Giga-tronics

Indirectly Synthesized

Microwave Signal Generators 50 MHz to 26 GHz

1026SWE1.MAX

Performance

Giga-tronics Microwave Signal Generators are designed to offer the performance you require for development, testing and maintenance of sophisticated EW, Radar and Telecommunications equipment. Indirect synthesis provides precise frequency control, stability and the spectral purity of fundamental oscillator outputs. The specially designed RF path modulates and controls the signal to your most exacting requirements. The integrity of your output signal is assured by microprocessor characterization and control of precision components throughout the system.

Reliability

Approximately 1 thousand Model 1026, 1018 and Series 900 instruments have been put into use throughout the world over the past 3½ years. Each instrument, prior to shipment, is aged in excess of 100 hours at 45°C and must pass stringent environmental testing for specification compliance from 0 to 50°C to insure high field reliability. Analysis of field failure records indicate that they have achieved a MTBF figure in excess of 10,000 hours, a phenominal reliability statistic for an instrument of such complexity.

Economy

The Giga-tronics line of Microwave Signal Generators lets you buy the instrument that most economically meets your requirement. The Models 1026 and 1018 can measure external microwave frequency (both CW and pulsed) and power, in addition to generating precise microwave signals. This eliminates the need for additional frequency counters and power meters in many R & D and maintenance applications. The Series 900 allows you to select only the frequency coverage your system requires, no need for broad-band coverage to accommodate narrow-band requirements.

A broad variety of options lets you further tailor the cost of the instrument to just the features that you require.

Indirect Synthesis

Giga-tronics uses a microprocessor controlled two-loop indirect synthesis technique to control frequency, stability and signal purity of the output signals from fundamental YIG oscillators. This technique phase locks the YIG output to a high stability 10 MHz crystal oscillator to provide the optimum combination of precise frequency control, switching speed and spectral purity for the most critical applications. No frequency multipliers are used. Fundamental YIG oscillator outputs cover the bands of 2 to 8, 8 to 12, 12 to 18 and 18 to 26 GHz. The 2 to 8 and 8 to 12 GHz bands are used in a down-converter mode to supply equally stable output frequencies below 2 GHz. For frequency coverage to 60 GHz consult the Giga-tronics Series 800 Frequency Extender brochure.

The RF Path

The design of the RF path determines the ultimate useability of any microwave signal generator. Between the YIG oscillator and the output connector the signal must be coupled (to control the synthesizer), leveled, modulated, filtered and attenuated. Proper design of the RF path avoids loss of useable output power, unacceptable harmonic content, excess video feed-through and general loss of signal integrity.

Optimum control of the signal is attained in Giga-tronics signal generators by accomplishing virtually all functions in specially designed modules within the leveling loop. Coupling, leveling, fine attenuation, pulse or amplitude modulation and filtering are combined in a special module for each frequency band. The solid-state output switch then switches the signal to the output connector through the leveling detector

and the 10 dB step attenuator. Clean, high powered, fully controlled signals are delivered to the unit you are testing.

Spectral Purity

Spectral purity determines the adaptability of a microwave signal generator to applications involving the testing of surveillance receivers, Doppler radars and many other sensitive devices. The design of Giga-tronics signal generators assures their applicability to these requirements.

Careful attention to details of instrument construction and individual band filtering within the leveling loop provides supression of both harmonic and spurious (non-harmonic) signals to <-55 dBc (typically <-65 dBc) throughout the frequency range of each instrument.

The indirect synthesis technique employed in Giga-tronics signal generators requires variation of loop gains, dependent on the output frequency being generated. This design has the further effect of varying the single sideband phase noise characteristic with variation of output frequency. The phase noise characteristics shown in chart 1 are worst-case figures. At many frequencies within a given band, phase noise characteristics will be as much as 10 dB better than the figures shown.

