Product Brochure

Anritsu

LMR Master™ S412E

Land Mobile Radio Modulation Analyzer, Signal Generator, Cable & Antenna Analyzer, Spectrum Analyzer

Overview

S412E LMR Master™

Introduction

The LMR Master S412E is a compact handheld multi-function analyzer that has been specifically developed for technicians and engineers who install and maintain public safety, utility and private mobile communications systems. The LMR Master also offers support for the emerging Positive Train Control (PTC) standard mandated by the U.S. government. Despite being a battery powered handheld instrument, the S412E offers unmatched measurement breadth, depth, and precision, reducing the number of different tools needed to verify operation and diagnose problems.

Standard features are:

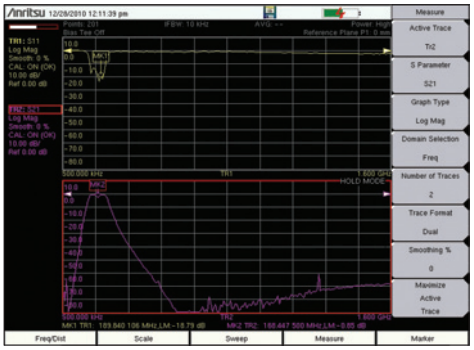
- 2-Port Vector Network Analyzer: 500 kHz to 1.6 GHz
- Spectrum Analyzer: 100 kHz to 1.6 GHz
- CW Signal Generator: 500 kHz to 1.6 GHz
- Power Meter: 10 MHz to 1.6 GHz
- Narrowband FM Analysis of Received Power, Carrier Frequency, Frequency Error, Deviation, Modulation Rate, SINAD, THD, CTCSS, DCS, and DTMF. Auto Scan locates and locks on to unidentified NBFM signal sources between 10 MHz and 1.6 GHz. Indoor Coverage Mapping of RSSI and transmitter SINAD is standard on the LMR Master. Outdoor Coverage Mapping is available with the optional GPS Receiver.

LMR Master S412E offers many options, including:

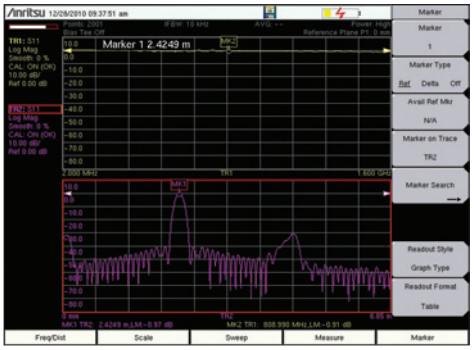
- Extension of Spectrum Analyzer to 6 GHz
- Extension of Vector Network Analyzer to 6 GHz
- Distance Domain Analysis on 1-path 2-port VNA
- Vector Voltmeter
- High Voltage Bias Tee (for both VNA and Spectrum Analyzer applications)
- High Accuracy Power Meter
- Interference Analyzer
- Channel Scanner
- GPS Receiver
- P25 Analyzer, including P25 Signal Generation
- NXDN Analyzer, including NXDN Signal Generation
- DMR Tier 2 Analyzer, including DMR Tier 2 Signal Generation
- PTC Analyzer, including PTC Signal Generation
- Coverage Mapping of RSSI, BER, and EVM (Modulation Fidelity) for NBFM, P25, NXDN, DMR, and PTC including the industry's only solution for indoor coverage mapping!
- LTE Analyzer including RF, Modulation Quality, and Over-the-Air Measurement
- IEEE 802.16 Fixed WiMAX Analyzer including RF and Demodulation Measurements
- IEEE 802.16 Mobile WiMAX Analyzer including RF, Demodulation, and Over-the-Air Measurements

LMR site technicians and RF engineers can use the S412E to accurately and quickly test and verify the installation and commissioning of base stations, mobiles, and portables. The LMR Master is equally suited for preventative maintenance and troubleshooting to help ensure the operation of wireless network infrastructures, including broadband and microwave backhaul systems.

2 Port Vector Network Analyzer



The VNA Mode in the S412E provides simultaneous measurement of insertion loss and return loss.



The VNA Mode in the S412E with Option 501 Domain Domain allows simultaneous viewing of cable return loss and distance to fault.

2 Port Vector Network Analyzer

LMR Master features a 2-port Vector Network Analyzer to be able to test and verify the performance of feedline, filtering, and antenna components. This includes:

- Connectors
- Cables/Jumpers
- Antenna Isolators
- Multicouplers/Diplexers/Duplexers
- Tower Mounted Amplifiers

2-port Transmission Measurements can help identify poor filter adjustment, antenna isolation, and degraded tower mounted amplifiers. The goal of these measurements is to maximize the system coverage and capacity with problem-free base stations.

Antenna System Failure Mechanisms

Maintenance is an on going requirement as antenna system performance can degrade at any point in time due to:

- Loose connectors
- Improperly weatherized connectors
- Pinched cables
- Poor grounding
- Corroded connectors
- Lightning strikes
- Strong winds misaligning antennas
- Water intrusion into cables
- Bullet holes, nails, or rodent damage to coax and feedlines

Making Measurements Easier

The LMR Master provides features for making measurements easier to perform and for analyzing test results such as:

- Fast sweep speed, measurement point selection, and flexible display formats make it easy to view and adjust base station RF system performance
- High RF Immunity mode for testing in harsh RF environments
- Trace Overlay compares reference traces to see changes over time
- Limit Lines and Alarming for providing reference standards
- High and Low Power output selection to test tower-top components without climbing the tower
- Internal Bias-Tee on VNA ports to power up TMAs for off-line testing
- Internal Bias-Tee on Spectrum Analyzer port for easy powering of pre-amplifiers
- GPS tagging of data to verify location of tests

Measurements

1-port Measurements

- VSWR, Return Loss, Phase, Linear Polar, Log Polar

Smith Chart

- Log/Mag/2 (1-port Cable Loss)
- Distance-to-Fault (DTF) Return Loss
- Distance-to-Fault (DTF) VSWR

Windowing Functions in Distance Domain

- Rectangular
- Normal Side Lobe
- Low Side Lobe
- Minimum Side Lobe

2-port Measurements

- Log Mag Insertion Loss/Gain, Phase, Linear Polar, Log Polar, Group Delay

Calibration

- User-variable Data Points from 2 to 4001
- Full S_{11} (Open, Short, Load)
- 1P2P (Open, Short, Load, Through)
- Response S_{11}
- Response S_{21}

Sweep Functions

- Run/Hold, Single/Continuous
- RF Immunity (High/Low)
- Averaging/Smoothing
- Output Power (High/Low)

Trace Functions

- Save/Recall, Copy to Display Memory
- No Trace Math, Trace ± Memory
- Trace Overlay

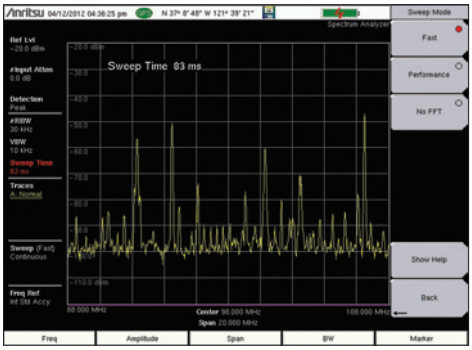
Marker Functions

- Up to 8 Markers, each with a Delta Marker
- Marker to Peak/Valley
- Marker to/Peak Valley between Markers
- Marker Table

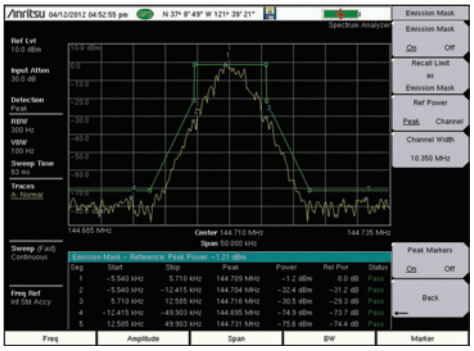
Limit Line Functions

- Limit Lines
  - Single Limit
  - Multi-segment (41)
  - Limit Alarm
- Limit Line Edit
  - Frequency, Amplitude
  - Add/Delete Point
  - Next Point Left/Right
  - Move Limit

Spectrum Analyzer



The spectrum analyzer mode in the S412E offers fast sweep speeds for interference hunting intermittent signals.



The Spectrum Analyzer mode in the S412E offers automated measurements including occupied bandwidth, adjacent channel power, and emission mask, as shown above. The mask can be quickly created using the standard limit line editor. The emission mask measurement function automatically moves the trace to match the peak of a modulated signal to conform to common mask standards.

Spectrum Analyzer

The S412E features the most powerful handheld spectrum analyzer in its class with unmatched performance such as:

- Sensitivity
- Dynamic Range
- Phase Noise
- Frequency Accuracy
- Resolution Bandwidth (RBW)

The goal of Spectrum Analyzer measurements is to be able to accurately monitor, measure, and analyze RF signals and their environments. It finds rouge signals, measures carriers and distortion, and verifies base stations' signal performance. It validates carrier frequency and identifies desired and undesired signals.

Simple But Powerful

The LMR Master features dedicated routines for one-button measurements. For more in-depth analysis, the technician has control over settings and features that are not found even on lab-grade benchtop spectrum analyzers. For example, the S412E offers:

- Multiple sweep detection methods – Peak, Negative, True RMS, Quasi-Peak, Sample
- Advanced marker functions – noise marker, tracking marker, peak search, sequential peak search, delta markers
- Advanced marker functions – noise marker, tracking marker, peak search, sequential peak search, delta markers
- Advanced limit line functions – automatic envelope creation, relative limits, limit mirror, point/segment/line adjustment
- Save-on-Event – automatically saves a sweep when crossing a limit line

The LMR Master offers full control over bandwidth and sweep settings, or can be set to automatically optimize for best possible trade-off between accuracy and speed.

GPS-Assisted Frequency Accuracy

With GPS Option 31 the frequency accuracy is improved to < 50 ppb (parts per billion). Also all measurements can be GPS tagged for exporting to maps.

Rx Noise Floor Testing

The LMR Master can measure the receive noise floor on a base station's uplink channel using the channel power measurement. An elevated noise floor indicates interference that can lead to call blocking, denial of service, call drops, low data rates, and lowered system capacity.

