

RF/Microwave Signal Generators MG37020A

Fast Switching Microwave Signal Generator,
100 μ sec Switching Speed, 10 MHz to 20 GHz

Introduction

The MG37020A Fast Switching Microwave Signal Generator is the “ideal microwave signal generator” for applications where fast frequency switching speed is a critical parameter, including data intensive applications, high throughput manufacturing test, and signal simulation. The MG37020A Fast Switching Microwave Signal Generator provides fast switching speed along with high output power, low phase noise, spectral purity, high performance pulse modulation, size, upgradeability, reliability, and service. Our signal generators are configurable for a broad range of applications from R&D to manufacturing and depot repair. Anritsu provides you a total solution including proven reliability and standard 3 year warranty plus pre- and post-sale support that is the best in the industry.





Signal Generator

The specifications in the following pages describe the warranted performance of the instrument for $25 \pm 10^\circ\text{C}$. "Typical" specifications describe expected, but not warranted, performance based on sample testing. They do not guarantee the performance of any individual product. "Typical" specifications do not account for measurement uncertainty.

Frequency Coverage

Model/Option	Frequency Coverage	Output Type
MG37022A	2 GHz to 20 GHz	K(f)
Option 4 ^a	10 MHz to 2.2 GHz	K(f)

a. Option 4: Frequency extension down to 10 MHz. Option 4 uses a digital down-converter (DDC) with successive divide-by-two circuitry. It offers reduced SSB phase noise compared to heterodyne down-converters.

CW Mode

Accuracy	Same as internal or external 10 MHz time base
Internal Time Base Stability	With aging: $< 2 \times 10^{-8}/\text{day}$ With temperature: $< 2 \times 10^{-8}/^\circ\text{C}$ over 0°C to 50°C
Internal Time Base Calibration	The internal time base can be calibrated via the System Cal Menu to match an external reference (10 MHz \pm 50 Hz).
Resolution	0.001 Hz
External 10 MHz Reference Input	Accepts external 10 MHz \pm 50 Hz (typical), 0 to +20 dBm time base signal Automatically detects and switches to the external reference (when applied) Rear panel BNC, 50 Ω impedance Selectable bandwidth for best phase noise immunity or best phase tracking performance
10 MHz Reference Output	Rear panel BNC: 50 Ω impedance, DC coupled, TTL compatible
Electronic Frequency Control (EFC) Input	-5 V to +5 V input range, 2.5×10^{-6} Hz/V sensitivity (typical) < 250 Hz modulation bandwidth, rear panel BNC: high impedance

Phase-Locked Step Mode

Sweep Width	Independently selected, 0.001 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)	0.001 Hz
Steps	User-selectable number of steps or the step size
Number of Steps	Variable from 1 to 10,000
Step Size	0.001 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 50 μs to 30 seconds

List Sweep Mode

Under remote control or via the front panel, up to 4 tables of 3 table types with 10,001 non-sequential frequency/power sets can be stored and then addressed as a phase-locked step sweep. One table type of 10,001 points is stored in volatile memory. All other tables are stored in nonvolatile memory.

Sweep Triggering

Sweep Triggering	Sweep triggering is provided for Step Frequency Sweep, and List Frequency Sweep.
Auto	Triggers sweep automatically
External	Triggers a sweep on the low to high transition of an external TTL signal AUX I/O connector or BNC, 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.
Manual (List Sweep)	GPIB GET or external TTL trigger will step to next index between start/stop indices.