Chart 1:

Frequency Range (GHz)	Offset from Carrier 100Hz	1kHz	10kHz	100kHz
.05-2	-77	-80	-75	-100
2-8	-78	-80	-78	-102
8-12	-75	-77	-75	-100
12-18	-72	-74	-79	-95
18-26	-70	-72	-75	-95

Worst-case SSB Phase Noise (dBc/Hz Noise Bandwidth, CW mode), any instrument with High Stability Time Base (Option 06)

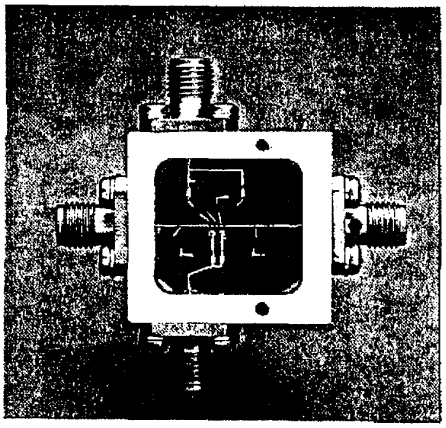
Complex Signal Simulation

Many microwave signal generator applications such as pulsed radar performance verification and testing of warning receivers require that the RF signal be modulated to simulate dynamic operating conditions.

Giga-tronics signal generators offer a full range of modulation capabilities to assure their adaptability to your most stringent simulation requirements. Each instrument features internal pulse modulation capability, eliminating the need for additional pulse generators in many applications. Instruments to 18 GHz may be externally amplitude modulated. Both of these functions are accomplished in the specially designed modules within the leveling loop of the RF path. High deviation (20 MHz, p-p) FM is offered as an option.

The Scan Modulator

The scan modulator option provides a powerful tool for complex signal simulation. A PIN diode attenuator inserted between the leveling loop and the output attenuator allows simultaneous, independent pulse and amplitude modulation of the RF signal. Its two modes of operation, DC coupled Scan to depths of 40 dB and AC coupled AM to depths of 90%, together with the standard pulse modulation capability of the instrument offer unlimited possibilities for complex signal simulation.



Scan Modulator Module

Output Power

Accurately controlled and calibrated output power is perhaps the most important single characteristic of a good microwave signal generator. Giga-tronics signal generators provide high powered (to +10 dBm) outputs designed to deliver sufficient test signal power to the device being tested through the sometimes complex switching paths of ATE systems. Of more importance, this output power is leveled and controlled and accurate to levels of <-100 dBm to satisfy the most stringent requirements of in-channel tangential sensitivity testing.

Prior to shipment, each instrument is completely characterized and correction factors are stored in permanent memory to automatically compensate the output power for variations in the output detector, attenuator, etc. across the entire frequency range. Figure 2 shows a composite plot of maximum available power and leveled output power from a typical Giga-tronics signal generator.

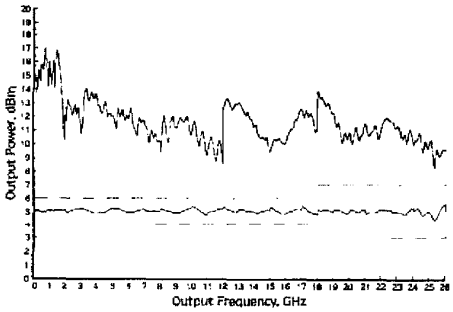


Figure 2: A composite plot of maximum available power and leveled output power from a typical Giga-tronics Model 1026. Dotted lines indicate specified accuracy and flatness tolerance of leveled output.

Sweep Operation

To further enhance the adaptability of Giga-tronics signal generators to the requirements of your application, each instrument has two modes of frequency sweep operation; digitally controlled continuous or step and lock. In the latter mode a frequency lock is attained at each step before continuing on to the next. Under control of the microprocessor the instrument may be swept between any two frequencies within its range. For faster (10 msec per band) analog sweep operation consult the Giga-tronics Series 910 Synthesized Sweeper brochure.

