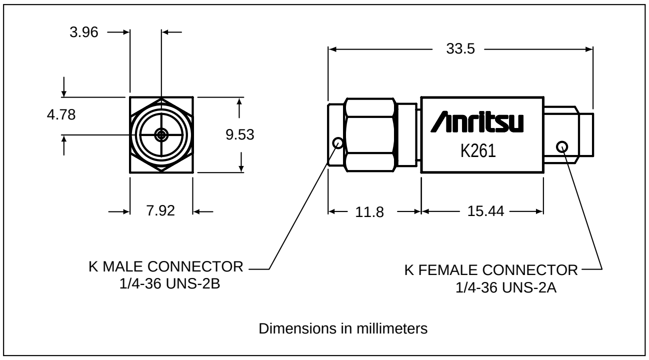
Model/Order No.	Name
V255	Gen II Wideband Bias Tee, 50 kHz to 65 GHz

PRECISION DC BLOCKS

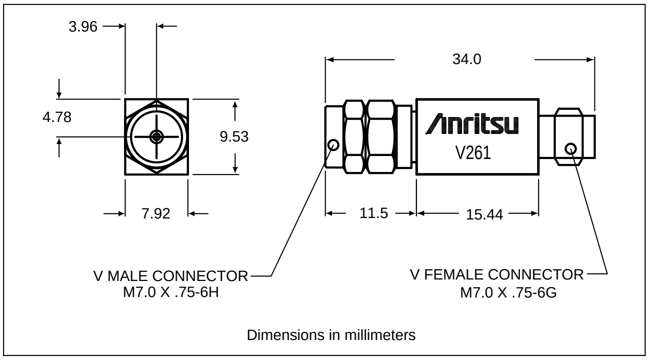
K261, V261

10 kHz to 40 GHz **50 kHz to 65 GHz**





K261 outline drawing



V261 outline drawing

These ultra-wide bandwidth DC Blocks have been optimized for optical communications and other high-speed pulse, data or microwave applications. Designed to apply AC drive signals to a device while eliminating any DC components, these DC Blocks feature wide bandwidth, excellent low frequency response, minimum insertion loss and flat group delay. Precision K Connector® and V Connector® interfaces assure excellent impedance match across the wide bandwidths available. A one year warranty is provided.

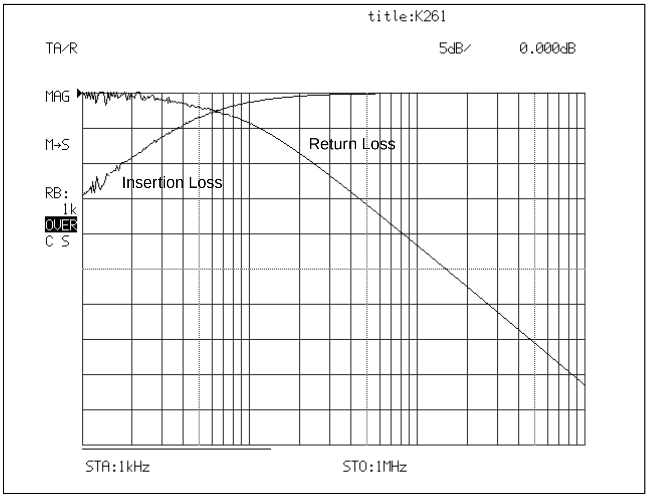
Features

- Ideal for Optical Communications and high-speed Pulse Applications
- <1.0 dB Insertion Loss (K261)
- Risetime: <5 ps (V261), <7 ps (K261)

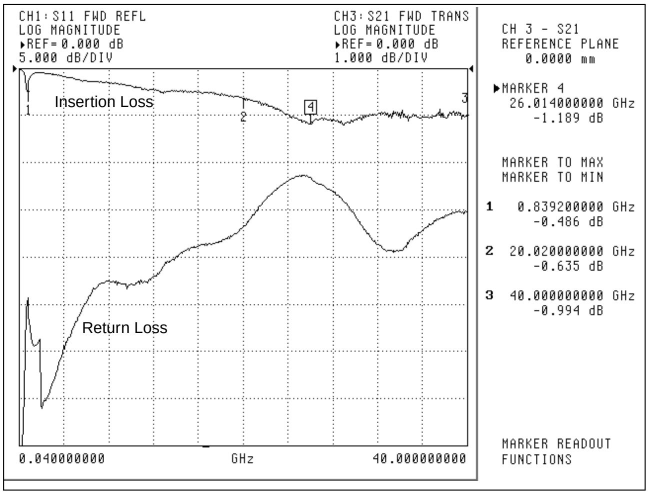
Specifications

Model	Frequency range	Insertion loss	Return loss	Rise time	Group delay	Max DC voltage	Max RF power	Connectors
K261	10 kHz to 40 GHz	<1.0 dB typical	See Plot	<7 ps typical	110 ±1 ps typical	16 VDC	1 W	RF In: K(m) RF Out: K(f)
V261	50 kHz to 65 GHz	<2.0 dB typical	See Plot	<5 ps typical	113 ±1 ps typical	16 VDC	1 W	RF In: V(m) RF Out: V(f)

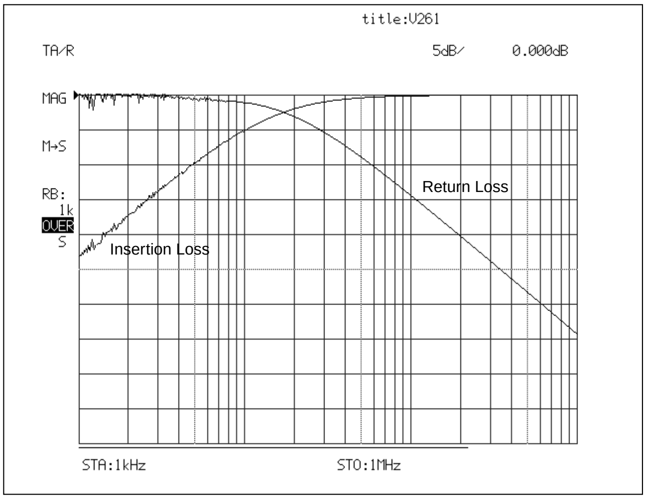
Specifications apply over the temperature range of 0°C to +70°C.



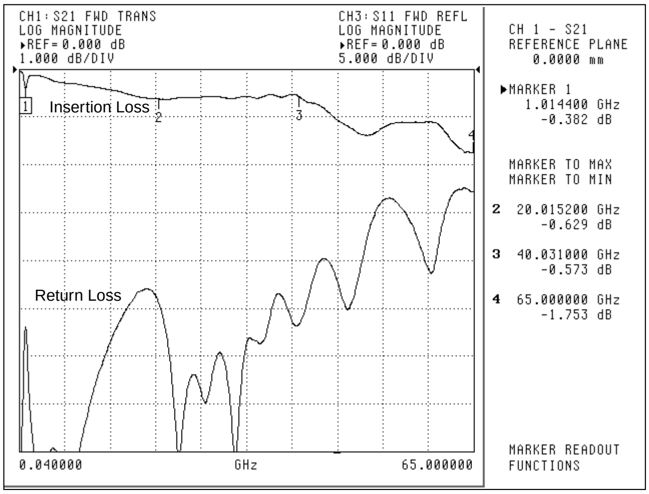
Typical Low Frequency Insertion Loss measured on K261 over the range of 1 kHz to 1 MHz.