Ultra-Stable Phase Tracking

Ultra-Stable Phase Tracking	Option 36 adds the rear panel BNC connectors and internal connections required to provide ultra stable phase tracking between multiple MG37020A synthesizers. Up to four instruments may be inter-connected.
100 MHz Reference Output	Provides the reference signal to drive up to three other MG37020A. All must have Option 36. This signal is only intended for use with other Option 36 instruments.
100 MHz Reference Input	Accepts the 100 MHz reference signal from another MG37020A with Option 36. This input is only intended for use with other Option 36 instruments.
Phase Drift	$< \pm 1^\circ$ over 100 seconds (typical), after 24 hours warm-up time

General

Stored Setups	Stores front panel settings on the hard disk drive. The number of stored settings is limited only by the available space on the hard disk drive. A system menu allows saving and recalling of instrument setups. Whenever the instrument is turned on, control settings return to the same functions and values as when the instrument was turned off.
Self-Test	Instrument self test is performed when the Self Test menu screen is selected. If an error is detected, an error message is shown in a window on the display, identifying the probable cause and remedy.
Parameter Entry	Instrument-controlled parameters can be entered in multiple ways: keypad, rotary data knob, the touch pads of the cursor-control key, directly on the touch screen, with an external USB keyboard, or with an external USB mouse. Controlled parameters are frequency, power level, sweep time, dwell time, and number of steps. Keypad entries are terminated by pressing the appropriate menu screen. Edits are terminated by exiting the edit menu.
Preset	Returns all instrument parameters to predefined default states or values. Any pending remote control command is aborted.
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	85 VAC to 264 VAC, 48 Hz to 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	20 kg maximum
Dimensions	H 133 mm x W 429 mm x D 450 mm
Warranty	3 years from ship date

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 Ethernet LAN, USB or 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 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 LCD.
Remote	Operating on the GPIB (All instrument front panel keys except for the RETURN TO LOCAL and the DISPLAY UPDATES soft keys 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.

Environmental

	(MIL-PRF-28800F, class 3)
Storage Temperature Range	-40 °C to +75 °C
Operating Temperature Range	0 °C to +50 °C
Relative Humidity	5 % to 95 % at 40 °C (non-condensing)
Altitude	4,600 meters, 43.9 cm Hg
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
Vibration	Random, 5Hz to 500 Hz, 0.015 to 0.0039 g ² /Hz PSD Sinusoidal, 5 Hz to 55 Hz, 0.33 mm displacement
Safety Directive	EN 61010-1: 1993 + A1: 92 + A2: 95

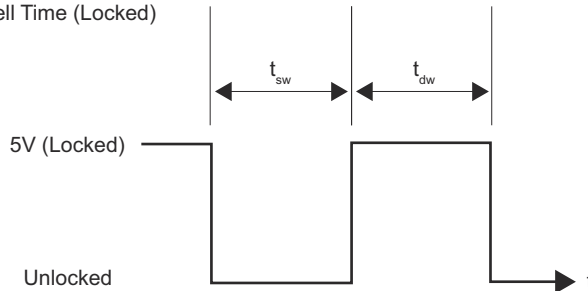
Frequency Switching Time

Free Running Mode

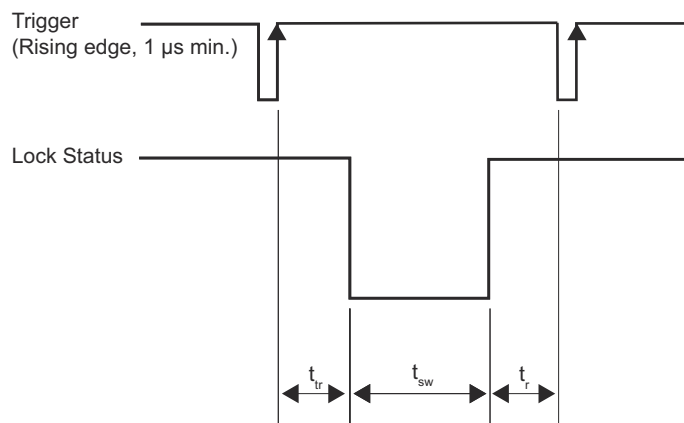
(Step or List sweep)

t_{sw} = Switching Time (Unlocked)

t_{dw} = Dwell Time (Locked)



Single Frequency Trigger Mode (Manual Trigger List Mode)



t_{tr} = Trigger Response Time 30 μs (typical)

(Applies to both remote control and external trigger)

t_r = Re-trigger Time 50 μs (minimum)

(Allows the system to program the next frequency)

Switching Time (t_{sw})

Optimum switching time will be achieved using list mode with external manual trigger, avoiding any remote programming.