Output Cable Calibration

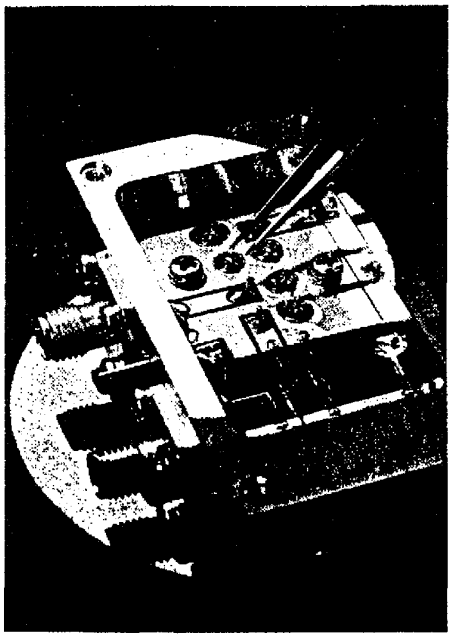
Good signal generators all deliver accurate power levels to the output of the generator. But, the cable carrying the signal to the unit being tested always exhibits varying loss characteristics over the frequency range. The unique combination of sweep operation, external power measurement capability and microprocessor control found in Giga-tronics signal generators has enabled us to provide an automatic routine whereby the cable of interest is swept across the entire frequency range and its loss factors are recorded in internal memory. Subsequent to this calibration run, the signal generator recalls these factors and compensates the output power to deliver accurate, calibrated power at the output end of the cable.

SERIES 1000 MICROWAVE TEST SETS

Model Number	Frequency Range	Maximum Leveled Output
1026	.05 to 26 GHz	+5 dBm
1018	.05 to 18 GHz	+3 dBm

SERIES 900 MICROWAVE SIGNAL GENERATORS

Model Number	Frequency Range	Maximum Leveled Output
to 26 GHz		
900/18-26	18 to 26 GHz	+5 dBm
900/12-26	12 to 26 GHz	
900/8-26	8 to 26 GHz	
900/2-26	2 to 26 GHz	
900/.05-26	.05 to 26 GHz	
to 18 GHz		
900/12-18	12 to 18 GHz	+5 dBm
900/8-18	8 to 18 GHz	+3 dBm
900/2-18	2 to 18 GHz	
900/.05-18	.05 to 18 GHz	
to 12 GHz		
900/8-12	8 to 12 GHz	+5 dBm
900/2-12	2 to 12 GHz	+3 dBm
900/.05-12	.05 to 12 GHz	
to 8 GHz		
900/2-8	2 to 8 GHz	+5 dBm



Specifications

Except as noted, the following specifications apply to all models.

FREQUENCY SYNTHESIZER

Frequency Characteristics
- Range: See Model No. Chart
- Resolution: 1 MHz (1 kHz with Option 03)
- Accuracy and Stability: Same as Time Base
- Time Base (Internal): 10 MHz, $<1 \times 10^{-6}$/year rate ($<1 \times 10^{-9}$/day with Option 06)
- Time Base (External): 10 MHz (5 MHz with Option 11) $\pm 1 \times 10^{-6}$ or better; 0.5 to 5V, p-p, overrides internal time base
- Time Base Output: Buffered 10 MHz, 2V, p-p, into 50 ohms, derived from internal or external time base

Spectral Purity
- Harmonics, Subharmonics: <-55 dBc
- Spurious (Nonharmonics): <-55 dBc

RF Output Characteristics
- Max Leveled Output: See Model No. Chart
- Accuracy: ± 1 dB to 18 GHz; ± 2 dB to 26 GHz
- Attenuation: 119 dB in 0.1 dB steps (Instruments to 18 GHz) 99 dB in 0.1 dB steps (Instruments to 26 GHz)
- Vernier Level Adjustment: -5 dB to +15 dB
- Source Impedance: 50 ohms, nominal

Sweep Operation
- Method: Digitally controlled continuous or step and lock
- Mode: Automatic recycle, single sweep or single step
- Range: Selectable over entire frequency range of the instrument
- Increments: Selectable 1, 10 or 100 MHz
- Sweep Time: Variable from 10 msec to 100 sec
- Sweep Rate: Typically 50 MHz/msec, max
- Sweep Trigger Input: TTL low to initiate single sweep or single step
- Ramp Output: 0 to +10V, proportional to frequency between any preset limits, any sweep mode
- Pen Lift Output: TTL low during retrace