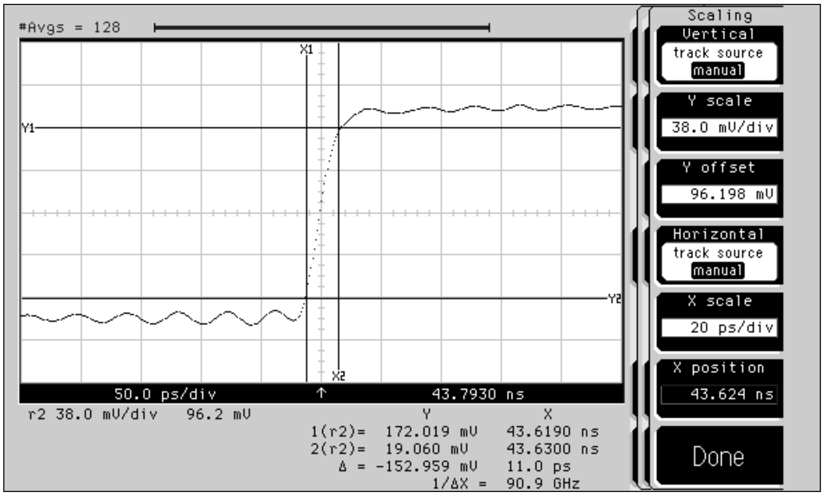
Typical Insertion Loss and Return Loss measured on K261 over the range of 40 MHz to 40 GHz.



Typical Low Frequency Insertion Loss measured on V261 over the range of 1 kHz to 1 MHz.



Typical Insertion Loss and Return Loss measured on V261 over the range of 40 MHz to 65 GHz.



```
#Avgs = 128
50.0 ps/div          ↑          43.7930 ns
r2 38.0 mV/div    96.2 mV
                        Y             X
           1(r2)=  172.019 mV    43.6190 ns
           2(r2)=   19.060 mV    43.6300 ns
             Δ = -152.959 mV    11.0 ps
                   1/ΔX =        90.9 GHz

Vertical track source manual
Y scale 38.0 mV/div
Y offset 96.198 mV
Horizontal track source manual
X scale 20 ps/div
X position 43.624 ns
```

Typical Uncorrected Pulse Response for V261. Absolute risetime for the DC Blocks is derived from this measured data by applying the RSS method to compensate for the risetime of the input pulse.

$$\sqrt{T_{BT}^2 + T_{PG}^2} = T\ meas.$$

T meas. = uncorrected risetime
T_{BT} = absolute Bias Tee risetime
T_{PG} = risetime of input pulse

$$T_{BT} = \sqrt{T_{meas}^2 - T_{PG}^2}$$

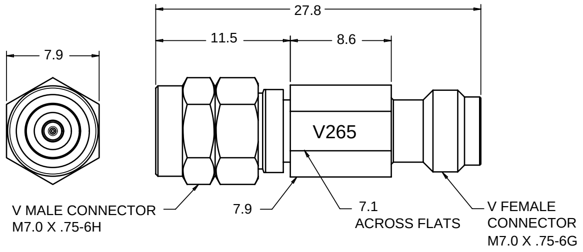
Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
K261	Precision DC Block, 50 kHz to 40 GHz
V261	Precision DC Block, 100 kHz to 65 GHz

DC BLOCK
V265
50 kHz to 65 GHz

V265



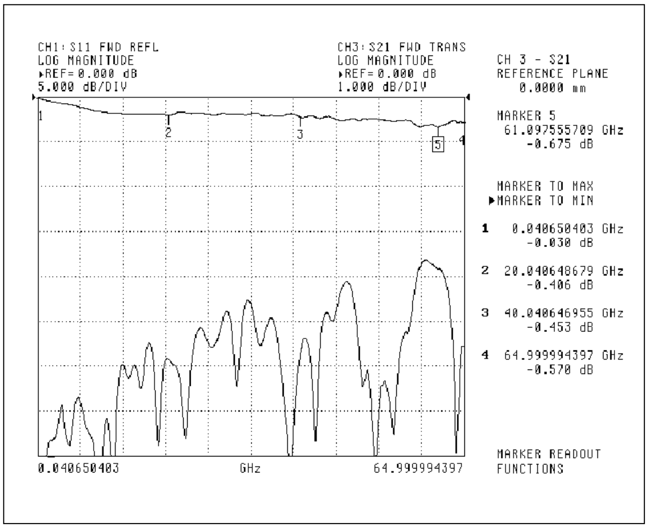
V265 outline drawing

The V265 DC Block has been designed and optimized for optical communications and other high speed pulse, data or microwave applications. Based on the coaxial resilient connection – which is the same as on our V255 Gen II Bias Tee – it provides excellent low frequency response with very low losses and flat group delay over the temperature of operation. Designed to apply AC drive signals to a device while eliminating any DC voltage or current components, the V265 DC Block can be used in isolating DC leakage between two electrical components. The DC block comes with a standard V Connector® and assures excellent impedance match across the wide bandwidth available. A one-year warranty is provided.

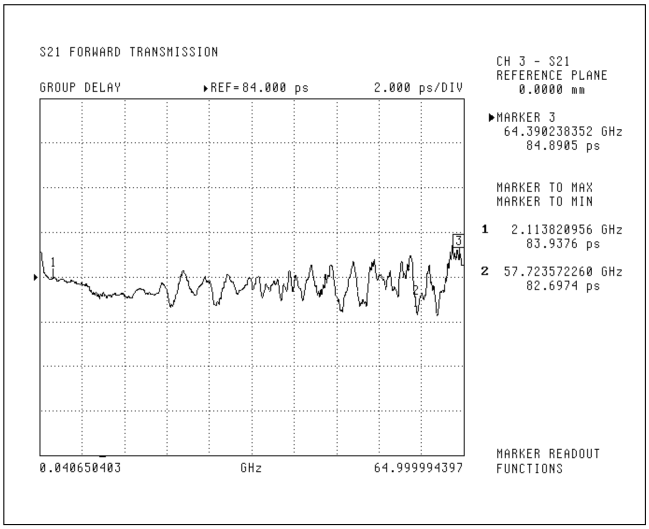
Features
- Ideal for Optical Communication applications.
- Low Insertion Loss
- Rise Time 3 ps typical

Specifications

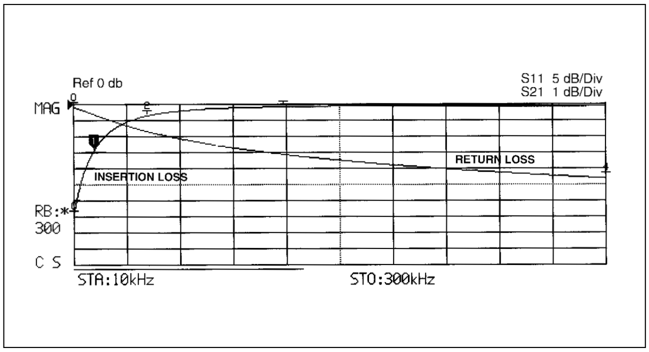
Model	Frequency range	Insertion loss	Return loss	Max RF power	Connector	Max DC voltage	Rise Time	Group delay	Operating temp.
V265	50 kHz to 65 GHz	0.9 dB to 65 GHz typ.	13 dB to 65 GHz typ.	1 W	V(f) V(m)	10 V	3 ps typ.	84 ±2 ps typ.	0°C to 80°C



Typical High Frequency Insertion Loss and Return Loss measured on V265 DC Block over the range of 40 MHz to 65 GHz



