

GT 9000 GT 9000S MICROWAVE SYNTHESIZER & SWEEPER

Now you can get the performance you need and the capability you want, at a price you can afford.

Both the Giga-tronics GT9000 Microwave Synthesizer and the GT 9000S Synthesized Microwave Sweeper give you better performance from 10 MHz to 20 GHz than competitive instruments costing thousands of dollars more.

This unequalled combination of high performance and low price is the result of an innovative *single* RF module and unique new filtering

techniques. Together, these engineering breakthroughs yield higher performance, greater reliability and better serviceability. And the single module is less expensive to manufacture and test, resulting in a lower price.

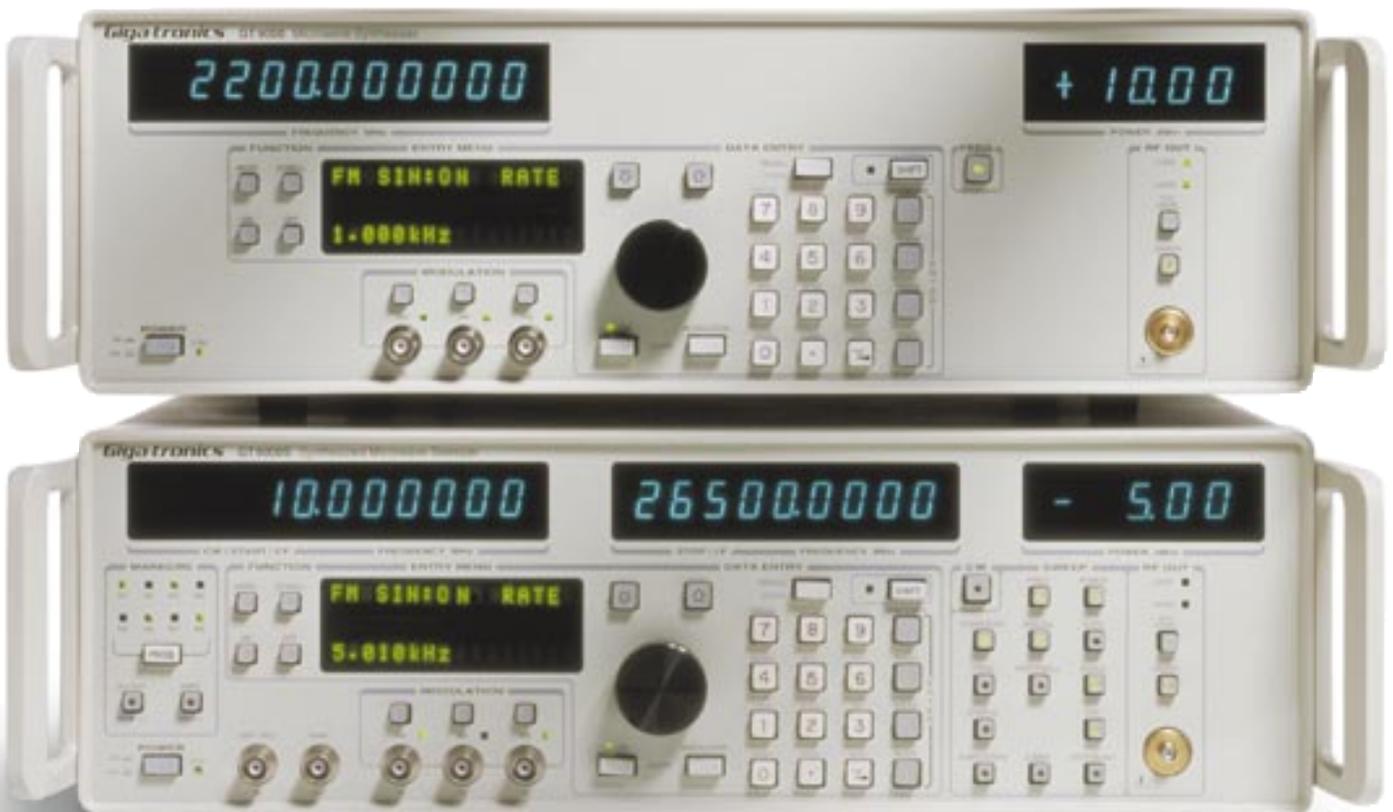
So now you can get a microwave synthesizer or sweeper with outstanding performance, capability and reliability at an incredibly low price.

Consider the characteristics of the GT 900 Synthesizer and GT 9000s Synthesized sweeper.