Filter Switching Dwell Frequencies 3.3, 5.5, 8.4, and 13.25 GHz

Filter Switching Dwell Frequencies < 2.2 GHz (Option 4):

12.5, 15.625, 22.5, 31.25, 43.75, 62.5, 87.5, 125, 175, 250, 350, 500, 700, 1050, and 1500 MHz

t_{sw} (μsec)	Condition
<100 μsec (typical)	Step not starting at or crossing a Dwell Frequency
<500 μsec (typical)	Step starting at or crossing a Dwell Frequency

Lock Status Indicator

Rear Panel AUX I/O connector (pin 11) or Phase Locked Status BNC connector

Signal goes high when locked (within 1 MHz of final frequency).

Dwell Time (locked), t_{dw} , is user adjustable. 50 μsec is the minimum to allow the system to program the next frequency.

Spectral Purity

All specifications apply at the lesser of the maximum specified leveled output power or +10 dBm output power level, unless otherwise indicated.

Spurious Signals

Harmonic and Harmonically Related

Frequency Range	Level
10 MHz to 100 MHz (Option 4)	< -40 dBc
> 100 MHz to 2.2 GHz (Option 4)	< -50 dBc
2 GHz to 20 GHz (2.2 GHz to 20 GHz with Option 4)	< -50 dBc ^a

a. -30 dBc typical with high power Option 15

Non-harmonic

Frequency Range	Level
10 MHz to 100 MHz (Option 4)	< -40 dBc
2 GHz to 20 GHz (2.2 GHz to 20 GHz with Option 4)	< -40 dBc

Power Line and Fan Rotation Spurious Emissions (dBc)

Frequency Range	Offset from Carrier		
	< 300 Hz	300 Hz to 1 kHz	> 1 kHz
10 MHz to 500 MHz (Option 4)	< -68	< -72	< -72
> 500 MHz to 1050 MHz (Option 4)	< -62	< -72	< -72
> 1050 MHz to 2.2 GHz (Option 4)	< -56	< -66	< -66
> 2.2 GHz to 8.4 GHz	< -50	< -60	< -60
> 8.4 GHz to 20 GHz	< -46	< -56	< -60

Residual FM (CW and Step Sweep Modes, 50 Hz to 15 kHz BW)

Frequency Range	Residual FM (Hz rms)
10 MHz to 10 GHz	< 80
> 10 GHz to 20 GHz	< 80

AM Noise Floor
Sub-Harmonics

Typically < -145 dBm/Hz at 0 dBm output and offsets > 5 MHz from carrier.