Measurements

- One Button Measurements
  - Field Strength – in dBm/m² or dBmV/m
  - Occupied Bandwidth - 1% to 99% of power
- Emission Mask
  - Channel Power - in specified bandwidth
  - ACPR - adjacent channel power ratio
  - AM/FM/SSB Demodulation - audio out only
  - C/I - carrier-to-interference ratio

Sweep Functions

- Sweep
  - Single/Continuous, Manual Trigger, Reset, Minimum Sweep Time
- Detection
  - Peak, RMS, Negative, Sample, Quasi-peak
- Triggers
  - Free Run, External, Video, Change Position, Manual

Trace Functions

- Traces
  - 1-3 Traces (A, B, C), View/Blank, Write/Hold
- Trace A Operations
  - Normal, Max Hold, Min Hold, Average, Number of Averages, (always the live trace)
- Trace B Operations
  - A → B, B←→C, Max Hold, Min Hold
- Trace C Operations
  - A → C, B←→C, Max Hold, Min Hold, A - B → C,
  - B - A → C, Relative Reference (dB), Scale

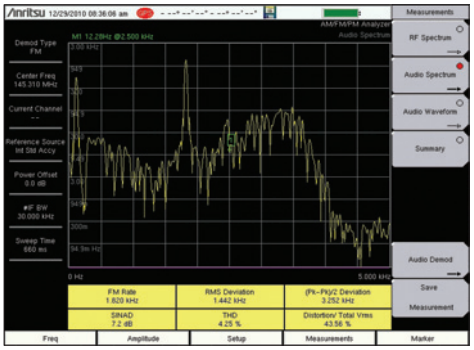
Marker Functions

- Markers
  - 1-6 Markers each with a Delta Marker, or Marker 1 Reference with 6 Delta Markers
- Marker Types
  - Fixed, Tracking, Noise, Frequency Counter
- Marker Auto-Position
  - Peak Search, Next Peak (Right/Left), Peak Threshold %, To Channel, To Center,To Reference Level, Delta Marker to Span
- Marker Table
  - 1-6 markers' frequency & amplitude plus delta markers' frequency offset & amplitude

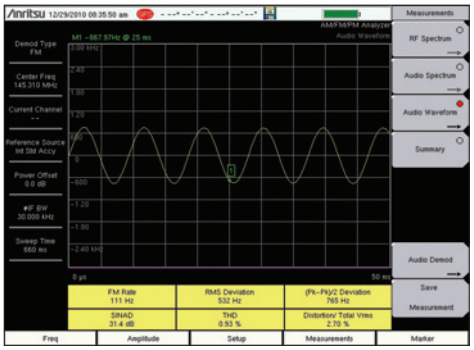
Limit Line Functions

- Limit Lines
  - Upper/Lower, Limit Alarm, Default Limit
- Limit Line Edit
  - Frequency, Amplitude, Add/Delete Point, Add Vertical, Next Point Left/Right
- Limit Line Move
  - To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
- Limit Line Envelope
  - Create, Update Amplitude, Number of Points (41), Offset, Shape Square/Slope
- Limit Line Advanced
  - Absolute/Relative, Mirror, Save/Recall

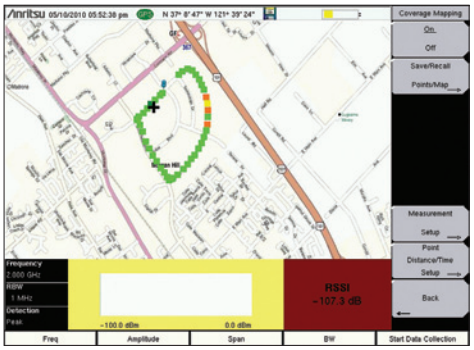
Spectrum Analyzer



The AM/FM/PM option 509 displays the demodulated audio spectrum vs. frequency with AM (%), Deviation (kHz) or Deviation (rad) for AM/FM/PM, respectively.



The AM/FM/PM option 509 displays the demodulated audio spectrum vs. time with AM (%), Deviation (kHz), or Deviation (rad) for AM/FM/PM, respectively.



The Coverage Mapping Option 0431 provides measurement RSSI or ACPR of a single channel along with a user downloaded map and GPS location.

AM/FM/PM Modulation Measurements

Option 509 AM/FM/PM Modulation Analyzer provides analysis and graphical display of common analog modulations. The RF Spectrum View displays the RF spectrum with carrier power (power in dB vs. frequency) along with center frequency, and occupied BW. Audio Spectrum shows the demodulated audio spectrum along with the audio rate, RMS deviation, Pk-Pk deviation (FM/PM) or depth (AM), SINAD, Total Harmonic Distortion (THD), and Total Distortion. Each demodulation also includes an Audio Waveform display that shows the time-domain demodulated waveform. A summary table shows a tabular list of all the RF and Demod measurement results.

AM/FM/PM Coverage Measurements

Coverage Mapping Option 431 provides on screen map displays of RSSI and ACPR.

Users can convert existing map images to a format compatible with the S412E using the included Map Master PC software. RSSI and ACPR measurements can then be superimposed on the maps with the S412E. Maps with GPS coordinates can take advantage of the optional GPS receiver to place measurements appropriately. For indoor measurements, without GPS, the user just touches the S412E display to place measurements at the proper location. The maps with measurements can be exported through the built-in USB port to as JPEG or Google Earth™ KML files.

Measurements

- One Button Measurements
  - Field Strength – in dBm/m^2 or dBmV/m
  - Occupied Bandwidth - 1% to 99% of power
  - Channel Power - in specified bandwidth
  - ACPR - adjacent channel power ratio
  - AM/FM/SSB Demodulation - audio out only
  - C/I - carrier-to-interference ratio

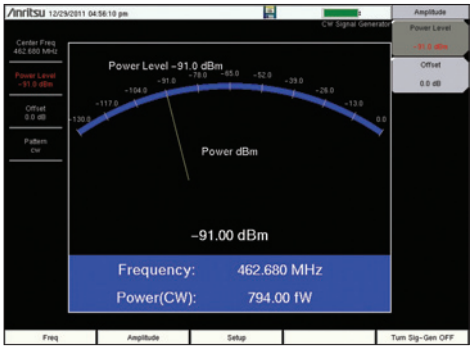
Sweep Functions

- Sweep
  - Single/Continuous, Manual Trigger, Reset, Minimum Sweep Time
- Detection
  - Peak, RMS, Negative, Sample, Quasi-peak

Triggers

- Free Run, External, Video, Change Position, Manual

Signal Generator



The S412E includes a standard Signal Generator with coverage from 500 kHz to 1.6 GHz and 120 dB power control range.

Signal Generator

The S412E includes a Signal Generator mode for use as a general purpose test signal. The generator can produce CW, modulated AM, and modulated FM signals. frequency can be adjusted from 500 kHz to 1.6 GHz in 1 Hz steps. Power can be adjusted from 1 to -120 dBm in 0.1 dB steps. The frequency accuracy follows the spectrum analyzer mode and is better than 50 ppb when the GPS is on and functioning.

Setup Parameters

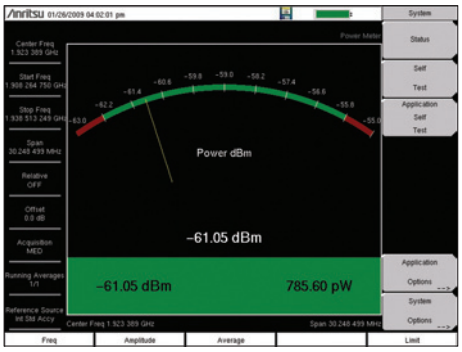
- Generator
  - On/Off
- Tx Output Level
  - -120 dBm to 0 dBm
- Tx Pattern

CW **RF Characteristics**

- Power Level Accuracy
  - 2.0 dB (CW Pattern, temperature range 15 °C to 35 °C, -120 dBm to 0 dBm) Typical
- Frequency Range
  - 500 kHz to 1.6 GHz
- Frequency Accuracy
  - Same as Spectrum Analyzer
- Modulation Adjustments
  - AM depth
  - FM deviation

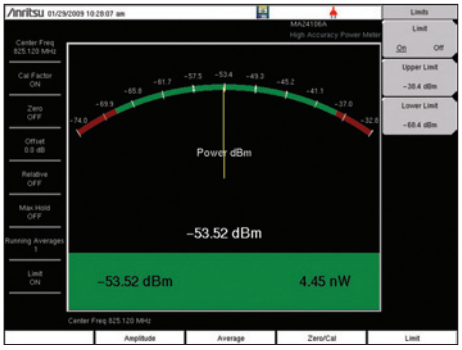
Power Meter

High Accuracy Power Meter (Option 19)



Power Meter Built-in

Power is displayed in an analog type display and, supports both Watts and dBm. RMS averaging can be set to low, medium, or high.

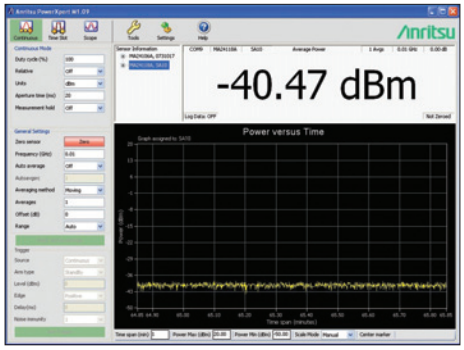


High Accuracy Power Meter

Requires external power sensor with convenient connection via a USB A/mini-B cable. Use upper/lower limit activation during pass/fail measurements.

USB Power Sensor

Anritsu offers a family of Power Sensors for your power measurement requirements. They are compact enough to fit in your shirt pocket.



PC Power Meter

These power sensors can be used with a PC running Microsoft Windows® via USB. A front panel display makes the PC appear like a traditional power meter.

Power Meters

The LMR Master offers a standard built-in Power Meter utilizing the RF In port, and an optional High Accuracy Power Meter when used with optional external power sensors.

Properly setting the transmitter output power of a base station is critical to the overall operation of a wireless network. A 1.5 dB change in power levels indicates a 15% change in coverage area. Too much power means overlapping coverage that translates into cell-to-cell self interference. Too little power, or too little coverage, creates island cells with non-overlapping cell sites and reduced in-building coverage. High or low values will cause dead zones/ dropped calls, lower data rates/reduced capacity near cell edges, and cell loading imbalances/blocked calls.

High Accuracy Power Meter (Option 19)

To address the most accurate power measurement requirements, select the high accuracy measurement option and a choice of sensors with:

- Frequency ranges: 10 MHz to 26 GHz[1]
- Power ranges: -40 dBm to +51.76 dBm[1]
- Measurement uncertainties: = ± 0.18 dB

[1]Depending on choice of sensor

These sensors enable users to make accurate measurements for CW and digitally modulated signals for LMR and cellular wireless networks.

The power sensor easily connects to the LMR Master via a USB A/Mini-B cable. An additional benefit of using the USB connection is that a separate DC supply (or battery) is not needed because the necessary power is supplied by the LMR Master's USB host port.

PC Power Meter

These power sensors can be used stand-alone with a PC running Microsoft Windows® via USB. They come with the PowerXpert™ application, an advanced data analysis and control software. The application has abundant features, such as data logging, power vs. time graph, large numerical display, and many more features, that enable quick and accurate measurements.

Remote Power Monitoring via LAN

A USB-to-LAN hub converter enables remote power monitoring via the Internet, if desired.