Typical Group Delay Performance measured on V265



Typical Low Frequency Insertion Loss and Return Loss on V265 DC Block over the range of 10 kHz to 300 kHz

Ordering information

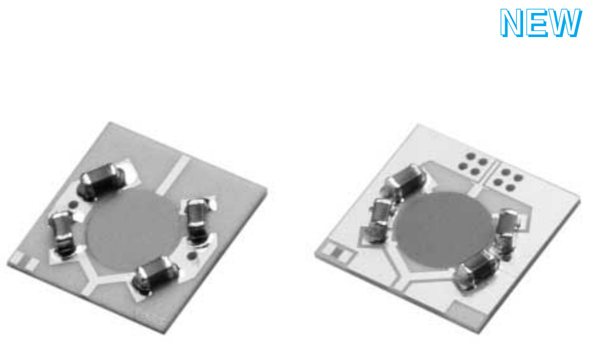
Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
V265	DC Block, 50 kHz to 65 GHz

BIAS TERMINATION

DBT60, DBT60CPW

50 kHz to 65 GHz



The Bias Termination is designed to meet the stringent electrical performance requirements and small size of passive components in optical communication networks. A broad bandwidth of 50 kHz to 65 GHz with very good return loss makes it ideal to provide DC Bias in 40 Gbps optical modulators. In addition, the small size of the bias termination makes integration of the biasing network easier.

The two different models available are DBT60 and DBT60CPW. Depending on the type of substrate configuration used within an optical modulator, one can use the DBT60 for 0.25 mm thick Microstrip or DBT60CPW for 0.25 mm thick CPW substrate. Bias Terminations can be customized to meet customer requirements for different substrate types, substrate thickness, frequency ranges, etc.

Features

- Low SWR
- Broad Frequency Performance
- High Voltage Capacity
- Small Form Size

Application

Figure 1 shows a typical block diagram of a Lithium Niobate Optical Modulator. Since the optical modulator is a voltage-controlled device, it does not require high current. In this case, bias can be provided through a high value shunt capacitor. Therefore DC voltage applied across the optical modulator will be the voltage applied across the capacitor and the DC bias is supplied through the internal bias termination rather than using an external bias tee. This approach has the advantage of reducing the cost and size of the system by eliminating the need for an external bias tee.

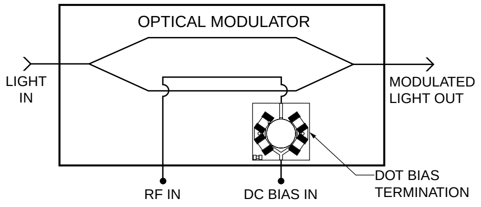
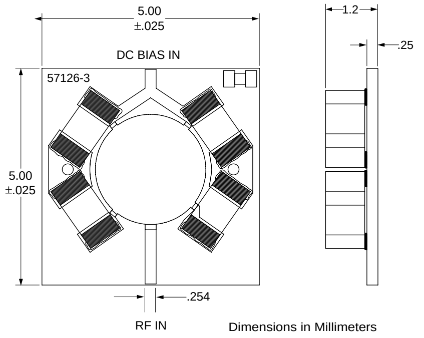


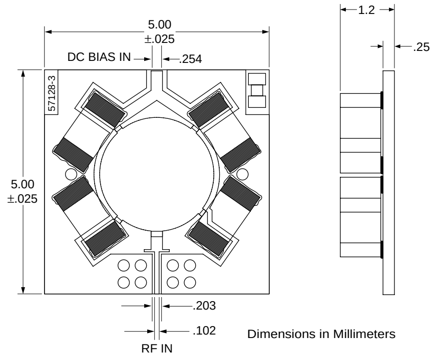
Figure 1. Lithium Niobate Optical Modulator

Specifications

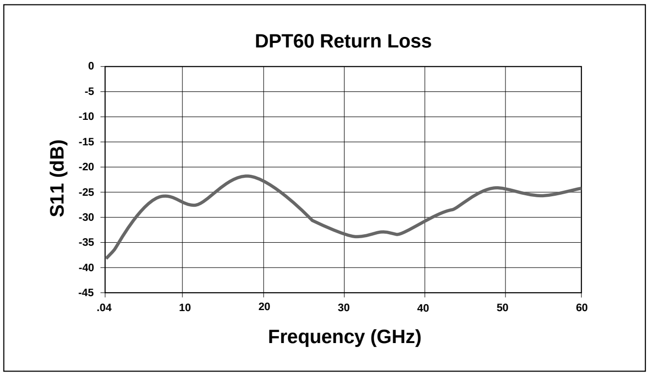
Model Number	Frequency Range	Return Loss	DC Voltage	DC Current	Operating Temperature
DBT60	50 KHz to 60 GHz	≥18 dB typical	16V	200 mA	0°C to 70°C
DBT60CPW	50 kHz to 50 GHz	≥17 dB typical	16V	200 mA	0°C to 70°C
	50 GHz to 60 GHz	≥14 dB typical			



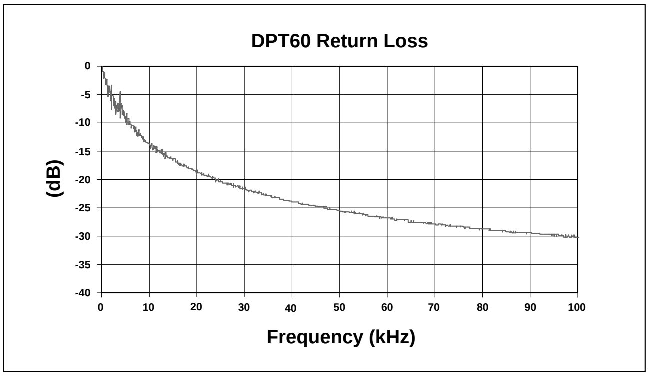
DBT60 Outline Drawing



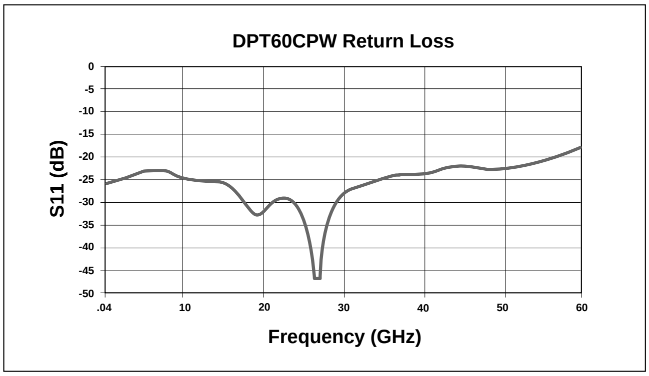
DBT60CPW Outline Drawing



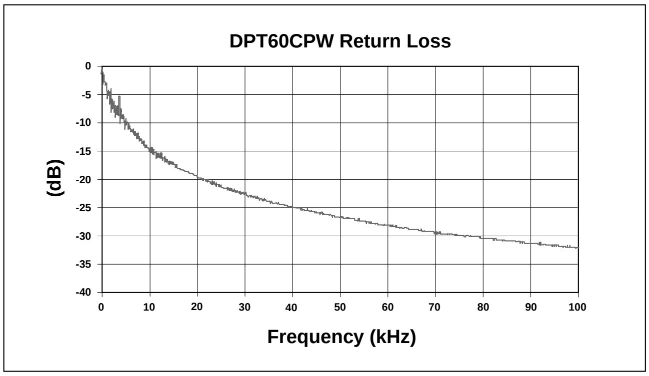
Typical High Frequency Return Loss measured on DBT60 over the range of 40 MHz to 65 GHz using Anritsu 37397C VNA.