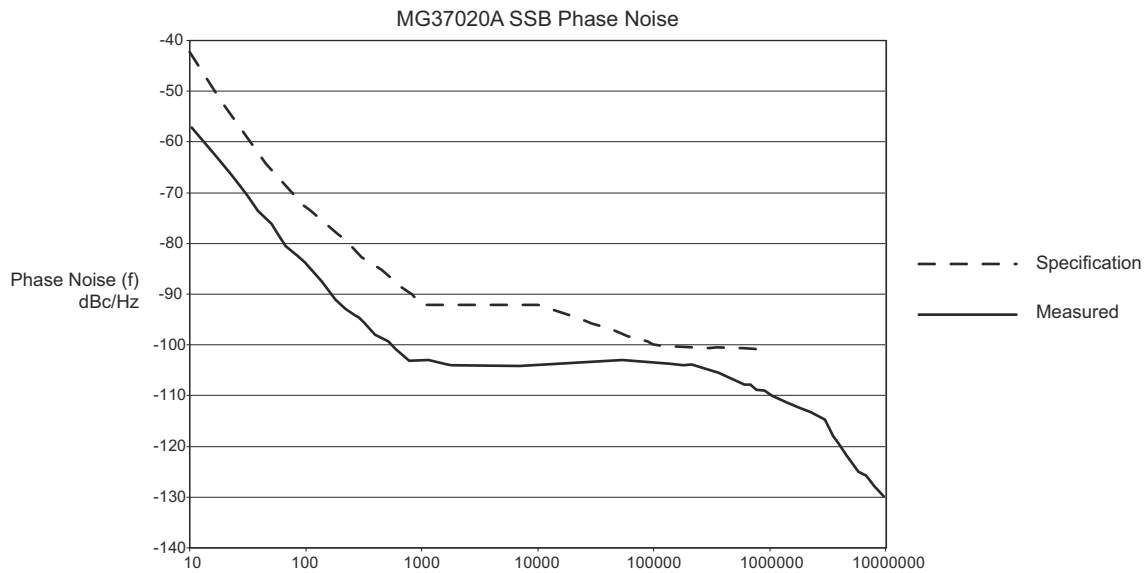
Frequency Range	Level
2 GHz to 2.5 GHz	< -30 dBc
2.5 GHz to 4 GHz	None
4 GHz to 20 GHz	< -30 dBc (typical)

Single-Sideband Phase Noise

Phase Noise is specified and guaranteed only with internal reference. In external reference mode, the phase noise of the external supplied reference and the external reference bandwidth will dictate the instrument phase noise performance. Phase noise is not degraded when adding the high power Option 15.

Single-Sideband Phase Noise (dBc/Hz, typical)

Frequency Range	Offset from carrier					
	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
10 MHz to 15.625 MHz (Option 4)	-101 (-115)	-126 (-132)	-139 (-143)	-142 (-145)	-142 (-145)	-145 (-148)
> 15.625 MHz to 31.25 MHz (Option 4)	-95 (-106)	-121 (-127)	-134 (-142)	-139 (-145)	-139 (-145)	-145 (-148)
> 31.25 MHz to 62.5 MHz (Option 4)	-89 (-96)	-116 (-122)	-129 (-140)	-135 (-145)	-137 (-145)	-142 (-150)
> 62.5 MHz to 125 MHz (Option 4)	-83 (-92)	-110 (-116)	-127 (-139)	-129 (-140)	-134 (-139)	-138 (-146)
> 125 MHz to 250 MHz (Option 4)	-77 (-89)	-104 (-113)	-123 (-133)	-123 (-137)	-128 (-134)	-132 (-144)
> 250 MHz to 500 MHz (Option 4)	-71 (-85)	-98 (-105)	-117 (-126)	-117 (-130)	-122 (-128)	-126 (-140)
> 500 MHz to 1050 MHz (Option 4)	-65 (-77)	-92 (-100)	-111 (-118)	-111 (-119)	-116 (-118)	-120 (-131)
> 1050 MHz to < 2.2 GHz (Option 4)	-59 (-70)	-86 (-95)	-105 (-112)	-105 (-117)	-110 (-114)	-114 (-122)
2 GHz (2.2 GHz with Option 4) to 6 GHz	-50 (-60)	-77 (-88)	-96 (-104)	-96 (-108)	-101 (-107)	-105 (-115)
> 6 GHz to 10 GHz	-46 (-55)	-73 (-83)	-92 (-102)	-92 (-105)	-100 (-104)	-101 (-115)
> 10 GHz to 20 GHz	-40 (-50)	-67 (-77)	-86 (-95)	-86 (-98)	-94 (-98)	-95 (-114)



Typical MG37020A Single Sideband Phase Noise at 10 GHz Carrier

RF Output

Power level specifications apply at 25 °C ± 10 °C

Maximum Leveled Output Power

Model Number	Configuration	Frequency Range	Output Power	Output Power with Option 2 Step Attenuator
MG37022A	Standard	2 GHz to 10 GHz > 10 GHz to 20 GHz	+19.0 dBm +17.0 dBm	+18.0 dBm +15.0 dBm
	Option 4	10 MHz to 2.2 GHz > 2.2 GHz to 10 GHz > 10 GHz to 20 GHz	+19.0 dBm +19.0 dBm +17.0 dBm	+18.0 dBm +18.0 dBm +15.0 dBm