Pulse/Square Wave Modulation
- Repetition Rate: Variable, 10 Hz to 50 kHz with calibrated 1 kHz point
- Pulse Width: Variable, 0.1 to 10 μsec with calibrated 1 μsec point
- On/Off Ratio: >60 dB (Instruments to 18 GHz) >30 dB (Instruments to 26 GHz)
- Rise/Fall Times: <25 nsec
- Overshoot, Undershoot and Ringing: ± 2 dB, max
- Settling Time: ± 1 dB within 100 nsec
- Sync Output: TTL level modulation waveform
- External: TTL level signal, 10 Hz to 1 Mhz 0.1 μsec min width, rising or falling edge triggering

External Amplitude Modulation (Model 1018 and Series 900 instruments to 18 GHz)
- Frequency Response: 10 Hz to 5 kHz at 3 dB points referenced to 1 kHz
- Modulation Depth: 0 to 20 dB
- Input Required: 1V, p-p, for 50% modulation at 1 kHz
- Input Impedance: 500 ohms, AC coupled
- Waveform: Any

FREQUENCY COUNTER (Models 1026 and 1018 only)

Measurement Characteristics
- Mode: CW or Pulsed RF
- Range: 100 MHz to max frequency of instrument
- Sensitivity: typically -30 dBm
- Impedance: 50 ohms, nominal
- Resolution: Direct, 100 Hz; Offset, 10 Hz
- Time Base: Same as Frequency Synthesizer
- Offset Range: ± 500 MHz
- Minimum Pulse Width (Pulsed RF Measurement): 0.5 μsec

POWER METER (Standard on Models 1026 and 1018, Option 09 for Series 900)

Measurement Characteristics
- Frequency: 50 MHz to 26 GHz
- Range (External): -30 to +10 dBm
- Accuracy: ± 1 dB (-10 to +10 dBm), ± 2 dB (-30 to -10 dBm)
- Resolution: 0.1 dB
- Power Meter Output: 0.5V/dBm, nominal (+10V at +10 dBm and -10V at -30 dBm into 2 kohms, min)

Standard Options

Frequency Options
- 02: No .05 to 2 GHz band (Model 1026 or 1018)
- 03: 1 kHz Resolution
- 06: High Stability Time Base: 1 X 10^{-9}/day
- 11: 5 MHz External Time Base Input
- 12: 12 GHz max frequency (Model 1026 or 1018)
- 18: 18 GHz max frequency (Model 1026)

Output Power Option*
- 10: High Output Power; +7 to +10 dBm, dependent on modulation requirements (consult factory for details). Available in individual frequency bands: 2-8, 8-12, 12-18 and 18-26 GHz

Interface Options
- 04: RS-232 in lieu of standard IEEE-488
- 13: MATE (CIIL) Interface in addition to standard IEEE-488 (Frequency Synthesizer parameters only on Models 1026 and 1018)
- 14: Control Bus for Frequency Extenders

Power Measurement Option (for Series 900)
- 09: Ext Power Measurement and Cable Cal Feature

Modulation Options
- 07: Scan Modulation (see below)
- 15: Frequency Modulation
  - Deviation: 20 MHz, p-p, 10 Hz to 100 kHz rates; 10 MHz, p-p, 100 kHz to 250 kHz rates
  - Frequency Response: +3 dB, 10 Hz to 1 MHz
  - Sensitivity: 3V, peak, for max deviation
  - Distortion: <5% at 1 MHz peak deviation and 100 kHz rate
  - Incidental AM: <5%
  - Input Impedance: 50 ohms, nominal