Typical DBT60 Low Frequency Return Loss Performance.



Typical High Frequency Return Loss measured on DBT60CPW over the range of 40 MHz to 65 GHz using Anritsu 37397C VNA.



Typical DBT60CPW Low Frequency Return Loss Performance.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
DBT60 DBT60CPW	Bias Termination Bias Termination

UNIVERSAL TEST FIXTURES
3680 Series
DC to 60 GHz

The 3680 series provide an accurate, repeatable solution for measuring microstrip and Coplanar substrate devices. Input and output connections are made to the substrate device by two spring-loaded jaws that include coax-to-microstrip/Coplanar launchers. The jaws accommodate substrates from 0.13 to 1.9 mm in thickness. No center section is required. One jaw is movable in two dimensions to accommodate substrates up to 50 mm long (100 mm for 3680-20) and substrates with line offsets of up to 13 mm (25 mm for 3680-20). The 3680 series includes three models: the 3680-20 covers DC to 20 GHz with APC-3.5™ connectors, the 3680K covers DC to 40 GHz with Anritsu's K Connector®, and the 3680V covers DC to 60 GHz with Anritsu's V Connector®.

Features
- DC to 60 GHz coverage
- Microstrip and coplanar measurement capability
- Accommodates offset and right-angle test devices
- Calibration/verification kits (optional)
- Substrate measurement capability

3680 series Universal Test Fixture	Substrate types supported	Microstrip or coplanar waveguide
	Overall size	10 x 12.7 x 6.4 cm
	Substrate length	0.5 cm min. 5 cm max. [10 cm with 3680-20]
	Maximum substrate width	No limit
	Substrate thickness	0.012 cm min. 0.19 cm max.
	Maximum line offset	±1.2 cm [±2.5 cm with 3680-20]
	Input and output connectors	3680-20: APC-3.5™ female 3680K: K Connector® female 3680V: V Connector® female
36802 MMIC Attachment	Substrate thickness	0.0 cm, 0.038 cm, 0.064 cm
	Minimum test substrate length	1.5 mm
	Maximum test substrate length	1.17 cm with standard block
	Maximum line offset	±1.2 cm
36801 Right Angle Launcher	Distance from in-line connector, axial	Minimum: 1 cm Maximum: 4 cm
	Distance from in-line connector, offset	Minimum: 0.0 cm Maximum: 2 cm

- **Electrical**

Model	Universal Test Fixture			Right-Angle Launcher		MMIC Attach-ment
	3680-20	3680K	3680V	36801K	36801V	36802
Frequency range (GHz)	DC to 20	DC to 40	DC to 60	DC to 40	DC to 60	DC to 60
Return loss (dB) DC to 20 GHz 20 to 40 GHz 40 to 60 GHz	>17	>17 >14	>17 >14 >8	>16 >12	>16 >12 >7	>12 >8 >6
Repeatability (dB) DC to 20 GHz 20 to 40 GHz 40 to 60 GHz	<±0.10	<±0.10 <±0.20	<±0.10 <±0.20 <±0.30	<±0.15 <±0.25	<±0.15 <±0.25 <±0.40	<±0.20 <±0.40 <±0.60

Temperature –20° to 70°C

Ordering information
Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
3680-20	Universal Test Fixture (20 GHz)
3680K	Universal Test Fixture (40 GHz)
3680V	Universal Test Fixture (60 GHz)
	Accessories
36801K	Right-Angle Launcher (40 GHz)
36801V	Right-Angle Launcher (60 GHz)
36802	MMIC Attachment
36803	Bias Probe
36805-10M	10 mil launchers[*1]
36805-15M	15 mil launchers[*1]
36805-25M	25 mil launchers[*1]
	Calibration/verification kits
36804B-10M	10 mil microstrip cal/verif. kit
36804B-15M	15 mil microstrip cal/verif. kit
36804B-25M	25 mil microstrip cal/verif. kit
36804B-25C	25 mil coplanar waveguide cal/verif. kit

*1: 36805 series includes (4) substrate launchers for the 36802 MMIC attachment

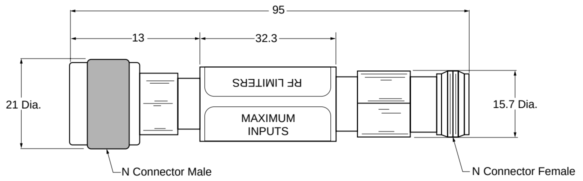
LIMITERS

1 Series

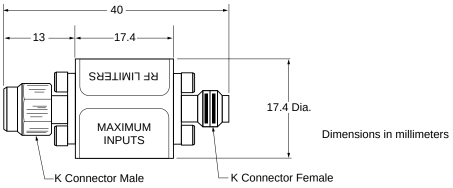
1 MHz to 26.5 GHz

1N50C

1K50B



1N50C and 1N75C Limiters outline



1K50A and 1K50B Limiters outline

Features

- High power protection: 5 Watts
- Very fast turn-on time: 10 ns maximum
- Broad frequency range: 0.01 to 26.5 GHz
- Low insertion loss: 2.7 dB to 20 GHz
- Excellent return loss: 11 dB at 20 GHz
- Single side limiting

Specifications

Model	1K50B	1K50A	1N50C	1N75C	1N50B	1N75B
Frequency range	0.01 to 26.5 GHz	0.01 to 20 GHz	0.01 to 18 GHz	0.01 to 3 GHz	0.01 to 3 GHz	0.01 to 3 GHz
Max. input power	3 Watts	5 Watts	5 Watts	5 Watts	1.5 Watts	1.5 Watts
Min. return loss (at 0 dBm input)	10 dB	14 dB, ≤12 GHz 11 dB, >12 GHz	14 dB, ≤12 GHz 11 dB, >12 GHz	15 dB	19 dB	19 dB
Max. insertion loss (at 0 dBm input)	3.9 dB	2.7 dB	2.9 dB	1.1 dB	1.3 dB	1.3 dB
Max. turn-on time	10 ns	10 ns	10 ns	10 ns	10 ns	10 ns
Input connector	K(m)	K(m)	N(m)	75 Ω N(m)	N(m)	75 Ω N(m)
Output connector	K(f)	K(f)	N(f)	75 Ω N(f)	N(f)	75 Ω N(f)
Input/output coupling	DC	DC	DC	DC	AC	AC

Limiting Level: Limiter begins compressing at approximately +10 dBm.
In compression, output level increases by 0.25 to 0.5 dB for each 1 dB increase at the input. Output power at 5 W input at 500 MHz is 21 dBm max.
Dimensions: 1N50B and 1N75B 3.8 cm x 2.5 cm x 2.5 cm
Temperature range: 0°C to +70°C

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Limiter
1N50C	N(m) to N(f), 50 Ω, 10 MHz to 20 GHz
1N75C	N(m) to N(f), 75 Ω, 10 MHz to 3 GHz
1K50A	K(m) to K(f), 50 Ω, 10 MHz to 20 GHz
1K50B	K(m) to K(f), 50 Ω, 10 MHz to 26.5 GHz

MATCHING PADS
12 Series
DC to 3000 MHz

12N50-75B

Specifications

Model	Frequency range (MHz)	SWR	Insertion loss (dB)	Connectors
12N50-75B	DC to 3000	1.25	7.5 max.	N(m) 50 Ω to N(f) 75 Ω
12N75B	DC to 3000	1.25	3.0 max.	N(m) 50 Ω to N(m) 75 Ω

Temperature range: 0°C to +70°C
Dimensions: 3.8 cm x 2.5 cm x 2.5 cm

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
12N50-75B	Matching Pad, DC to 3000 MHz
12N75B	Minimum Loss Adapter, DC to 3000 MHz

RF matching pad and impedance adapter features

- DC to 3000 MHz frequency range
- Matching pad matches 50 Ω to 75 Ω or 75 Ω to 50 Ω circuits
- Impedance adapter converts 50 Ω to 75 Ω with <3 dB loss

The 12N50-75B matching pad is a two-resistor design that matches 50 Ω to 75 Ω or 75 Ω to 50 Ω circuits.
The 12N75B impedance adapter is a one-resistor design that converts 50 Ω to 75 Ω with less than 3 dB loss.