Minimum Leveled Output Power

Model Number	Configuration	Frequency Range	Output Power	Output Power (dBm) with Option 2 Step Attenuator
MG37022A	Standard	10 MHz to 20 GHz	-5.0 dBm (-10.0 dBm typical)	-105.0 dBm (-110.0 dBm typical)
	High Power (Option 15)	10 MHz to 20 GHz	-5.0 dBm (-10.0 dBm typical)	-105.0 dBm (-110.0 dBm typical)

Maximum Leveled Output Power with High Power Option 15

Model Number	Configuration	Frequency Range	Output Power	Output Power with Option 2 Step Attenuator
MG37022A	Standard	2 GHz to 20 GHz	+23.0 dBm	+21.0 dBm
	Option 4	10 MHz to ≤2.2 GHz > 2.2 GHz to 20 GHz	+19.0 dBm +21.0 dBm	+18.0 dBm +19.0 dBm

Unleveled Output Power Range (typical)

- Without Step Attenuator (Option 2) > 40 dB below max settable power
- With Step Attenuator (Option 2) > 130 dB below max settable power

Power Level Switching Time (to within specified accuracy)

- Without Change in Step Attenuator (Option 2) < 100 μs typical
- With Change in Step Attenuator (Option 2) < 20 ms typical

Accuracy and Flatness

Accuracy specifies the total worst case accuracy. Flatness is included within the accuracy specification. Specification only applies to the output level from maximum leveled output power to 100 dB below maximum leveled output power.

Accuracy	± 1.0 dB
Flatness	± 0.8 dB
Accuracy and Flatness with high power (Option 15)	
Accuracy	± 1.5 dB
Flatness	± 1.5 dB

Other Output Power Specifications

Output Units	Output units are in dBm
Output Power Resolution	0.01 dB
Source Impedance	50 Ω nominal
Source VSWR (Internal Leveling)	< 2.0:1 typical
Power Level Stability with Temperature	0.04 dB/°C typical
Output On/Off	Toggles the RF output between an on and off state During the off state, the RF oscillator is turned off. The Off or On state is indicated by two LEDs located above and below the Output On/Off key on the front panel. Switching the RF on from an off state will require 1 ms for the output to be phase-locked and leveled.
RF On/Off Between Frequency Steps	System menu selection of RF On or RF Off during frequency switching in CW, Step Sweep and List Sweep modes. RF Off state will provide > 40 dB of attenuation of output power and will increase any switching time.
Internal Leveling	Power is leveled at the output connector in all modes.

Modulation**Pulse Modulation (Option 26)**

Option 26 adds pulse modulation, driven externally via a rear panel BNC connector (TTL levels) and an internal modulation waveform generator. Pulse modulation specifications apply at maximum rated power unless otherwise indicated.

On/Off ratio	> 80 dB (> 70 dB with high power Option 15)
Minimum Leveled Pulse Width	
< 100 ns	≥ 1 GHz
< 1 μs	< 1 GHz
Minimum Unleveled Pulse width	< 10 ns
Leveled 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)	50 ns in External Mode
Pulse Repetition Frequency (PRF) Range	DC to 10 MHz, unleveled 100 Hz to 5 MHz, leveled