*Harmonic specification may degrade at output levels in excess of 0 dBm

Scan Modulation

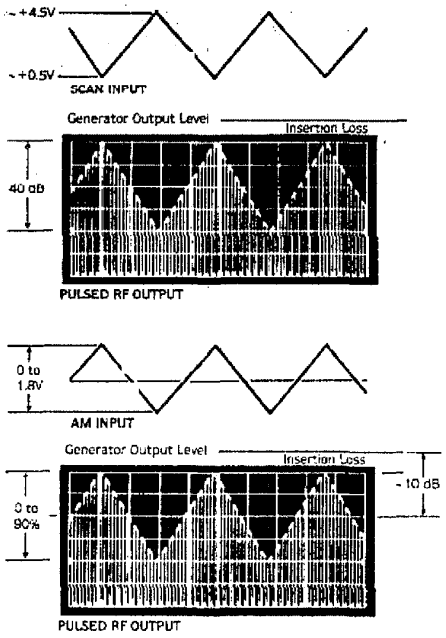
Available for Model 1018 and Series 900 Instruments to 18 GHz

Modes of Operation
- OFF: Normal CW or Pulse Modulated operation. Generator RF power settings are valid.
- SCAN: Scan Modulated CW or Pulsed RF operation. Modulator insertion loss must be subtracted from generator RF power setting.
- AM: Amplitude Modulated CW operation. RF output level is automatically set ~10 dB below generator RF power setting

Modulator Insertion Loss: 5 dB, max; 3 dB, typical

SCAN MODE
- Dynamic Range: 40 dB, min (~-5 to -45 dB below set output level)
- Linearity (Cal points are 1, 5, 10 and 15 GHz): ± 0.6 dB (0 to 20 dB), ± 1 dB (20 to 50 dB)
- Frequency Response: DC to 20 kHz (Sine Wave)
- Rise or Fall Time Response to Step Input: .0 μsec (typically 6 μsec) up to 40 dB step
- Delay Time: 5 to 6 μsec, typical
- Input Sensitivity: 0.1V/dB (10 dB/V): ~ +0.5V is insertion loss level, +5V is 50 dB depth
- Input Impedance: 45 kohms nominal, DC coupled

AM MODE
- Modulation Depth: 0 to 90%
- RF Output Level: ~10 dB below generator setting
- Total Harmonic Distortion: 5%, max (2%, typical) at 80% modulation; 10% max (5%, typical) at 30% modulation
- Input Sensitivity: 1V, p-p, for 50% modulation at 1 kHz
- Input Impedance: 22.5 kohms, nominal, AC coupled



General Specifications

Display: Frequency, 9 digits; Power, 3 digits
Remote Interface: IEEE STD 488-1978 (RS-232 by Option 04) - All front panel controls and readouts except variable modulation rate and width.
Operating Temperature Range: 0 to 50°C
Warm-up Time (to meet all specifications): 20 minutes, max
Environmental: Complies with MIL-T-28800B, Type III, Class 5, Style E
Power: 100/120/220/240 VAC ±10%, 50-400 Hz, 250 W
Weight and Dimensions:

	Net	Packed for Air Shipment
Width:	16.75 in. (42.5 cm)	24 in. (60.9 cm.)
Depth:	24 in. (60.9 cm.)	31 in. (78.7 cm.)
Height:	5.25 in. (13.3 cm.)	11.25 in. (28.6 cm.)
Volume:	1.22 cu. ft. (.0345 cu. m.)	4.84 cu. ft. (.1372 cu. m.)
Weight (Nom):	65 lbs. (29.6 kg.)	80 lbs. (36.3 kg.)

Accessories Included

1 ea. Operation and Maintenance Manual
Model 1026, Pt. No. 104AM01100
Model 1018, Pt. No. 103AM00300
Series 900, Pt. No. 105AM02600
1ea. Extender Board Service Kit, Accessory No. A006
1 ea. Power Cord, 6 ft., Pt. No. WMPO-03006

Available Accessories

Cable Kit, Accessory A001
Rack Mt. with Chassis Slides, Accessory No. A002
Rack Mt. with no Chassis Slides, Accessory No. A003