Power Sensors

PSN50

- High Accuracy RF Power Sensor
  - 50 MHz to 6 GHz
  - Type N(m), 50 Ω
  - -30 to + 20 dBm (.001 to 100 mW)
  - True-RMS

MA24104A

- Inline High Power Sensor
  - 600 MHz to 4 GHz
  - +3 to +51.76 dBm (2 mW to 150 W)
  - True-RMS

MA24105A

- Inline Peak Power Sensor
  - 350 MHz to 4 GHz
  - +3 to +51.76 dBm (2 mW to 150 W)
  - True-RMS

MA24106A

- High Accuracy RF Power Sensor
  - 50 MHz to 6 GHz
  - -40 to +23 dBm (0.1 µW to 200 mW)
  - True-RMS

MA24108A

- Microwave USB Power Sensor
  - 10 MHz to 8 GHz
  - -40 to +20 dBm (0.1 µW to 100 mW)
  - True-RMS
  - Slot Power
  - Burst Average Power

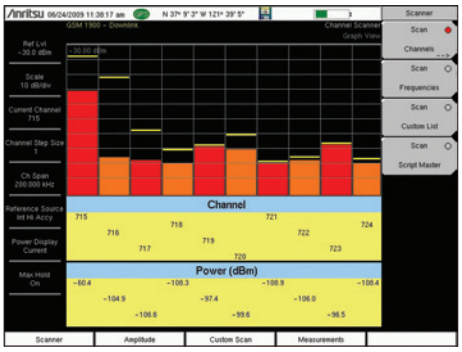
MA24118A

- Microwave USB Power Sensor
  - 10 MHz to 18 GHz
  - -40 to +20 dBm (0.1 µW to 100 mW)
  - True-RMS
  - Slot Power
  - Burst Average Power

MA24126A

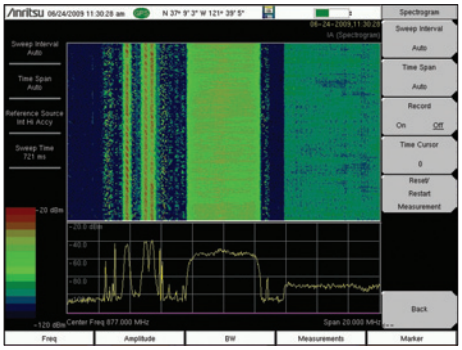
- Microwave USB Power Sensor
  - 10 MHz to 26 GHz
  - -40 to +20 dBm (0.1 µW to 100 mW)
  - True-RMS
  - Slot Power
  - Burst Average Power

Interference Analyzer (Option 25) Channel Scanner (Option 27)



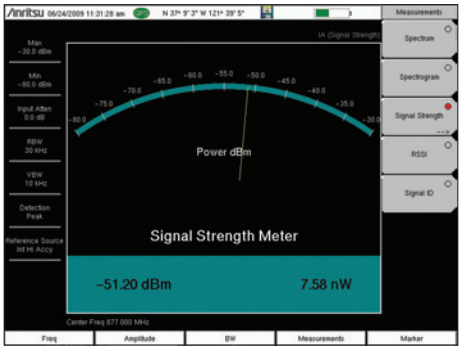
Channel Scanner

Works on any signal and is useful when looking for IM or harmonics. Can help spot signals widely separated in frequency that turn on and off together.



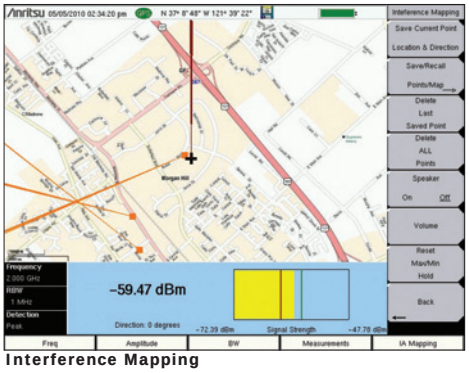
Spectrogram

For identifying intermittent interference and tracking signal levels over time for up to 72 hours with an external USB flash drive.



Signal Strength Meter

Can locate an interfering signal, by using a directional antenna and measuring the signal strength and by an audible beep proportional to its strength.



Interference Mapping

Eliminates the need to use printed maps and draw lines to triangulate location. Use on-screen maps generated with GPS coordinates with Map Master™.

Interference Analyzer (Option 25) Channel Scanner (Option 27)

Interference is a continuously growing problem for wireless network operators. Compounding the problem are the many sources that can generate interference such as:

- Intentional Radiators
- Unintentional Radiators
- Self Interference

Interference causes Carrier-to-Interference degradation, robbing the network of capacity. In many instances, interference can cause an outage to a sector, a cell, and/or neighboring cells. The goal of these measurements is to resolve interference issues as quickly as possible.

Monitoring Interference

The LMR Master offers many tools for monitoring intermittent interferers over time to determine patterns:

- Spectrogram
- Received Signal Strength Indicator
- Remote Monitoring over the Internet
- Save-on-Event – crossing a limit line

Master Software Tools for your PC features diagnostic tools for efficient analysis of the data collected during interference monitoring. These features include:

- Folder Spectrogram – creates a composite file of multiple traces for quick review
- Movie playback – playback data in the familiar frequency domain view
- Histogram – filter data and search for number of occurrences and time of day
- 3D Spectrogram – for in-depth analysis with 3-axis rotation viewing control

Identifying Interference

The LMR Master provides several tools to identify the interference – either from a neighboring wireless operator, illegal repeater or jammer, or self-interference:

- Signal ID (up to 12 signals at once)
- Signal Analyzer Over-the-Air Scanners
- Channel Scanner (up to 1200 channels, 20 at a time)

Locating Interference

Once interference has been identified, the Signal Strength Meter with its audible output beep coupled with a directional antenna makes finding the interference easier.

Interference Analyzer Measurements

- Spectrogram
- Signal Strength Meter
- Received Signal Strength Indicator (RSSI)
- Signal ID (up to 12 signals)
  - FM
  - GSM/GPRS/EDGE
  - W-CDMA/HSDPA
  - CDMA/EV-DO
  - Wi-Fi
- Spectrum
  - Field Strength – in dBm/m^2 or dBmV/m
  - Occupied Bandwidth - 1% to 99% of power
  - Channel Power - in specified bandwidth
  - ACPR - adjacent channel power ratio
  - AM/FM/SSB audio monitor
  - C/I - carrier-to-interference ratio

Channel Scanner

- Scan
  - 20 channels at once, by frequency or channel
  - Noncontiguous channels
  - Different channel bandwidths in one scan
- Display
  - Current plus Max hold display
  - Graph View
  - Table View
- Script Master™
  - Up to 1200 Channels
  - Auto-repeat sets of 20 channels and total
  - Auto-save with GPS tagging

Distance Domain Analysis

Wire Cable Bundle Diagnostics for Aircraft and Shipboard

This innovative new Distance-to-Fault technique finds damaged aircraft wire bundles at bulkheads or other points of vulnerability. It uses the Time Domain option and Frequency Domain Reflectometry with special fixtures to launch high frequency sweep signals into the wiring harnesses. Find out more by downloading Anritsu's Application Note 11410-00565, "Troubleshoot Wire Cable Assemblies with Frequency-Domain-Reflectometry."

Distance Domain (Option 501)

Distance-to-Fault Analysis is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the LMR Master sweeps a user-specified band of full power operational frequencies (instead of fast narrow pulses from TDR-type approaches) to more precisely identify discontinuities.

The LMR Master converts S-parameters from frequency domain into distance (or time) domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable and the discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar time domain analysis is available on transmission (S_{21}) measurements.

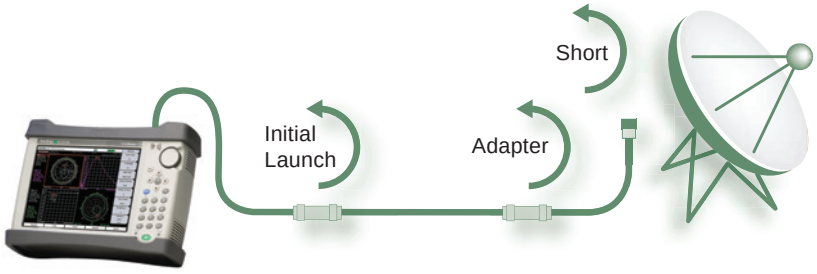
Option 501 Distance Domain will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation (or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and so minimize or prevent downtime of the system.

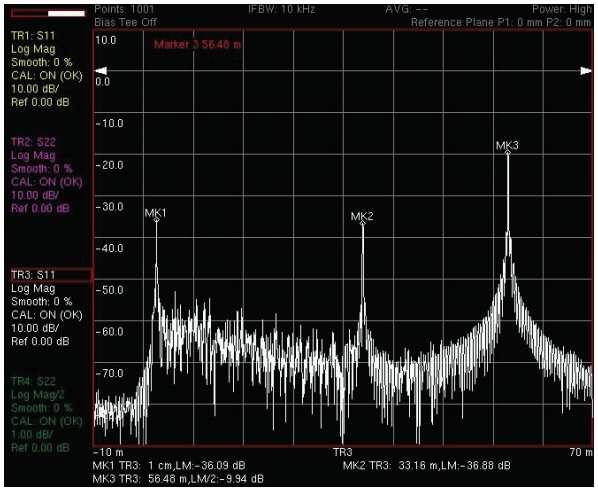
Measurements

- DTF Return Loss
- DTF Insertion Loss

Setup Parameters

- Start Distance
- Stop Distance
- Start Frequency (FDR)
- Stop Frequency (FDR)
- Windowing: Rectangular, Nominal Side Lobe, Low Side Lobe, Minimum Side Lobe
- Propagation Velocity
- Cable Loss
- Units: meters or feet
- Distance Info display





Distance-to-Fault Analysis

This illustration shows a typical cable measurement scenario with an adapter between the near and far end of the cable. With a short on the far end, the VNA Master can convert frequency domain results into corresponding distance-domain readout. Moving left to right, we can see the initial launch (MK1), the intermediate adapter (MK2), and the short at the far end of the cable (MK3). It is easy to interpret the discontinuities as normal or faults by simply looking at the location and amplitude of the peaks. Since the short shows as -20 dB, this means that the one-way cable loss must be 10 dB.

Introduction to Signal Analyzers

LMR Master testing from a service vehicle

Signal Analyzers

The LMR Master features Signal Analyzers for the major wireless standards around the world. The Signal Analyzers are designed to test and verify the:

- RF Signal Strength and Quality
- Modulation Quality
- Downlink (Talk-Out) Coverage
- Downlink Channel Capture
- Receiver Sensitivity

Trunked System Control Channel Downlink Messages

The low phase noise of the S412E supports refined measurement of the RF modulation quality and improves sensitivity for realistic coverage mapping measurements. The optional internal GPS receiver provides location information for coverage mapping plus improves the internal reference accuracy to 50 ppb.

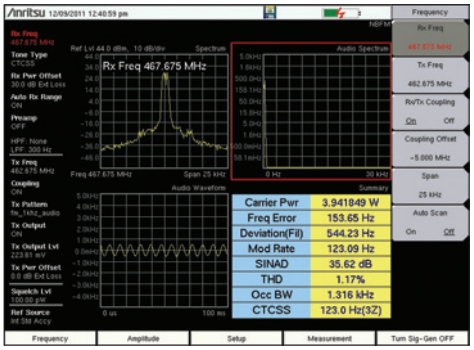
A wide variety of LMR coverage mapping options are available to support in-service and out-of-service measurements of FM, P25, NXDN, DMR, and PTC systems. The signal generator offers a 120 dB power control range to measure receiver sensitivity. The signal generator provides CW, modulated FM, and digital LMR modulation test patterns for use in downlink and uplink (talk-in) coverage mapping. The signal generator's amplitude, frequency, and deviation or test pattern are independently adjustable to allow stimulus of a repeater input while observing the transmitter output.

The LTE and WiMAX Measurement options support testing the downlink signals while cabled directly to a base station or when testing over the air.