Frequency Range	Rise and Fall Time ^a	Overshoot	Pulse Width Compression	Video Feedthrough
10 MHz to 31.25 MHz (Option 4)	400 ns typical	33 % typical	40 ns typical	± 70 mV typical
> 31.25 MHz to 125 MHz (Option 4)	90 ns typical	22 % typical	12 ns typical	± 130 mV typical
> 125 MHz to 500 MHz (Option 4)	33 ns typical	11 % typical	12 ns typical	± 70 mV typical
> 500 MHz to < 2.2 GHz (Option 4)	15 ns typical	10 %	12 ns typical	± 50 mV typical
2 GHz (2.2 GHz with Option 4) to 20 GHz	10 ns (5 ns typical)	10 %	8 ns typical	± 30 mV typical

a. Rise and Fall Time, 10 % to 90 %

External Input	Rear panel BNC
Drive Level and Input Logic	TTL compatible input, active high or active low selectable from modulation menu

Internal Pulse Generator (Included with Option 26)

Modes	Single, double, triple, quadruple
Triggers	Free-run, triggered, gated
Inputs/Outputs	Video pulse and sync out, rear panel BNC connectors

Pulse Parameter	Specification, 100 MHz Clock Rate
Pulse Width	10 ns to 10 s
Pulse Period	30 ns to 10 s
Variable Delay, Single Pulse	0 to 10 s
Variable Delay, Doublet, Triplet, Quadruplet	100 ns to 10 s
Resolution	10 ns
Accuracy	10 ns (5 ns typical)

Inputs and Outputs

Connectors may be available, but not active if the associated option is not ordered.

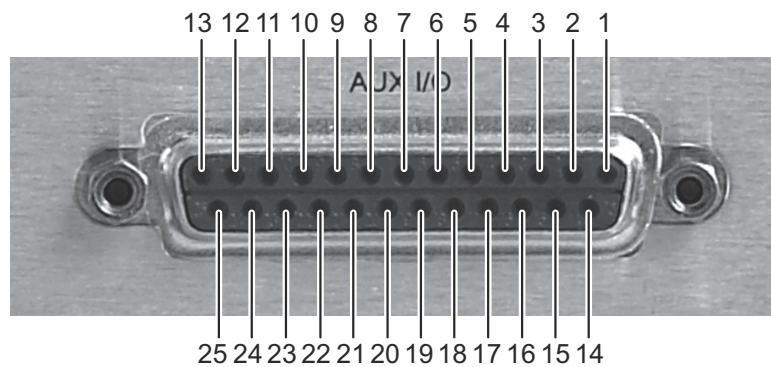
Input and Output Connections



MG37020A Rear Panel Connectors

Connector	Type	Location	Description
RF OUTPUT	K (female)	Front Panel	Provides for RF output from a 50 Ω source impedance. K Connector, female.
RF OUTPUT (Option 9)	K (female)	Rear Panel	Option 9 moves the RF output connector to the rear panel.
10 MHz REF IN	BNC	Rear Panel	Accepts an external 10 MHz \pm 100 Hz, 0 to +20 dBm time-base signal.
10 MHz REF OUT	BNC	Rear Panel	Provides a DC coupled, TTL compatible 10 MHz signal derived from internal frequency standard. 50 Ω impedance.
100 MHz REF IN (Option 36)	BNC	Rear Panel	Accepts the 100 MHz signal from an MG37020A with Option 36 for ultra stable phase tracking.
100 MHz REF OUT (Option 36)	BNC	Rear Panel	Provides the 100 MHz signal for the MG37020A Option 36 ultra stable phase tracking.
AUX I/O (Auxiliary Input/Output)	25 Pin D-type (female)	Rear Panel	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 other Anritsu instruments. (see figure below).
SERIAL I/O (Serial Input/Output)	9 Pin D-type (male)	Rear Panel	Provides access to RS-232 terminal ports.
EFC IN	BNC	Rear Panel	Provides the capability to frequency modulate the internal crystal oscillator, allowing phase locking in an external lock loop. Specifications are on page 2-2.
IEEE-488 GPIB	Type 57	Rear Panel	Provides input/output connections for the General Purpose Interface Bus (GPIB).
USB-2.0 I/O (Host)	USB type A (2 each)	Front Panel	Two type A USB connectors for USB Host interface.
USB-2.0 I/O (Host)	USB type A (2 each)	Rear Panel	Two type A USB connectors for USB Host interface.
USB-2.0 I/O (Device)	USB type B	Rear Panel	One type B connector for USB device mode.
ETHERNET (100BaseT LAN) I/O	RJ45	Rear Panel	Provides input/output connections for the LAN interface.
PULSE TRIG IN (Option 26)	BNC	Rear Panel	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 26, Pulse Modulation.
PULSE SYNC OUT (Option 26)	BNC	Rear Panel	Provides a TTL compatible signal, synchronized to the internal pulse modulation output, Option 26.
PULSE VIDEO OUT (Option 26)	BNC	Rear Panel	Provides a video modulating signal from the internal pulse generator, Option 26.
EXT TRIG	BNC	Rear Panel	Accepts an external LVTTTL compatible signal (5 V tolerant) to trigger a frequency sweep, frequency step, list sweep or the next step in a list.
LOCK STATUS OUT	BNC	Rear Panel	Provides a TTL compatible signal with a high level indicating the RF Output is phase locked and leveled.
EXT MONITOR	15 Pin VGA (female)	Rear Panel	Provides a VGA connector for the use of an external display monitor.