PERIPHERAL EQUIPMENT

PORTABLE TEST RACK

MB23A, MB24A

MB23A

MB24A

The MB23A and MB24A can be folded so they can be transported easily and used in places with space limitations. Metal fittings to accommodate both current and new cabinet designs are included.

MB23A

- By easy operation of the lever, the table can be inclined at five different angles for optimum instrument viewing ease.
- Thanks to Anritsu's exclusive construction, just a light touch of the lever is all it takes to move the angle safely up to 45°.

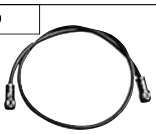
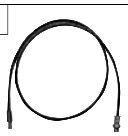
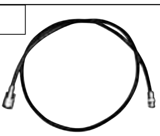
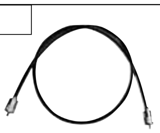
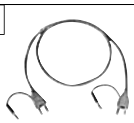
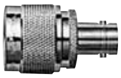
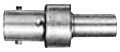
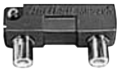
MB24A

- The table is fixed in a horizontal position.
- Since the rack can support up to 100 kg, several instruments may be stacked.

COAXIAL CORDS, ADAPTERS

	Impedance	Figure No.	Name			Order No.
			Item	Composition (connector · cable · connector)	Length	
Connecting cords	50 Ω	1	Coaxial cord	N-P · 5D-2W · N-P	1 m 2 m	J0576B J0576D
		30	Coaxial cord	S-5DWP · 5D-2W · S-5DWP	1 m 2 m	J0025A J0025C
		2	Coaxial cord	3CA-P2 · TG-58A/U · 3CA-P2	1 m 2 m	J0133A J0133C
		3	Clip conversion pad	N-J · Clip		J0047
		4	Coaxial cord	3CA-P2 · TG-58A/U · Alligator clip	1 m	J0054A
	75 Ω	5	Coaxial cord	3CV-P2 · 3C-2V · 3CV-P2	1 m 2 m	J0026A J0081
		6	Coaxial cord	SP-3CP · 3C-2WS · SP-3CP	1 m 2 m	J0028A J0028B
		7	Coaxial cord	SP-3CP · 3C-2WS · 3CW-P	1 m 2 m	J0029A J0029B
		8	Coaxial cord	P-5CP · 5C-2W · P-5CP	1 m 2 m	J0030A J0030B
		9	Coaxial cord	M-P-3 · 3C-2V · 3CV-P2	1 m 2 m	J0027A J0027B
		10	Coaxial cord	M-P-5 · 5C-2V · M-P-5	1 m 2 m	J0031A J0031B
	(balanced)	11	Balanced cord	I-214APS · C1UUS shielded connecting cord · I-214APS	1 m 2 m	J0032 J0033
		12	Balanced cord	M-214S · Shielded connecting cord · M-214S	1 m	J0050A
		13	CS1-MM2 shielded connecting cord		2 m	J0034
Conversion connectors	50 Ω	14	Coaxial adapter	N-P · N-P	–	J0038
		15	Coaxial adapter	N-J · N-J	–	J0039
		16	Coaxial adapter	N-P · BNC-J	–	J0040
		17	Coaxial adapter	N-J · BNC-J	–	J0044
		18	Coaxial adapter	N-J · BNC-P	–	J0043
	–	19	Coaxial adapter	N-P · M-J		J0041
		20	Coaxial adapter	N-J · M-P	–	J0042
	75 Ω	21	Coaxial adapter	NC-P · SP-3CJ	–	J0046
		22	Coaxial adapter	NC-P · BNC-J	–	J0055
		23	Coaxial adapter	BNC-P · M-J	–	J0045
		24	Coaxial adapter	SP-3CJ · 3C-P (BNC-P)	–	J0053
		25	Coaxial adapter	SP-3CP · 3C-J (BNC-J)	–	J0052
U-link	75 Ω	26	MP529A U-Link		–	–
Coaxial T-connectors	50 Ω	27	Coaxial T-connector	S (N)-type	–	J0048
	70 Ω	28	Coaxial T-connector	M-type	–	J0049

PERIPHERAL EQUIPMENT

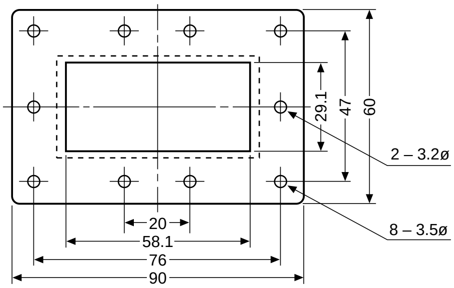
Order Number Item/Composition	J0576B/D 1  Coaxial cord 1 m/2 m N-P · 5D-2W · N-P	J0133A/C 2  Coaxial cord 1 m/2 m 3CA-P2 · RG-58A/U · 3CA-P2	J0047 3  Clip conversion pad, N-J · clip
J0054A 4  Coaxial cord 1 m 3CA-P2 · RG-58A/U · Alligator clip	J0026A J0081 5  Coaxial cord 1 m/2 m 3CV-P2 · 3C-2V · 3CV-P2	J0028A/B 6  Coaxial cord 1 m/2 m SP-3CP · 3C-2WS · SP-3CP	J0029A/B 7  Coaxial cord 1 m/2 m SP-3CP · 3C-2WS · 3CW-P
J0030A/B 8  Coaxial cord 1 m/2 m P-5CP · 5C-2W · P-5CP	J0027A/B 9  Coaxial cord 1 m/2 m M-P-3 · 3C-2V · 3CV-P2	J0031A/B 10  Coaxial cord 1 m/2 m M-P-5 · 5C-2V · M-P-5	J0032 J0033 11  Balanced cord 1 m/2 m I-214APS · C1UUS shielded connecting cord · I-214APS
J0050A 12  Balanced cord 1 m, M-214S · shielded connecting cord · M-214S (compatible with I-214APS)	J0034 13  CS1-MM2 shielded connecting cord, 2 m	J0038 14  Coaxial adapter N-P · N-P	J0039 15  Coaxial adapter N-J · N-J
J0040 16  Coaxial adapter N-P · BNC-P	J0044 17  Coaxial adapter N-J · BNC-J	J0043 18  Coaxial adapter N-J · BNC-P	J0041 19  Coaxial adapter N-P · M-J
J0042 20  Coaxial adapter N-J · M-P	J0046 21  Coaxial adapter NC-P · SP-3CJ	J0055 22  Coaxial adapter NC-P · BNC-J	J0045 23  Coaxial adapter BNC-P · M-J
J0053 24  Coaxial adapter SP-3CJ · 3C-P (BNC-P)	J0052 25  Coaxial adapter SP-3CP · 3C-J (BNC-J)	– 26  MP529A U-Link	J0048 27  Coaxial T-connector, 50 Ω, S (N) type
J0049 28  Coaxial T-connector, 75 Ω, M type	J0025A/C 29  Coaxial cord 1 m/2 m S-5DWP · 5D-2W · S-5DWP		