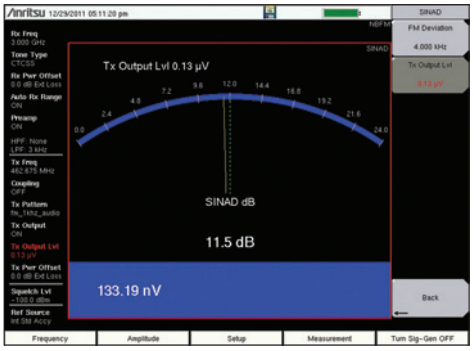
Signal Analyzers

- Narrowband FM (NBFM)
- P25
- NXDN
- DMR Tier 2
- Positive Train Control (PTC)
- LMR Coverage Measurements
- Public Safety LTE
- WiMAX (IEEE 802.16, Fixed and Mobile

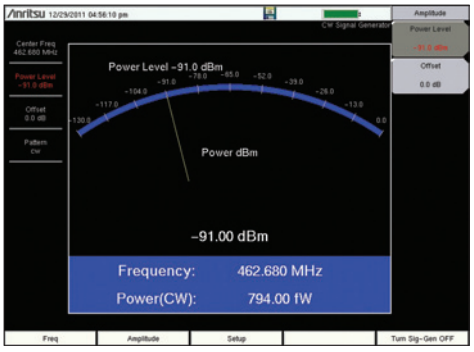
NBFM Analyzer



When cabled to a radio, the NBFM Analyzer features an Auto Scan function that can automatically determine and tune to the carrier frequency of an unknown transmitter.



Dedicated 20 dB Quieting and 12 dB SINAD tools provide quick and accurate measurement of analog receiver performance.



The NBFM Analyzer can generate a CW or FM carrier with adjustable deviation for modulation patterns including 1 kHz, CTCSS/DCS, and DTMF.

NBFM Analyzer

The NBFM Analyzer is a standard feature on all LMR Master S412E instruments and is designed to analyze the performance of both receivers and transmitters according to guidelines in the TIA-603-D Measurement and Performance Standard.

Auto Scan can be used to identify (and automatically tune to) the center frequency of an unknown transmitter. Once locked to the center frequency the Summary display shows Received Power, Frequency Error, Deviation, Modulation Rate, Occupied Bandwidth and THD. Standard values for CTCSS, DCS (both Normal and Inverted), and DTMF are decoded and displayed. 20 dB Quieting and 12 dB SINAD test screens are provided for receiver alignment. Units are adjustable for dBm, Volts, or Watts as needed.

Filters (high-pass, low-pass, pre-emphasis and de-emphasis) allow selection of audio passband components for precise measurements.

The built-in signal generator can provide everything from pure clean CW to modulated FM with test tone and privacy tone at variable deviations.

NBFM Coverage Mapping is also standard on the S412E LMR Master. When GPS signals are available, the optional GPS receiver (Option 31) allows location tagging of RSSI, THD, and SINAD points which are displayed on the S412E's map viewer. Results are then exportable as tab-delimited data, JPEG image, and industry-standard KML for offline analysis in Google Earth(tm) or other mapping applications. The S412E LMR Master offers the industry's only indoor mapping solution for land mobile radio — simply load a building floorplan and begin taking measurements by tapping locations right on the instrument's high-resolution touchscreen display.

- RF Quality
- Modulation Quality
- Downlink (Talk-Out) Coverage
- Baseband I-Q Channel Capture
- Trunked System Control Channel Messages
- P25 Test Signal Generator for Receiver Sensitivity and Coverage Measurements

RF Measurements

- Received Channel Power
- Carrier Frequency
- Frequency Error
- Occupied Bandwidth (% of Power or > dBc method)
- RSSI Coverage Mappin

Modulation Measurements

- Deviation
- Modulation Rate
- SINAD
- THD
- CTCSS / DCS / Inverted DCS / DTMF
- THD Coverage Mapping
- SINAD Coverage Mapping
- Quieting

Filter Types

- 750 µs Pre-Emphasis
- 750 µs De-Emphasis
- High Pass: 300 Hz, 3 kHz, None
- Low Pass: 300 Hz, 3 kHz, 15 kHz, None

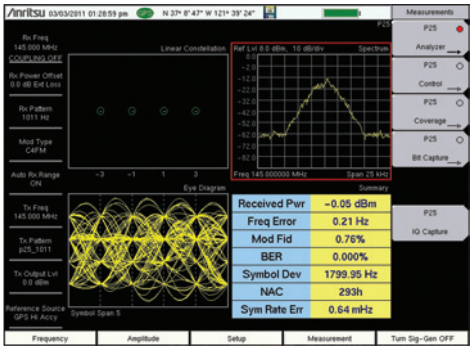
Analyzer Adjustments

- Auto Scan (10 MHz - 1.6 GHz)
- RX Frequency
- TX Frequency
- RX/TX Coupling
- RX/TX Duplex Offset
- Channel Span
- Audio Span
- Audio Sweep Time
- RX Units
- TX Units
- Numerical Squelch Level

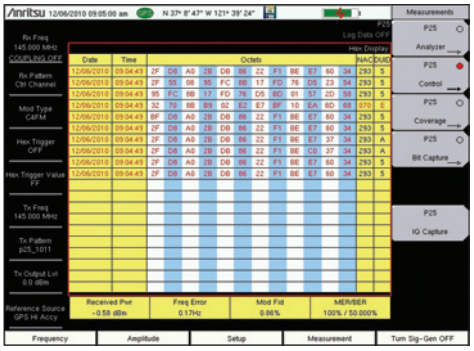
Signal Generator Test Patterns

- CW
- FM + CTCSS
- FM + DCS
- FM + DTMF
- FM + 1 kHz + CTCSS
- FM + 1 kHz + DCS

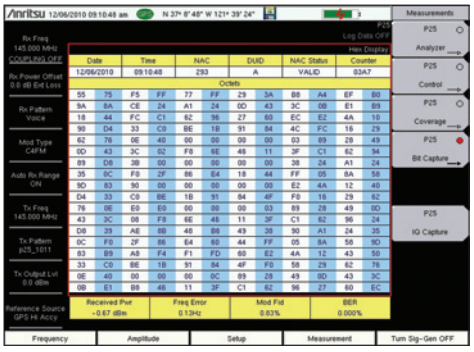
P25 Signal Analyzer (Option 521)



The P25 analyzer display gives a complete summary of the RF Quality.



The P25 Control channel display provides a hex display of the Trunked Downlink data in hex format. Anritsu offers a free software script to convert the hex information to text messages.



The P25 Bit Capture display displays the uplink traffic and exports this to USB memory.

P25 Analyzer

The P25 Signal Analyzer, Option 521, is designed to test and verify the performance of P25 conventional and trunked radio systems. The P25 Analyzer supports measurement of P25 transmitted signals while directly connected to the transmitter (through a power attenuator) or over-the-air with an antenna. The signal analyzer input has the sensitivity to measure P25 signals down to -115 dBm allowing transmitter problems to be analyzed and verified miles away. Separate demodulators are available for C4FM (Phase 1 P25 systems) and π()/4 DQPSK (LSM and Phase 2 P25 systems). Receive test patterns include the P25 standard 1011 Hz BER pattern, the O.153 PN9 BER pattern, a proprietary voice pattern that estimates BER from audio transmissions, and a control channel pattern that measures the control channel message error rate and estimates the control channel BER based on the forward error correction bits.

The built-in P25 signal generator offers over ten P25 test patterns including the standard 1011 Hz voice-framed BER pattern and the O.153 PN9 BER pattern. The generator power level can be controlled over a 120 dB range from 0 to -120 dBm to support receiver sensitivity measurements. The 0 dBm signal level supports amplification to higher levels with an external amplifier for use as a temporary BER test transmitter for coverage assessment. The frequency of the P25 signal generator can be either locked to or controlled independently from the P25 Analyzer frequency.

Control channel messages on trunked P25 Phase 1 systems can be captured as hexidecimal data to the LMR Master display and exported to USB memory for conversion to standard test messages using a Python script available from Anritsu at no charge.

A 12.5 kHz channel I-Q capture function is also available to record a channel's baseband data to USB memory as tab-delimited data for later analysis and replay.

- RF Quality
- Modulation Quality
- Downlink (Talk-Out) Coverage
- Baseband I-Q Channel Capture
- Trunked System Control Channel Messages
- P25 Test Signal Generator for Receiver Sensitivity and Coverage Measurements

RF Measurements

- Received channel power
- Frequency error
- Channel Spectrum
- Eye Diagram
- Constellation

Modulation Measurements

- Modulation Fidelity
- Symbol Deviation
- Symbol Rate Error
- Symbol Histogram

Protocol Measurements

- BER and EVM on 1011 Hz, O.153, Voice, or Control Channel
- NAC

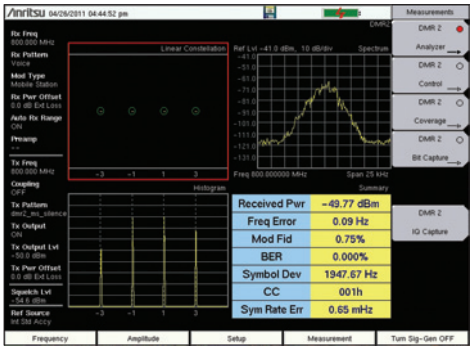
P25 Analyzer Patterns

- 1011 Hz
- O.153 (V.52, PN9)
- Voice
- Control Channel

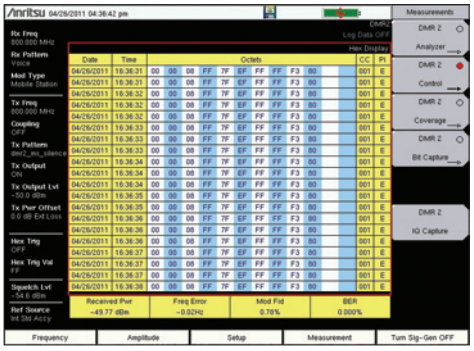
P25 Generator Test Patterns

- p25_1011
- p25_511(O.153)
- p25_1011_cal
- p25_intfr
- p25_silence
- p25_busy
- p25_idle
- p25_high_dev
- p25_low_dev
- p25_fidelity
- cw
- am_1khz_audio
- fm_1khz_audio

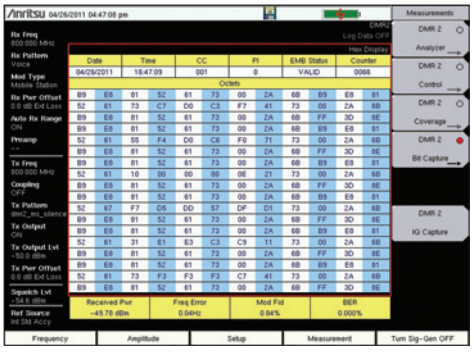
DMR2 Signal Analyzer (Option 591)



The DMR analyzer display gives a complete summary of the RF and Modulation Quality.



The P25 Control channel display provides a hex display of the Trunked Downlink data in hex format. Anritsu offers a free software script to convert the hex information to text messages.



The DMR Bit Capture display displays the uplink traffic and exports this to USB memory.

DMR2 Analyzer

The DMR Analyzer, Option 591, is designed to test and verify the performance of DMR Tier 2 radio systems. The DMR Analyzer supports measurement of time-slotted DMR transmitted signals while directly connected to the transmitter (through a power attenuator) or over-the-air with an antenna. The signal analyzer input has the sensitivity to measure DMR signals down to -115 dBm allowing transmitter problems to be analyzed and verified miles away. Separate demodulators are available for Base Station (BS) and Mobile Station (MS) systems. Receive test patterns include the DMR standard 1031 Hz BER pattern, the O.153 PN9 BER pattern, a proprietary voice pattern that estimates BER from audio transmissions, Silence and Idle patterns, and a control channel pattern that measures the control channel message error rate and estimates the control channel BER based on the forward error correction bits.

The built-in DMR signal generator offers over ten DMR test patterns including the standard 1031 Hz voice-framed BER pattern and the O.153 PN9 BER pattern. The generator power level can be controlled over a 120 dB range from 0 to -120 dBm to support receiver sensitivity measurements. The 0 dBm signal level supports amplification to higher levels with an external amplifier for use as a temporary BER test transmitter for coverage assessment. The frequency of the DMR signal generator can be either locked to or controlled independently from the DMR Analyzer frequency.