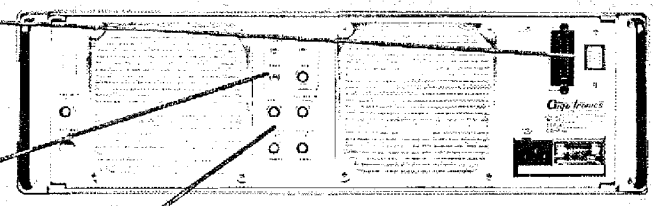
Special Configurations

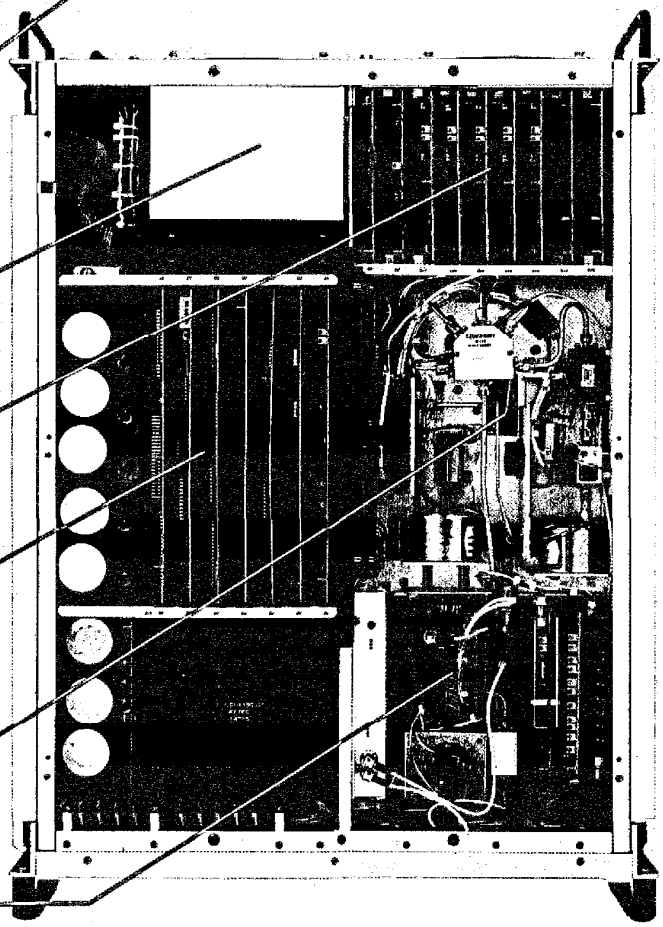
Giga-tronics has designed its line of synthesized signal generators and their options to provide the flexibility to most economically meet your microwave testing requirements. We realize, however, that in many instances equipment needs to be specially modified or configured to best adapt it to the application. Often, in ATE applications, these special requirements do not become apparent until system integration is well underway. We, at Giga-tronics, willingly work with you, both before and after the sale, to assure the compatibility of our signal sources to your requirement in the most economical way.

All Giga-tronics signal generators may be controlled via the IEEE-488 Bus (standard) or RS-232 Interface (Option 04). Optional parallel interface bus to frequency extenders is also available.

External ALC is provided to allow remote leveling with a standard negative output diode type detector, including adjustments for gain and offset calibration of the detector.

Internal time base output, external time base input, a pen lift signal during sweep retrace or hold and a phase-lock loop reference input for controlling frequency from an external source are standard on all models.





DC power for the instrument is provided by regulated power supplies housed in a heat sink assembly directly in the exhaust path of the cooling fan. Average internal temperature rise above ambient is maintained at less than 6°C.

The microwave electronics; the phase-lock loops and individual YIG drivers are packaged on separate, easy-to-service plug-in circuit assemblies.

The computer section processes information from the front panel or the interface bus to control the operation of the entire instrument.

The microwave deck contains the YIG oscillators and the specially designed coupling, leveling, modulating and switching modules connected through precision semi rigid cabling.

Internal pulse modulation and leveling loop control are provided by plug-in PC assemblies and the 10 dB step attenuator delivers the RF signal to the output connector.

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