List of principal coaxial cables

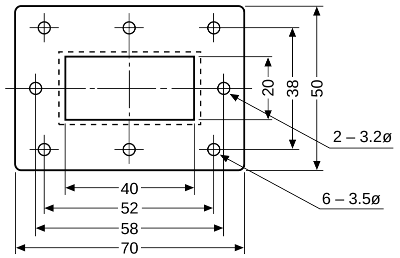
Coaxial cable	Characteristic impedance	Nominal attenuation (10 MHz)	Nominal capacitance	Finished diameter	Mass (g/m)	Suitable connector	Remarks
3C-2V	75 ±3 Ω (10 MHz)	0.042 dB/m	67 pF/m	5.8 mm	48	3C connector	Single outer conductor, PVC covered
3C-2W				6.5 mm	75		Double outer conductor, PVC covered
3C-2Z				3.8 mm	28	3C connector	Single outer conductor, No PVC covered
3C-2T		(0.013 dB/m, 1 MHz)		7.4 mm	110		Triple outer conductor, PVC covered
3C-2WS	75 ±1 Ω (10 MHz)	0.048 dB/m		6.6 mm	76	SP connector	Double outer conductor, PVC covered
5C-2V	75 ±3 Ω (10 MHz)	0.027 dB/m		7.8 mm	75	5A connector plug for 1 V type, connector for 1 V type	Single outer conductor, PVC covered
5C-2W				8.5 mm	110		Double outer conductor, PVC covered
5C-2Z				5.8 mm	48		Single outer conductor, No PVC covered
3D-2W	50 ±2 Ω (10 MHz)	0.047 dB/m	100 pF/m	6.4 mm	75		Double outer conductor, PVC covered
5D-2V		0.031 dB/m		7.5 mm	85	S connector	Single outer conductor, PVC covered
5D-2W				8.2 mm	120		Double outer conductor, PVC covered
RG-55/U	53.5 ±2.5 Ω (4 MHz)	0.0328 dBm	93.5 pF/m	5.25 mm	55	BNC	Double outer conductor, PE covered
RG-58/U				4.95 mm	50	BNC, N	Single outer conductor, PVC covered
RG-58A/U	50 ±2 Ω (10 MHz)	0.0427 dB/m					

Dimensions of waveguide flanges

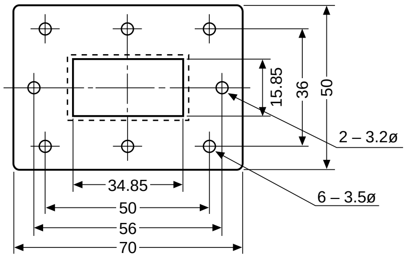
BRJ-4 (3.30 to 4.90 GHz)



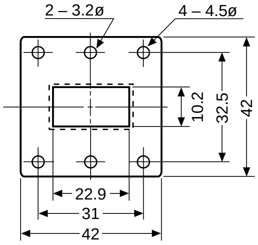
BRJ-6 (4.90 to 7.05 GHz)



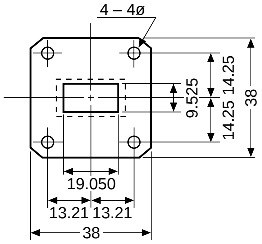
BRJ-7 (5.85 to 8.20 GHz)



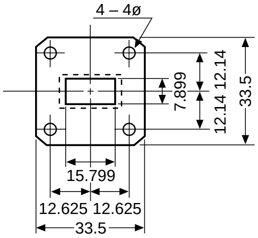
BRJ-10 (8.20 to 12.40 GHz)



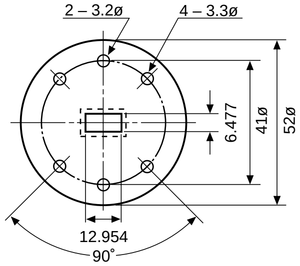
BRJ-120 (9.84 to 15.0 GHz)



BRJ-140 (11.9 to 18.0 GHz)



BRJ-18 (14.5 to 22.0 GHz)



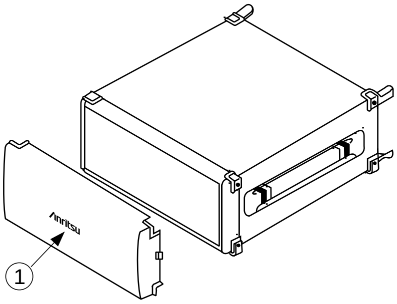
(Unit: mm)

ACCESSORIES FOR F-SERIES CABINETS

Anritsu's F-series cabinet was designed using basic dimensions that conform to EIA and IEC racking specifications, permitting compatible equipment to be easily stacked up to form a system, or to be mounted on the EIA/IEC standard rack.
The accessories of the F-series cabinet are easy to mount and use, and blend with the design of the cabinet. The F-series can be identified by its green feet.

- **Protective cover**

Protects front of cabinet

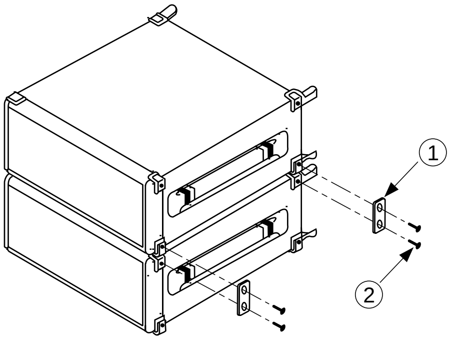


No.	Description	Quantity
①	Protective cover	1

Item	Order No.
Protective cover 1MW2U	B0329A
Protective cover 1MW3U	B0329B
Protective cover 1MW4U	B0329C
Protective cover 1MW5U	B0329D
Protective cover 3/4MW3U	B0329F
Protective cover 3/4MW4U	B0329G
Protective cover 2/3MW4U	B0329K
Protective cover 1/2MW2U	B0329L

- **Coupler**

To mount two or more F-series cabinet in a stack

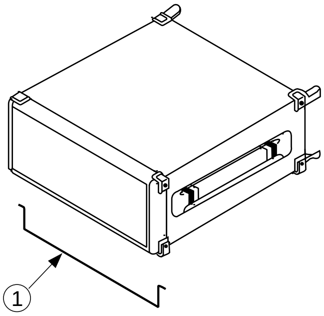


No.	Description	Quantity
①	Coupler	4
②	Screw	8

Item	Order No.
Coupler	B0332

- **Tilt stand**

Allows cabinet to be used at an angle

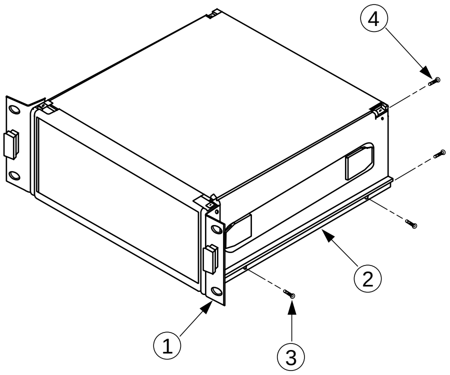


No.	Description	Quantity
①	–	1

Item	Order No.
Tilt stand 1MW450D	B0330A
Tilt stand 3/4MW450D	B0330B
Tilt stand 3/4MW350D	B0330C
Tilt stand 2/3MW350D	B0330D