A 12.5 kHz channel I-Q capture function is also available to record a channel's baseband data to USB memory as tabdelimited data for later analysis and replay.

- RF Quality
- Modulation Quality
- Downlink (Talk-Out) Coverage
- Baseband I-Q Channel Capture
- DMR Test Signal Generator for Receiver Sensitivity and Coverage Measurements

RF Measurements

- Received channel power
- Frequency error
- Channel Spectrum
- Eye Diagram
- Constellation

Modulation Measurements

- Modulation Types: Base Station (BS) and Mobile Station (MS)
- Modulation Fidelity
- Symbol Deviation
- Symbol Rate Error
- Symbol Histogram

Protocol Measurements

- BER and EVM on 1031 Hz, O.153, Voice, or Control Channel
- Color Code

DMR Analyzer Patterns

- 1031 Hz
- O.153 (V.52, PN9)
- Voice
- Control Channel
- Silence
- Idle

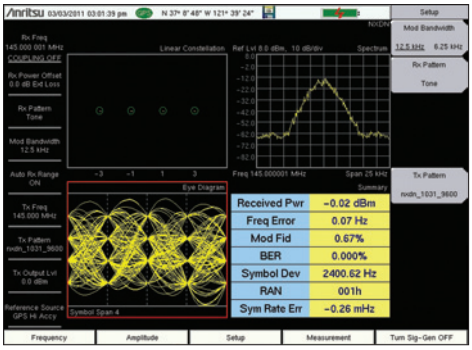
Base Station Test Patterns

- dmr_bs_1031
- dmr_bs_511(O.153)
- dmr_bs_silence
- dmr_bs_1031_1_pcnt_ber
- dmr_bs_511(O.153)_1_pcnt_ber
- dmr_bs_tscc
- cw
- am_1khz_audio
- fm_1khz_audio

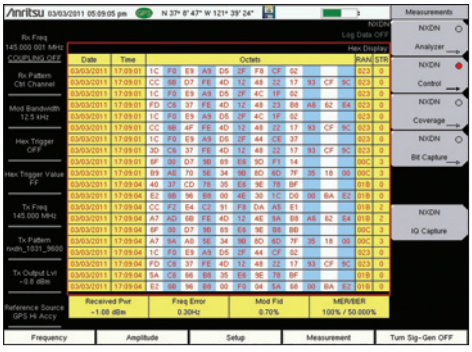
Mobile Station Test Patterns

- dmr_ms_1031
- dmr_ms_511(O.153)
- dmr_ms_silence
- dmr_ms_1031_1_pcnt_ber
- dmr_ms_511(O.153)_1_pcnt_ber
- cw
- am_1khz_audio
- fm_1khz_audio

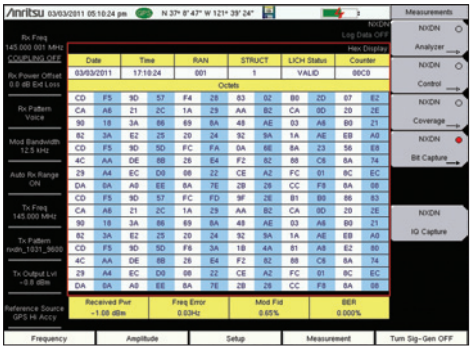
NXDN Signal Analyzer (Option 531)



The NXDN analyzer display gives a complete summary of the RF Quality.



The NXDN Control channel display provides a hex display of the Trunked Downlink data in hex format. Anritsu offers a free software script to convert the hex information to text messages.



The NXDN Bit Capture display displays the uplink traffic and exports this to USB memory.

NXDN Analyzer

The NXDN Analyzer, Option 531, is designed to test and verify the performance of NXDN conventional and trunked radio systems. The NXDN Analyzer supports measurement of NXDN transmitted signals with a direct connection to the transmitter (through a power attenuator) or over-the-air with an antenna. The signal analyzer input has the sensitivity to measure NXDN signals down to -115 dBm, allowing transmitter problems to be analyzed and verified miles away. Separate demodulators are available for 12.5 kHz and 6.25 kHz NXDN systems. Receive BER test patterns include the NXDN standard 1031 "Tone" BER pattern and the O.153 (PN9) BER pattern. For in-service BER testing, Option 0531 offers a proprietary voice pattern that estimates BER from forward error correction bits, and a control channel BER pattern that measures the control channel message error rate, and estimates the control channel BER from the forward error correction bits.

The built-in NXDN signal generator offers over seven NXDN test patterns at both 9600 (12.5 kHz) and 4800 (6.25 kHz) rates including the standard 1031 "Tone" BER pattern and the 511 (O.153) BER pattern.

The generator power level can be controlled over a 120 dB range from 0 to -120 dBm to support receiver sensitivity measurements. The 0 dBm signal level supports amplification to higher levels with an external amplifier for use as a temporary BER test transmitter for coverage assessment. The frequency of the NXDN signal generator is independently settable from the NXDN Analyzer frequency.

Control channel messages on trunked NXDN systems can be captured as hex data to the internal display and exported to USB memory for converting to standard test messages using a Python script available from Anritsu at no charge.

A 12.5 kHz channel I-Q capture is also available to capture channel baseband data to USB memory as tab delimited data for later analysis and replay.

- RF Quality
- Modulation Quality
- Downlink (Talk-Out) Coverage
- Baseband I-Q Channel Capture
- Trunked System Control Channel Messages
- NXDN Test Signal Generator for Receiver Sensitivity Measurements

RF Measurements

- Received channel power
- Frequency error
- Channel Spectrum
- Eye Diagram
- Constellation

Modulation Measurements

- Modulation Fidelity
- Symbol Deviation
- Symbol Rate Error
- Symbol Histogram

Protocol Measurements

- BER on 1031 Hz, O.153, Voice, or Control Channel
- RAN

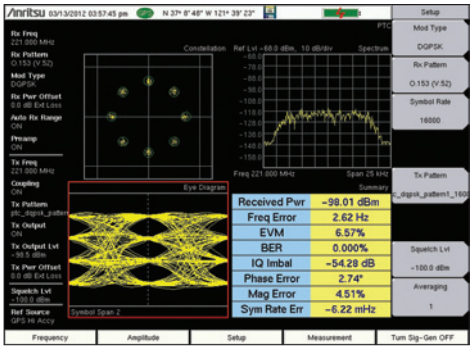
NXDN Analyzer Patterns

- 1031 Hz
- O.153 (V.52, PN9)
- Voice
- Control Channel

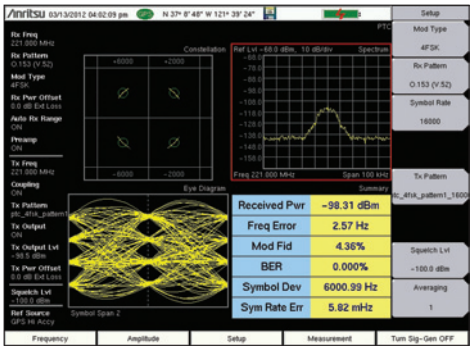
NXDN Generator Test Patterns

- nxdn_1031_9600
- nxdn_511(O.153)_9600
- nxdn_high_dev_9600
- nxdn_low_dev_9600
- nxdn_udch_pat_10_9600
- nxdn_cac_9600
- cw
- am_1khz_audio
- fm_1khz_audio

PTC Analyzer (Option 721)



PTC Main Screen DQPSK



PTC Main Screen 4FSK

PTC Signal Analyzer

The PTC Analyzer, Option 721, is designed to test and verify the performance of Positive Train Control radio systems compliant with the ITCR v1.0 R02 standard. The PTC Analyzer supports measurement of PTC transmitted signals with a direct connection to the transmitter (through a power attenuator) or over-the-air with an antenna. The signal analyzer input has the sensitivity to measure PTC signals down to -115 dBm, allowing transmitter problems to be analyzed and verified miles away. Support for both 4-level FSK and Differential QPSK at 8 ksps and 16 ksps symbol rates is provided.

The built-in PTC signal generator offers three test patterns with various combinations ranging from simple O.153 (PN9) pattern to O.153 patterns with various preambled (as defined by ITCR v1.0 R02).

The generator power level can be controlled over a 120 dB range from 0 to -120 dBm to support receiver sensitivity measurements. The 0 dBm signal level supports amplification to higher levels with an external amplifier for use as a temporary BER test transmitter for coverage assessment. The frequency of the PTC signal generator is independently settable from the PTC Analyzer frequency.

Features include analysis of:

- RF Quality
- Modulation Quality
- Channel Quality

RF Measurements

- Received channel power
- Frequency error
- Channel Spectrum
- Eye Diagram
- Constellation

4FSK Modulation Measurements

- Modulation Fidelity
- BER
- Symbol Deviation
- Symbol Rate Error
- Symbol Histogram

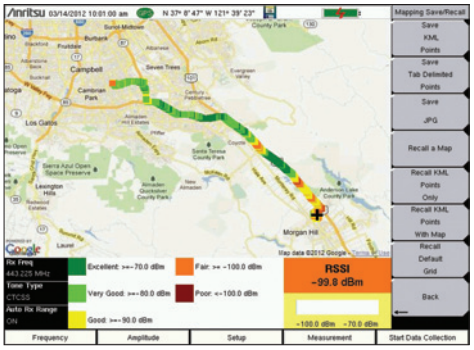
DQPSK Modulation Measurements

- Error Vector Magnitude
- BER
- IQ Imbalance
- Magnitude & Phase Error
- Symbol Rate Error

PTC Analyzer Patterns

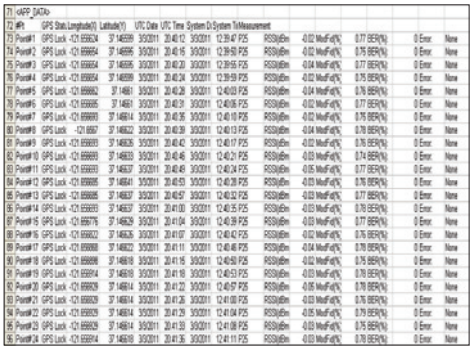
- Pattern 0 = O.153 (aka PN9) pattern with no Preamble
- Pattern 1 = O.153 (aka PN9) pattern with FF0A Preamble
- Pattern 2 = O.153 (aka PN9) pattern with F337 Preamble
- cw
- am_1khz_audio
- fm_1khz_audio

LMR Coverage Measurements



The LMR Coverage Mapping options provide a map-based view of measurement results along with GPS status. The data points are color-coded according to user-definable level bins for the selected measurement.

The LMR Coverage Mapping options generate a Google Earth KML file with color push pins indicating BER, Modulation Fidelity, RSSI, THD, or SINAD



The LMR Coverage Mapping options provide a tab delimited text file for viewing with spreadsheet applications, custom post-processing scripts, or for importing into 3rd-party coverage prediction software.

LMR Coverage Measurements

The LMR Coverage Measurement options, combined with the GPS Option 31, measures and logs key signal quality parameters of land mobile radio systems. For analog FM systems, RSSI, THD and Transmitter SINAD can be mapped. For digital LMR systems BER, Modulation Fidelity (or Error Vector Magnitude), and RSSI can be mapped. All data points are tagged with a GPS location and time and saved to memory approximately once every two seconds. Two files are exportable; a tab-delimited text file for importing to spreadsheet and custom analysis scripts, or an industry-standard KML file for viewing with geo-mapping software such as Google Earth™. In cases where a GPS signal is not available, the LMR Master allows the user to import a floorplan or other map image and use the high-resolution color touchscreen to record data points.