Aux I/O Pins



Index	Description	Index	Description
1	Horizontal Output	14	V/GHz Output
2	Chassis Ground	15	n/c
3	Sequential Sync Output	16	n/c
4	n/c	17	n/c
5	n/c	18	n/c
6	Retrace Blanking Output	19	n/c
7	n/c	20	Bandswitch Blanking Output
8	Chassis Ground	21	n/c
9	n/c	22	Horizontal Sweep Input
10	Sweep Dwell Output	23	n/c
11	Lock Status Output	24	Chassis Ground
12	n/c	25	n/c
13	External Trigger Input		

Ordering Information

Model	
MG37022A	2 to 20 GHz Fast Switching Signal Generator
Options	
MG37022A-001	Rack Mount with Slides Kit contains a set of track slides, mounting ears, and front panel handles for a standard 19 inch equipment rack.
MG37022A-011	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.
MG37022A-002	Mechanical Step Attenuator Adds a 110 dB range, 10 dB/step attenuator. RF output power is reduced.
MG37022A-004	10 MHz to 2.2 GHz RF Coverage Uses a digital down converter to significantly reduce SSB phase noise.
MG37022A-009	Rear Panel Output Moves the RF output connector to the rear panel.
MG37022A-015	High Power Adds high-power RF components to the instrument to increase the output power level.
MG37022A-017	Delete Front Panel Deletes the front panel for use in remote controlled applications. (Only available with Option 1)
MG37022A-026	Pulse Modulation Includes internal waveform generator and external input via a rear panel BNC connector.
MG37022A-035	Removable Hard Drive Provides the capability to remove the internal hard drive, and includes one replacement hard drive with instrument software.
MG37022A-036	Ultra Stable Phase Track Provides the capability for ultra-stable phase tracking between instruments using the internal 100 MHz reference.
MG37022A-037	Performance Suite For ease of ordering and package pricing, this option bundles Options 2, 4, 15, and 26.
MG37022A-088	250 μ sec Switching Speed Limit Limits the frequency switching speed to 250 μ sec to comply with United States Export Control regulations.
MG37022A-098	Standard Calibration to ISO17025 and ANSI/NCSL Z540 Provides a calibration certificate, decal, and "Calibration void if removed" tamper seals.
MG37022A-099	Premium Calibration to ISO17025 and ANSI/NCSL Z540 Provides everything included with Option 98 plus test report and uncertainty data.
Optional Accessories	
34RKNF50	DC to 20 GHz ruggedized K male to Type-N female adapter
63270	Transit case (16 kg, 65 cm x 81 cm, roll-away on two wheels)
806-97	AUX I/O cable, 25 pin to BNC: Sequential Sync, Marker Out, Bandswitch Blanking, Retrace Blanking, Sweep Dwell In, V/GHz, and Horizontal Out



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