- **Rack mount kit**

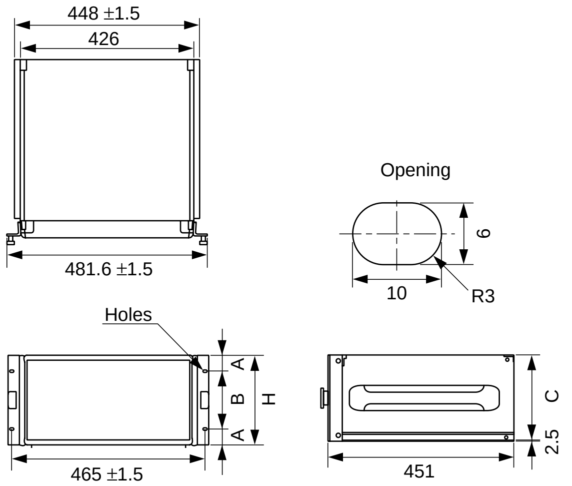
The rack mount accessory is for use with 1MW450D cabinet.
For EIA/IEC standard rack



No.	Description	Quantity
①	Rack flange	2
②	Side rail	2
③	5NPS25S7 + SW	2
④	4NPS6S7 + SW	4

Item	Order No.
Rack mount kit 2U	B0333A
Rack mount kit 3U	B0333B
Rack mount kit 4U	B0333C
Rack mount kit 5U	B0333D

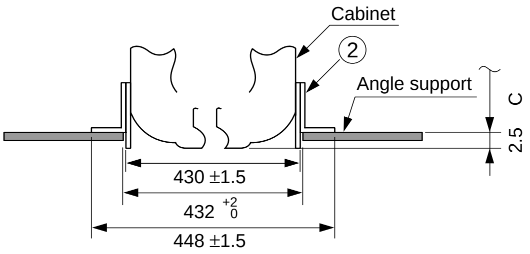
• F-series cabinet rack mount dimensions



Unit: mm

Cabinet height	H	A	B	C
2U	88	5.9	76.2	85.5
3U	132.5	37.7	57.1	130
4U	177	37.7	101.6	174.5
5U	221.5	37.7	146.1	219

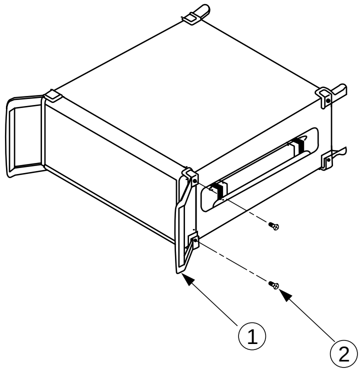
• Cabinet angle support dimensions



Note: Merely attaching the equipment to the rack with rack mount kit does not provide enough support. Use either angle supports or shelves to provide the necessary support.

• Front handle

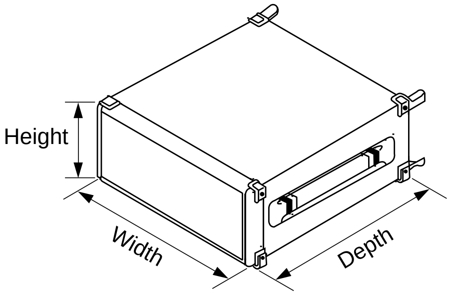
Protects the front section



No.	Description	Quantity
①	Front handle	2
②	Screw	4

Item	Order No.
Front handle 2U	B0331A
Front handle 3U	B0331B
Front handle 4U	B0331C
Front handle 5U	B0331D

• Symbol and dimensions of F-series cabinet



Height

Symbol	Dimension (mm)
2U	88
3U	132.5
4U	177
5U	221.5
6U	266

Width

Symbol	Dimension (mm)
1MW	426
3/4MW	320
2/3MW	284
1/2MW	213

Depth

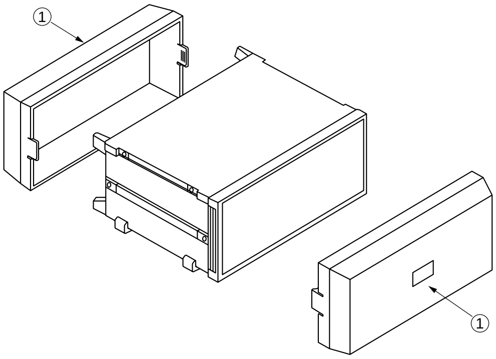
Symbol	Dimension (mm)
250D	251
350D	351
450D	451

Note: knobs, handles, and feet are not included in cabinet external dimensions.

ACCESSORIES FOR E-SERIES CABINETS

Anritsu's E-series cabinet was designed using basic dimensions that conform to EIA and IEC racking specifications, permitting compatible equipment to be easily stacked up to form a system, or to be mounted on the EIA/IEC standard rack. Featuring a balanced design, the E-series cabinet accessories provide ease of mounting and use. The E-series cabinet can be identified by the four silver metal sections between its top and side surfaces.

- **Front/rear cover**

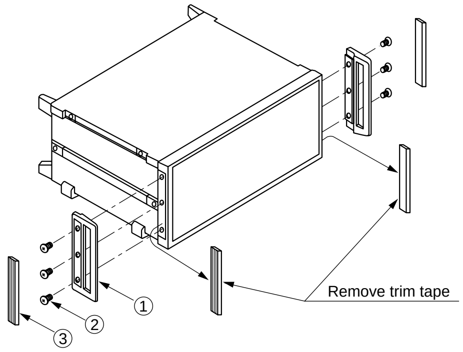


Protects front and back of cabinet.
Due to projections, the rear cover may not be usable with some equipment. Front handles and front cover cannot be used simultaneously.

No.	Description	Quantity
①	Front/rear cover	1

Item	Order No.
Front/rear cover 1MW2U	B0018
Front/rear cover 1MW3U	B0019
Front/rear cover 1MW4U	B0020
Front/rear cover 1MW5U	B0021
Front/rear cover 1MW6U	B0022
Front/rear cover 2/3MW2U	B0023
Front/rear cover 2/3MW3U	B0024
Front/rear cover 2/3MW4U	B0025
Front/rear cover 1/2MW2U	B0026
Front/rear cover 1/2MW3U	B0027

- **Front handle kit**



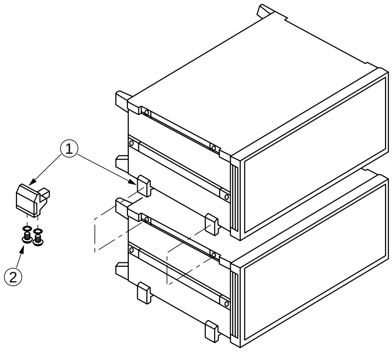
Front cover cannot be used.