The RSSI value stored into memory is an average of approximately 50,000 separate samples per second taken during the measurement period.

The EVM or Modulation Fidelity values give a good indication of the amount of multipath on the measured signal.

Four different BER measurement methods are available. For channels which can be taken out of service, the P25 Standard 1011 Hz pattern provides the BER (before error correction) on voice framed data. The O.153 / PN9 pattern provides high resolution BER measurements on unframed data.

For in-service channel measurements, the Control Channel pattern measures the message error rate and estimates the BER from analysis of the forward error correction on the control channel data.

The Voice pattern estimates the BER on live voice traffic from analysis of the forward error correction data, eliminating the need to take critical systems off the air for analysis and allowing coverage confirmation without operational disruption.

Coverage Mapping Parameters

- Received Channel Frequency
- Receive Signal Pattern
- Auto Receive Range
- Indoor Mapping Repeat Type (Time or Distance)
- Repeat Time
- Repeat Distance
- Distance Units

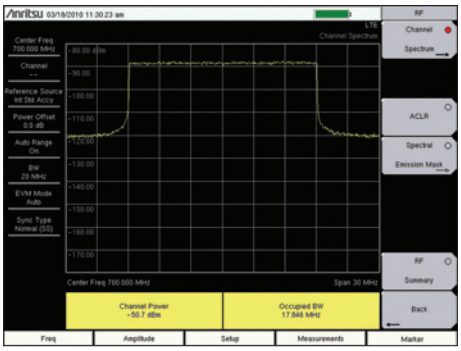
Coverage Mapping Types

- Analog FM: RSSI, THD, SINAD
- Digital LMR: RSSI, BER, Mod Fid

Mapping Color Codes

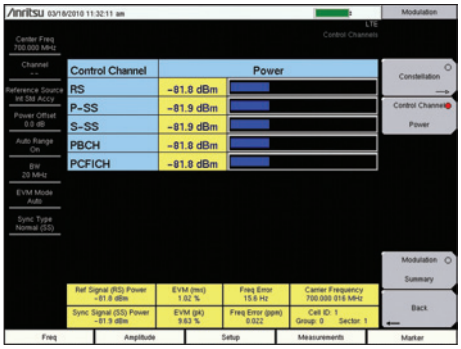
- 5 Levels
- 4 Break Points
- User-adjustable

LTE Signal Analyzers (Options 541, 542, 546)



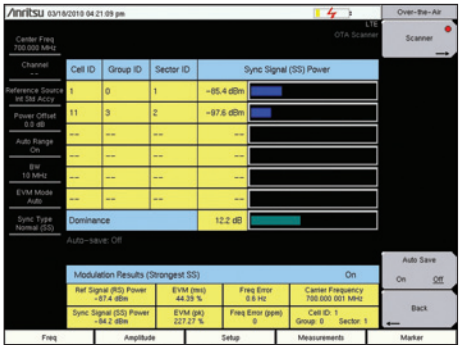
RF Measurements – Occupied Bandwidth

The bandwidth that contains 99% of the total carrier power. Excessive occupied bandwidth means excessive adjacent channel interference.



Modulation Quality – EVM

High values will create larger areas of cell-to-cell interference and create lower data rates near cell edges.



Over-the-Air Measurements – Sync Signal Power

Too many strong sectors at the same location create co-channel interference. This leads to low data rate, low capacity, and excessive handoffs.

LTE Signal Analyzers

The LMR Master features three LTE measurement modes:

- RF Measurements
- Modulation Measurements
- Over-the-Air Measurements (OTA)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous, one can directly connect to the base station to check the signal quality and transmitter power.

Adjacent Channel Leakage Ratio (ACLR)

Adjacent Channel Leakage Ratio (ACLR) measures how much BTS signal gets into neighboring RF channels. ACLR checks the closest (adjacent) and the second closest (alternate) channels. Poor ACLR can lead to interference with adjacent carriers and legal liability. It also can indicate poor signal quality which leads to low throughput.

Cell ID (Sector ID, Group ID)

Cell ID indicates which base station is being measured OTA. The strongest base station at your current location is selected for measurement. Wrong values for Cell ID lead to inability to register. If the cause is excessive overlapping coverage, it also will lead to poor EVM and low data rates

Frequency Error

Frequency Error is a check to see that the carrier frequency is precisely correct. The Cell Master can accurately measure Carrier Frequency Error OTA if the instrument is GPS enabled or in GPS holdover. Calls will drop when mobiles travel at higher speed. In some cases, cell phones cannot hand off into, or out of the cell.

Sync Signal Mapping

Sync Signal Scanner can be used with the GPS to save scan results for later display on a map. The EVM of the strongest synch signal available at that spot is also recorded. The Cell, Sector, and Group ID information is also included so that it's easier to interpret the results. Once the Synch Signals are mapped, it becomes much easier to understand and troubleshoot any interference or coverage issues.

RF Measurements
(Option 541)

- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
- ACLR

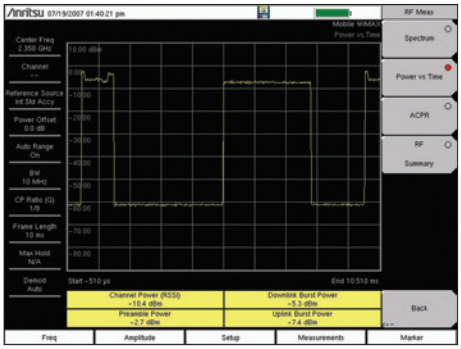
Modulation Measurements
(10 MHz Bandwidth)
(Option 542)

- Constellation
  - Reference Signal Power
  - Sync Signal Power
  - EVM
  - Frequency Error
  - Carrier Frequency
  - Cell ID
- Control Channel Power
  - RS
  - P-SS
  - S-SS
  - PBCH
  - PCFICH

Over-the-Air Scanner (OTA)
(Option 546)

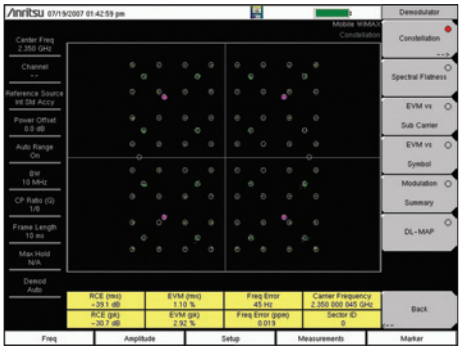
- Synch Signal Power (Six Strongest)
  - Power
  - Cell ID
  - Sector ID
  - Group ID
- Dominance
- Auto-Save with GPS Tagging and Logging

Fixed and Mobile WiMAX Signal Analyzers (Options 46, 47, 66, 67, 37)



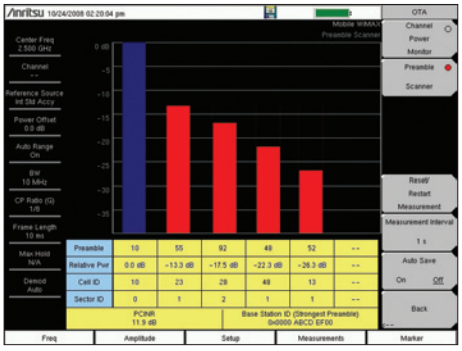
RF Measurement – Preamble Power

High or low values will create larger areas of cell-to-cell interference and create lower data rates near cell edges. Low values affect in-building coverage.



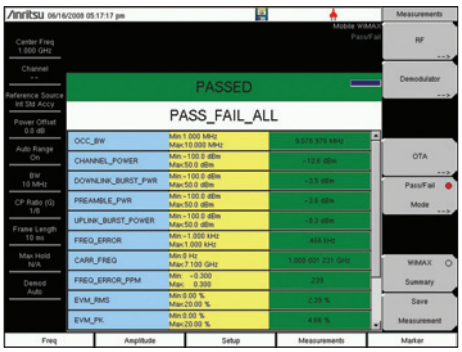
Demodulation – Frequency Error

Calls will drop when user's equipment travels at high speed. In severe cases, handoffs will not be possible at any speed, creating island cells.



Over-the-Air Measurements – PCINR

A low Physical Carrier to Interference plus Noise Ratio (PCINR) indicates poor signal quality, low data rate and reduced sector capacity.



Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations, leads to inconsistent network behavior.

Fixed and Mobile WiMAX Signal Analyzers

The LMR Master features two Fixed WiMAX and three Mobile WiMAX measurement modes:

- RF Measurements
- Demodulation (up to 10 MHz)
- Over-the Air Measurements (OTA) (Mobile only)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Cell ID, Sector ID, and Preamble

Cell ID, Sector ID, and Preamble show which cell, sector, and segment are being measured OTA. The strongest signal is selected automatically for the additional PCINR and Base Station ID measurement. Wrong values for cell, sector and segment ID lead to dropped handoffs and island cells. If the cause is excessive coverage, it also will lead to large areas of low data rates.

Error Vector Magnitude (EVM) Reletive Constellation Error (RCE)

RCE and EVM measure the difference between the actual and ideal signal. RCE is measured in dB and EVM in percent. A known modulation is required to make these measurements. High RCE and EVM causes low signal quality, low data rate, and low sector capacity. This is the single most important signal quality measurement.

Preamble Mapping (Mobile WiMAX)

Preamble Scanner can be used with the GPS to save scan results for later display on a map. PCINR ratio for the strongest WiMAX preamble available at that spot. The Base Station ID and Sector ID information are also included so that it's easier to interpret the results. Once PCINR data is mapped, it becomes much easier to understand and troubleshoot any interference or coverage issues.

RF Measurements
(Option 46/66, Fixed/Mobile)

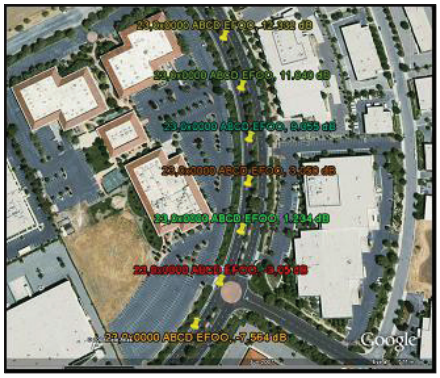
- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
- Power vs. Time
  - Channel Power
  - Preamble Power
  - Downlink Burst Power (Mobile only)
  - Uplink Burst Power (Mobile only)
  - Data Burst Power (Fixed only)
  - Crest Factor (Fixed only)
- ACPR

Demodulation (10 MHz maximum)
(Option 47/67, Fixed/Mobile)

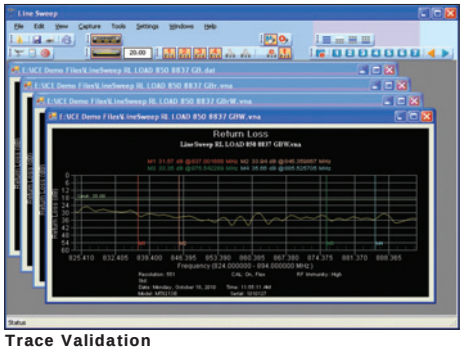
- Constellation
  - RCE (RMS/Peak)
  - EVM (RMS/Peak)
  - Frequency Error
  - CINR (Mobile only)
  - Base Station ID
  - Carrier Frequency
  - Sector ID
- Spectral Flatness
  - Adjacent Subcarrier Flatness
- EVM vs. Subcarrier/Symbol
  - RCE (RMS/Peak)
  - EVM (RMS/Peak)
  - Frequency Error
  - CINR (Mobile only)
  - Base Station ID
  - Sector ID (Mobile only)
- DL-MAP (Tree View) (Mobile only)

Over-the-Air (OTA)
(Option 37 Mobile only)

- Channel Power Monitor
  - Preamble Scanner (Six)
  - Preamble
  - Relative Power
  - Cell ID
  - Sector ID
  - PCINR
  - Dominant Preamble
    - Base Station ID
- Auto-Save with GPS Tagging and Logging

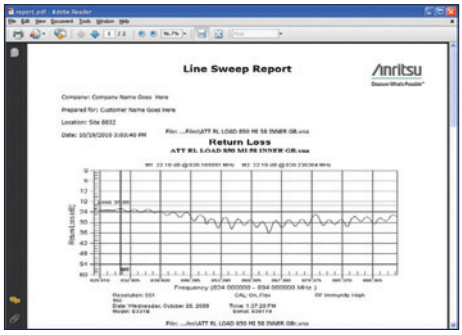


Line Sweep Tools™ and Master Software Tools™ (for your PC)



Trace Validation

Marker and Limit Line presets allow quick checks of traces for limit violations.



Report Generation

Create reports with company logo, GPS tagging information, calibration status, and serial number of the instrument for complete reporting.

Line Sweep Tools™

Line Sweep Tools increases productivity for people who deal with dozens of Cable and Antenna traces, or Passive Inter-Modulation (PIM) traces, every day.

User Interface

Line Sweep Tools has a user interface that will be familiar to users of Anritsu's Hand Held Software Tools. This will lead to a short learning curve.

Marker and Limit Line Presets

Presets make applying markers and a limit line to similar traces, as well as validating traces, a quick task.

Renaming Grid

A renaming grid makes changing file names, trace titles, and trace subtitles from field values to those required for a report much quicker than manual typing and is less prone to error.

Report Generator

The report generator will generate a professional looking PDF of all open traces with additional information such as contractor logos and contact information.

Line Sweep Features

Presets

7 sets of 6 markers and 1 limit line
Next trace capability

File Types

Input: HHST DAT, MNA and VNA Measurements: Return Loss (VSWR), Cable Loss, DTF-RL, DTF-VSWR, PIM
Output: LS DAT, MNA, VNA, CSV, PNG, BMP, JPG, PDF

Report Generator

Logo, title, company name, customer name, location, date and time, filename, PDF, HTML, all open traces

Tools

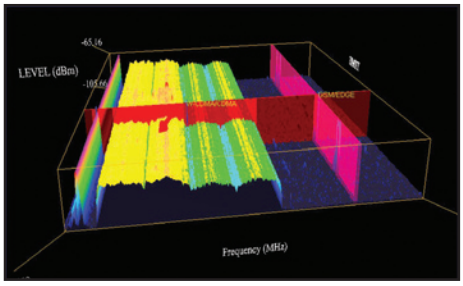
Cable Editor
Distance to Fault
Measurement calculator
Signal Standard Editor
Renaming Grid

Interfaces

Serial, Ethernet, USB

Capture Plots to

Screen, Database, DAT files, JPEG, Instrument



3D Spectrogram

For in-depth analysis with 3-axis rotation viewing, threshold, reference level, and marker control. Turn on Signal ID to see the types of signals.

Master Software Tools™

Master Software Tools (MST) is a powerful PC software post-processing tool designed to enhance the productivity of technicians in data analysis and testing automation.

Folder Spectrogram

Folder Spectrogram – creates a composite file of up to 15,000 multiple traces for quick review, also create:

- Peak Power, Total Power, and Peak Frequency plotted over time
- Histogram – filter data and plot number of occurrences over time
- Minimum, Maximum, and Average Power plotted over frequency
- Movie playback – playback data in the familiar frequency domain view
- 3D Spectrogram – for in-depth analysis with 3-axis rotation viewing control

Master Software Tools Features

Database Management

Full Trace Retrieval
Trace Catalog
Group Edit
Trace Editor

Data Analysis

Trace Math and Smoothing
Data Converter
Measurement Calculator

Mapping (GPS Required)

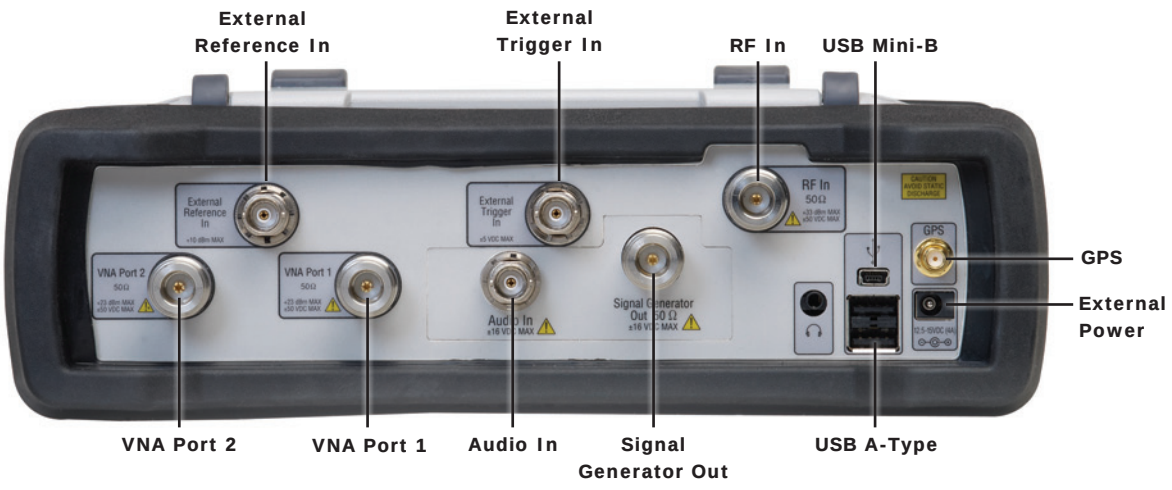
Spectrum Analyzer Mode
Mobile WiMAX OTA Option
TS-SCDMA OTA Option
LTE, both FDD and TDD Options

Folder Spectrogram

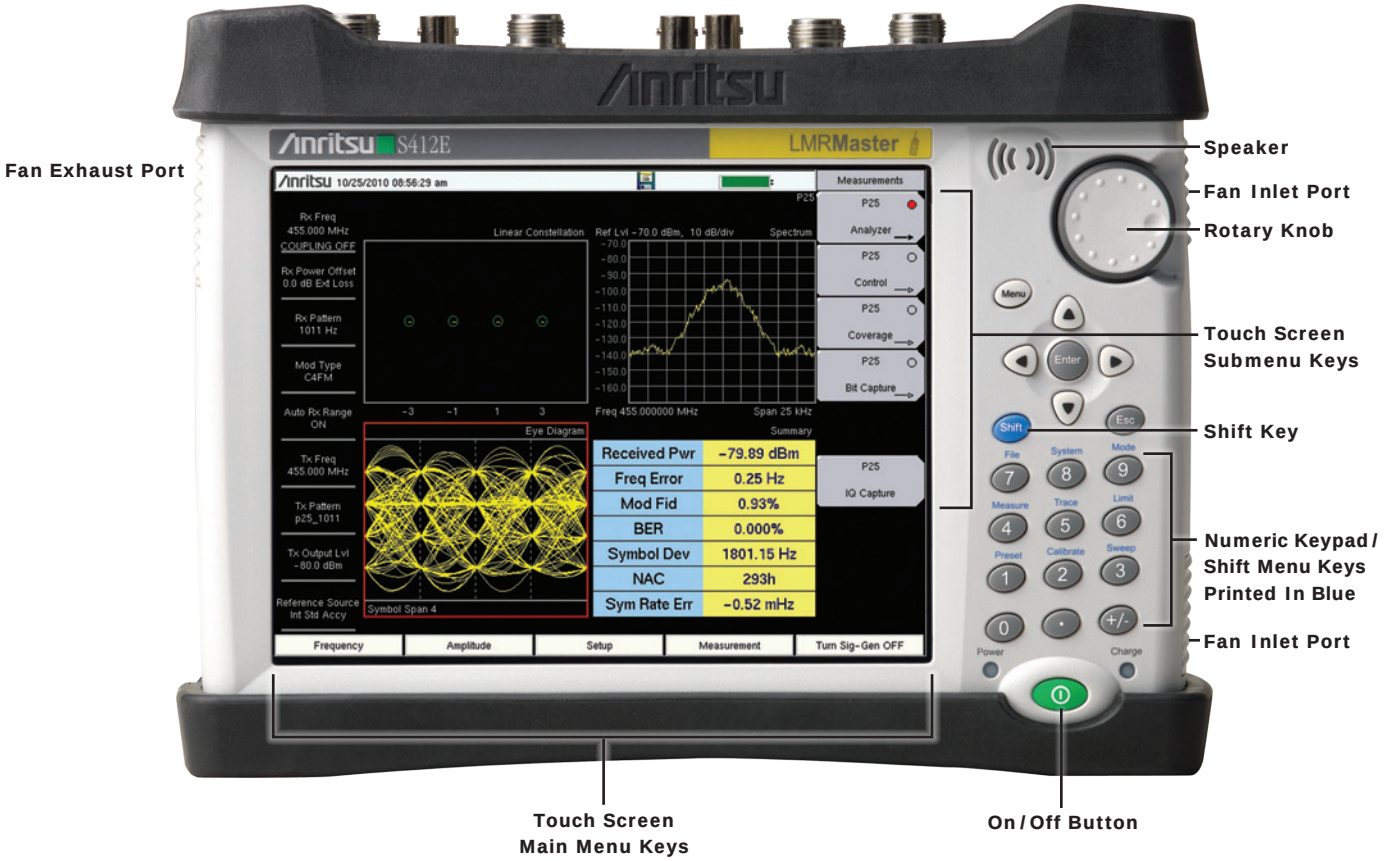
Folder Spectrogram – 2D View
Video Folder Spectrogram – 2D View
Folder Spectrogram – 3D View

List / Parameter Editors

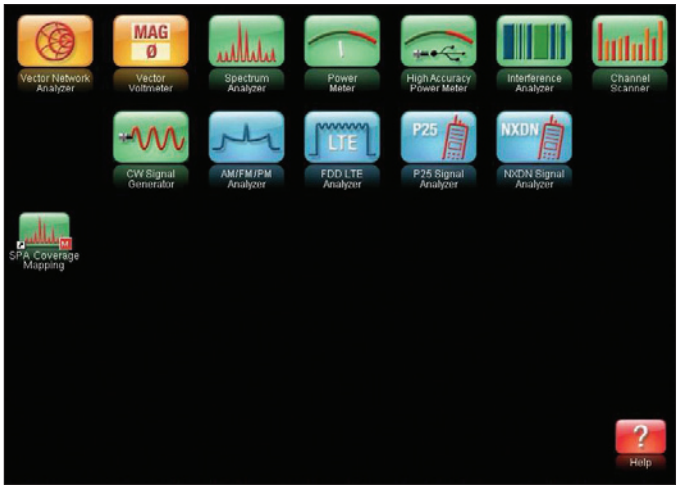
Traces
Antennas, Cables, Signal Standards
Product Updates
Firmware Upload
Pass/Fail
VSG Pattern Converter
Languages
Mobile WiMAX
Display



All Connectors are conveniently located on the top panel, leaving the sides clear for handheld use



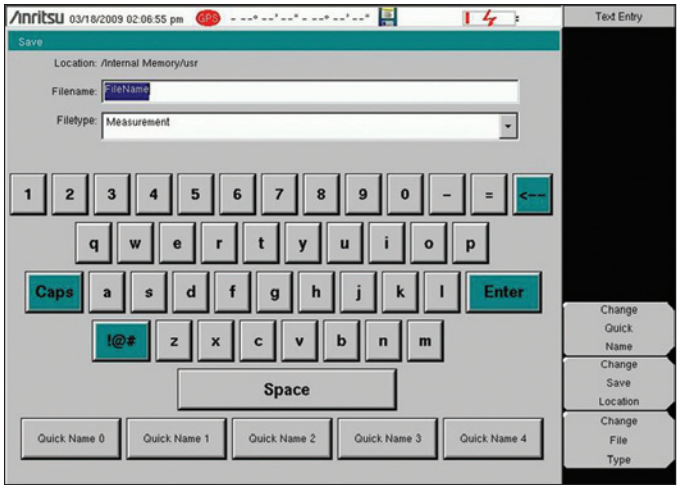
Handheld Size: 273 x 199 x 91 mm, (10.7 x 7.8 x 3.6 in), Lightweight: 3.6 kg, (7.9 lbs)



Touchscreen Menu

The Menu Key activates the touchscreen menu for one button access to all of the Analyzers.