No.	Description		Quantity
①	Front handle		2
②	Screw	2U to 3U^{*1}	4
		4U to 6U	6
③	Trim tape		2

∗1: Denotes height of cabinet

Item	Order No.
Front handle kit 2U	B0036
Front handle kit 3U	B0037
Front handle kit 4U	B0038
Front handle kit 5U	B0039
Front handle kit 6U	B0040

- **Stacking foot**



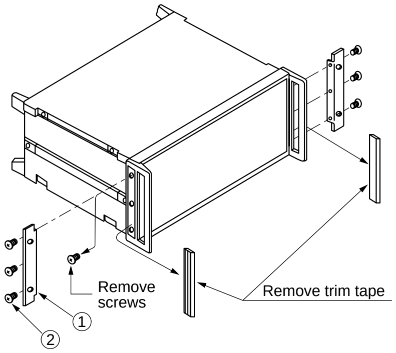
These one-touch lock feet replace the standard molded feet for use when stacking equipment of the same width and depth, and when mounting the equipment on a portable test rack.

No.	Description	Quantity
①	Stacking foot	4
②	Screw	8

Item	Order No.
Stacking feet	B0029

Note: By replacing the standard molded feet with stacking feet (B0029), the 1MW cabinet can be used with Anritsu's portable test racks MB23A and MB24B.

• Rack flange kit



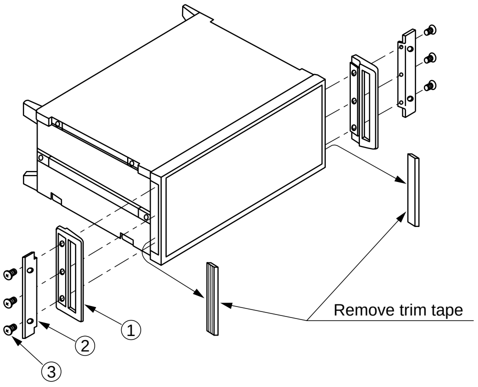
The rack mount accessory is for use with equipment having 1MW cabinet width providing front handles.

No.	Description		Quantity
①	Rack flange		2
②	Screw	2U to 3U	4
		4U to 6U	6

Item	Order No.
Rack flange kit 2U	B0046
Rack flange kit 3U	B0047
Rack flange kit 4U	B0048
Rack flange kit 5U	B0049
Rack flange kit 6U	B0050

Note: • For 1MW cabinets
• When assembled, the panel width is suitable for 19-inch racks.
• For EIA/IEC standard rack

• Rack mount kit



The rack mount accessory is for use with equipment having 1MW cabinet width.

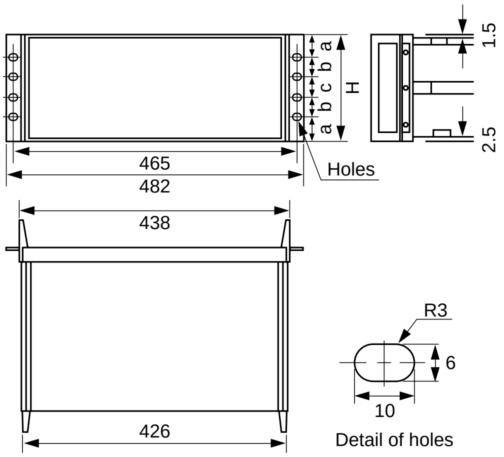
Note: Merely attaching the equipment to the rack with rack mount kit does not provide enough support. Use either angle supports or shelves to provide the necessary support.

No.	Description		Quantity
①	Front handle		2
②	Rack flange		2
③	Screw	2U to 3U	4
		4U to 6U	6

Item	Order No.
Rack mount kit 2U	B0041
Rack mount kit 3U	B0042
Rack mount kit 4U	B0043
Rack mount kit 5U	B0044
Rack mount kit 6U	B0045

Note: • For 1MW cabinets
• When assembled, the panel width is suitable for 19-inch racks.
• For EIA/IEC standard rack

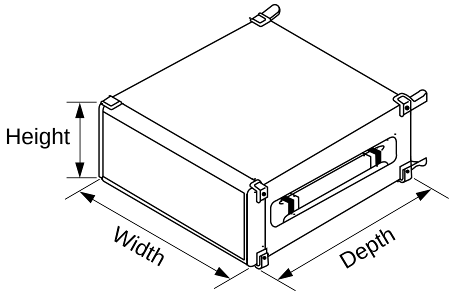
• E-series cabinet rack mount dimensions



Cabinet height	H (mm)	a	b	c
2U	88	5.9	–	76.2
3U	132.5	37.7	–	57.1
4U	177	37.7	–	101.6
5U	221.5	37.7	–	146.1
6U	266	37.7	57.1	76.2

Note: This space provides room to attach a flange for supporting the equipment

• Symbol and dimensions of E-series cabinet



Height

Symbol	Dimension (mm)
2U	88
3U	132.5
4U	177
5U	221.5
6U	266

Width

Symbol	Dimension (mm)
1MW	426
3/4MW	320
2/3MW	284
1/2MW	213

Depth

Symbol	Dimension (mm)
250D	251
350D	351
450D	451

Note: knobs, handles, and feet are not included in cabinet external dimensions.

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ISO9000/14000

IP Network, Wireless and Precision products contained in this catalogue are manufactured under a quality system and environment management system in conformance to the ISO international standard.

Factory name	Conformed standard	Qualification number	Qualified date	Qualification organization
Atsugi factory	ISO9001	JQA-0316	Nov. 15, 1993	Japan Quality Assurance Organization (JQA)
	ISO14001	JQA-EM0210	Aug. 28, 1998	
Tohoku Anritsu	ISO9002	JQA-0737	Dec. 28, 1994	
	ISO14001	JQA-EM0560	Oct. 22, 1999	
England factory	ISO9001	FS22679	May 24, 1999	BSI Quality Assurance
	ISO14001	EMS54120	Mar. 15, 2000	
U.S.A factory	ISO9001	6495	Apr. 17, 2001	The Seal of National Quality Assurance Limited

Quality and Reliability Assurance for Products

- **Planning stage**

Management resources are focused on measuring instruments related to growing fields such as mobile Internet, WDM and digital broadcasting, System solutions, precision measurement business and device businesses. New products are planned to provide solutions whenever required by users.

- **Design stage**

To realize a design with high-safety and high-reliability, several levels of design assessments are performed. Power consumption is reduced from the viewpoint of environment considerations, starting with evaluation of specifications, legal regulations and used parts. Evaluations are also implemented for improving the recycling ratio and so forth, and the design quality is improved.
Anritsu engages a design that targets customer satisfaction.

- **Evaluation stage**

In addition to safety, reliability and environment considerations of test models for the new product, functions and performance are verified by an operating environmental conditions test and operability, uncertainty, maintainability and flexibility of design are evaluated fully. After passing these tests, the products can be commercialized.

- **Manufacturing and inspection stages**

Based on our policy, “post-processing is the customer”, the product is manufactured by experienced employees according to the work standards. In the adjustment and inspection stage, automatic measurement is promoted. An expert will be in charge of the adjustment if high-skilled adjustment is required.

- **After sold**

In each service department, traceability assurance by calibrations based on high-technical capabilities , as well as rapid repair and preventive maintenance are performed.

Parts standardization and improving activities for quality and reliability

For parts generally used in each measuring instrument, quality improvement and standardization are actively promoted. All field data are analyzed, arranged and completely made known to each department while required actions are taken for reliability improvement. In addition, failure rate, MTBF observation and parts failure rate are calculated based on this information.

Traceability assurance

As defined in the International Vocabulary of Basic and General Terms in Metrology (VIM; 1993), traceability is defined as "the property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." Anritsu's system to ensure traceability is shown below. Measurements made by Anritsu's laboratory's are traceable to national, international, or intrinsic standards, where such standards are available.