User defined shortcuts can be created for one-button access to commonly used functions.



Touchscreen Keyboard

A built-in touchscreen keyboard saves valuable time in the field when entering trace names.

For Cable and Antenna Analysis, a Quick Name Matrix can be customized for quickly naming your line sweeps.

Tilt bails are integrated into the case and soft case for better screen viewing.

Ordering Information – Options

	S412E	Description
	500 kHz to 1.6 GHz	Vector Network Analyzer
	100 kHz to 1.6 GHz	Spectrum Analyzer
	10 MHz to 1.6 GHz	Power Meter
	500 kHz to 1.6 GHz	CW Signal Generator
	Options	
	S412E-0010	High Voltage Variable Bias Tee
	S412E-0501	Distance Domain
	S412E-0031	GPS Receiver (requires external GPS antenna 2000-1528-R or 2000-1652-R)
	S412E-0019	High-Accuracy Power Meter (requires External Power Sensor)
	S412E-0025	Interference Analyzer (Option 0031 recommended)
	S412E-0027	Channel Scanner
	S412E-0006	6 GHz Coverage on Spectrum Analyzer
	S412E-0016	6 GHz Coverage on Vector Network Analyzer
	S412E-0015	Vector Voltmeter
	S412E-0431	Coverage Mapping (requires Option 0031)
	S412E-0509	AM/FM/PM Analyzer
	S412E-0521	P25 Analyzer Measurements
	S412E-0522	P25 Coverage Measurements (requires Options 0031 and 0521)
	S412E-0591	DMR2 Analyzer Measurements
	S412E-0592	DMR2 Coverage Measurements (requires Options 0031 and 0591)
	S412E-0531	NXDN Analyzer Measurements
	S412E-0532	NXDN Coverage Measurements (requires Options 0031 and 0531)
	S412E-0721	PTC Analyzer Measurements
	S412E-0722	PTC Coverage Measurements (requires Options 0031 and 0721)
	S412E-0541	LTE RF Measurements (requires Option 0031)
	S412E-0542	LTE Modulation Quality (requires Option 0031)
	S412E-0546	LTE Over-the-Air Measurements (requires Option 0031)
	S412E-0046	IEEE 802.16 Fixed WiMAX RF Measurements (requires Option 0031)
	S412E-0047	IEEE 802.16 Fixed WiMAX Demodulation (requires Option 0031)
	S412E-0066	IEEE 802.16 Mobile WiMAX RF Measurements (requires Option 0031)
	S412E-0067	IEEE 802.16 Mobile WiMAX Demodulation (requires Option 0031)
	S412E-0037	IEEE 802.16 Mobile WiMAX Over-the-Air Measurements (requires Option 0031)
	S412E-0098	Standard Calibration (ANSI 2540-1-1994)
	S412E-0099	Premium Calibration to Z540 plus test data

LMR Master™ S412E Ordering Information

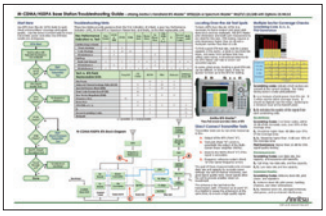
Power Sensors (For complete ordering information see the respective datasheets of each sensor)

Part Number	Description
PSN50	High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +20 dBm
MA24106A	High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24104A	Inline High Power Sensor, 600 MHz to 4 GHz, +51.76 dBm
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +51.76 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm

Manuals (soft copy included on Handheld Document Disc and at www.anritsu.com)

Part Number	Description
10920-00060	Handheld Instruments Documentation Disc
10580-00318	LMR Master User Guide (Hard copy included)
10580-00289	Vector Network Analyzer Measurement Guide
10580-00244	Spectrum Analyzer Measurement Guide - Interference Analyzer, Channel Scanner, Gated Sweep, CW Signal Generator, AM/FM/PM Analyzer, Interference Mapping, Coverage Mapping
10580-00234	3GPP Signal Analyzer Measurement Guide - GSM/EDGE, W-CDMA/HSDPA, TD-SCDMA/HSDPA, LTE, TD-LTE
10580-00243	Land Mobile Radio Measurement Guide
10580-00240	Power Meter Measurement Guide - High Accuracy Power Meter
10580-00319	Programming Manual

Troubleshooting Guides (soft copy at www.anritsu.com)



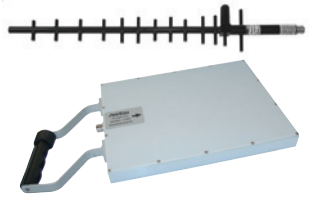
Part Number	Description
11410-00551	Spectrum Analyzers Field User Guide
11410-00472	Interference Troubleshooting Guide
11410-00473	Cable, Antenna and Components
11410-00566	LTE eNode Testing
11410-00470	Fixed WiMAX Base Stations
11410-00469	Mobile WiMAX Base Stations

Standard Accessories (included with instrument)

Part Number	Description
10920-00060	Handheld Instruments Documentation Disc
10580-00318	LMR Master User Guide (includes Bias-Tee, GPS Receiver)
2000-1654-R	Soft Carrying Case
2300-498	Master Software Tools (MST) CD Disc
2300-532	Map Master CD Disc
633-44	Rechargeable Li-Ion Battery
40-168-R	AC-DC Adapter
806-141-R	Automotive Cigarette Lighter Adapter
3-2000-1498	USB A/5-pin mini-B Cable, 10 feet/305 cm
11410-00486	LMR Master S412E Technical Data Sheet One Year Warranty (Including battery, firmware, and software) Certificate of Calibration and Conformance

Optional Accessories

Directional Antennas



Part Number	Description
2000-1411-R	824 MHz to 896 MHz, N(f), 10 dBd, Yagi
2000-1412-R	885 MHz to 975 MHz, N(f), 10 dBd, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N(f), 10 dBd. Yagi
2000-1414-R	1850 MHz to 1990 MHz, N(f), 9.3 dBd, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N(f), 10 dBd, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N(f), 10 dBd, Yagi
2000-1519-R	500 MHz to 3 GHz, log periodic

Portable Antennas

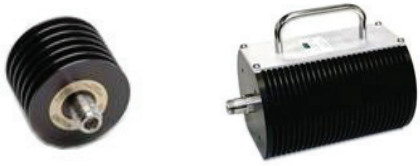
2000-1200-R	806 MHz to 866 MHz, SMA(m), 50 Ω *
2000-1473-R	870 MHz to 960 MHz, SMA(m), 50 Ω *
2000-1035-R	896 MHz to 941 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1030-R	1710 MHz to 1880 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave) *
2000-1031-R	1850 MHz to 1990 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA(m), 50 Ω *
2000-1032-R	2400 MHz to 2500 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA(m), 50 Ω *
2000-1636-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA(m), 50 Ω *
2000-1487	Telescoping Whip Antenna, BNC **

* Requires 1091-27-R SMA(f) to N(m) adapter
** Requires 1091-172-R BNC(f) to N(m) adapte

Filters

1030-114-R	806 MHz to 869 MHz, N(m) to SMA(f), 50 Ω
1030-109-R	824 MHz to 849 MHz, N(m) to SMA(f), 50 Ω
1030-110-R	880 MHz to 915 MHz, N(m) to SMA(f), 50 Ω
1030-105-R	890 MHz to 915 MHz, N(m) to N(f), 50 Ω
1030-111-R	1850 MHz to 1910 MHz, N(m) to SMA(f), 50 Ω
1030-106-R	1710 MHz to 1790 MHz, N(m) to N(f), 50 Ω
1030-107-R	1910 MHz to 1990 MHz, N(m) to N(f), 50 Ω
1030-112-R	2400 MHz to 2484 MHz, N(m) to SMA(f), 50 Ω
1030-149-R	High Pass, 150 MHz, N(m) to N(f), 50 Ω
1030-150-R	High Pass, 400 MHz, N(m) to N(f), 50 Ω
1030-151-R	High Pass, 700 MHz, N(m) to N(f), 50 Ω
1030-152-R	Low Pass, 200 MHz, N(m) to N(f), 50 Ω
1030-153-R	Low Pass, 550 MHz, N(m) to N(f), 50 Ω
1030-155-R	2500 MHz to 2700 MHz, N(m) to N(f), 50 Ω

Attenuators



3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N(m) to N(f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N(m) to N(f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N(m) to N(f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N(m) to N(f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N(m) to N(f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N(m) to N(f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N(m) to N(f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N(m) to N(f)

Phase-Stable Test Port Cables, Armored w/ Reinforced Grip (recommended for cable & antenna line sweep applications)

15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω

Optional Accessories (continued)

Phase-Stable Test Port Cables, Armored (recommended for use with tightly spaced connectors and other general purpose applications)

15NNF50-1.5C	1.5 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N(m) to N(m), 50 Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N(m) to N(m), 50 Ω

Adapters

1091-26-R	SMA(m) to N(m), DC to 18 GHz, 50 Ω
1091-27-R	SMA(f) to N(m), DC to 18 GHz, 50 Ω
1091-80-R	SMA(m) to N(f), DC to 18 GHz, 50 Ω
1091-81-R	SMA(f) to N(f), DC to 18 GHz, 50 Ω
1091-172	BNC(f) to N(m), DC to 1.3 GHz, 50 Ω
510-102-R	N(m) to N(m), DC to 11 GHz, 50 Ω, 90 degrees right angle

Precision Adapters

34NN50A	Precision Adapter, N(m) to N(m), DC to 18 GHz, 50 Ω
34NFNF50	Precision Adapter, N(f) to N(f), DC to 18 GHz, 50 Ω

Miscellaneous Accessories

2000-1528-R	GPS Antenna, SMA(m)
2000-1528-R	GPS Antenna, SMA(m) with 15 ft cable
2000-1652-R	GPS Antenna, SMA(m) with 1 ft cable
633-44	Extra Rechargeable Li-Ion Battery
2000-1374	External Charger for Li-Ion Battery
2300-532	Map Master CD
2000-1653	Protective Screen Cover (Package of 2)
66864	Rack Mount Kit, Master Platform

Backpack and Transit Case

67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle

Notes

Notes

Notes

Anritsu

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