PERFORMANCE

The GT 9000 and GT 9000S give you a choice of frequency ranges. For most general purpose microwave applications, our 2 to 20 GHz models are ideal. Because more and more test applications require signals below 1 GHz, you may prefer the models with coverage from 500 MHz to 20 GHz. And if you need even lower frequencies, choose our 10 MHz to 20 GHz models.

Measuring critical narrow-band characteristics such



The GT 9000 and GT 9000S give you outstanding performance and proven reliability at an incredibly low price.

as adjacent channel sensitivity requires low phase noise. So phase noise at 2 GHz is -125 dBc/Hz at 100 kHz offset. And it's equally impressive across the full range of the instrument.

Output power is +13 dBm or greater from 10 MHz to 20 GHz. That's enough to overcome most system losses without adding the signal degradation and extra cost of external power amplifiers.

And with harmonics less than -65 dBc at +6 dBm, you can accurately test over a wide bandwidth with complete confidence that the measurements you make are a result of the system under test, and not your synthesizer.

CAPABILITY

The GT 9000 and GT 9000S both come with standard internal pulse modulation. You can add internally generated AM and FM, eliminating the need for costly external generators. And for really complex patterns, both offer fast scan modulation with 60 dB depth.

The GT 9000S Sweeper adds digital and analog sweep of both frequency and power, yet maintains all the perfor-

mance characteristics of the synthesizer.

If you need speed, the GT 9000S gives you analog sweep speeds up to 600 MHz and 1 dB per ms. If you need precision, you select digital sweep for precise 1 Hz and 0.01 dB steps from 1 ms to 200 s. And you can use frequency and power sweep individually, alternately or simultaneously.

Select from 5 sweep modes with up to eight markers. And be assured of compatible operation with analyzers from all major manufacturers, including the Giga-tronics 8003 Scalar Analyzer.

RELIABILITY

Giga-tronics has an 18 year history of building test and measurement gear for the most demanding requirements. We've shipped thousands of microwave test instruments to commercial and military customers for use in radar testing, electronic warfare, satellite and telecommunications systems.

So you're assured of reliable operation, even under less than ideal situations.

All specifications apply to the GT 9000 and GT 9000S, unless indicated otherwise.

ORDERING INFORMATION

MODEL NUMBERS AND FREQUENCY RANGES:

Model Number	Frequency Range	Product Type
GT 9000/.01 – 20	10 MHz to 20 GHz	Synthesizer
GT 9000/.5 – 20	500 MHz to 20 GHz	Synthesizer
GT 9000/2 – 20	2 GHz to 20 GHz	Synthesizer
GT 9000S/.01 – 20	10 MHz to 20 GHz	Synthesized Sweeper
GT 9000S/.5 – 20	500 MHz to 20 GHz	Synthesized Sweeper
GT 9000S/2 – 20	2 GHz to 20 GHz	Synthesized Sweeper

AVAILABLE OPTIONS:

- Option 16: Provides 1 Hz resolution throughout the frequency range.
 Option 22: Moves the RF Output Connector from the instrument's front panel to its rear panel. This option may decrease maximum output power by as much as 2 dB.
 Option 24: Provides built-in function generators for generating AM and FM.
 Option 26: Provides a 110 dB built-in attenuator, in 10 dB steps.
 Option 27: Provides scan modulation and linear AM.
 Option 28: Provides high stability time base: $<5 \times 10^{-10}$ /day

AVAILABLE ACCESSORIES:

- Accessory A001: Cable kit consisting of 2 low loss cables (18 and 72 inch lengths) and 2 output connector adapters (F-F and M-F).
 Accessory A002: Instrument configured for standard rack mounting with chassis slides.
 Accessory A003: Instrument configured for standard rack mounting without chassis slides.
 Accessory A006: Extra extender board service kit (one furnished standard with each instrument).
 Accessory A010: Extra operation and/or maintenance manuals (one furnished with each instrument; specify type of manual when ordering).
 Note: See current Giga-tronics price list for possible new option and/or accessory availability.

CW OPERATION

- Range: 0.01, 0.5 or 2 to 20 GHz (see Ordering Information)
 Resolution: 1 kHz (1 Hz with option 16)
 Accuracy and Stability: Identical to time base oscillator
 Time Base (Internal): 10 MHz
 Aging Rate: $<1 \times 10^{-9}$ /day after 72 hours of continuous operation; $<5 \times 10^{-10}$ /day (with option 28)
 Temperature Stability: $<\pm 2 \times 10^{-10}$ /°C (0 to +50°C)
 Time Base (External): 5 MHz or 10 MHz ($\pm 1 \times 10^{-6}$ or better), user selectable from the front panel or via GPIB.
 Switching Time: <50 ms (20 ms, typically) to within specified frequency accuracy

RF OUTPUT POWER

Maximum Levelled Output:

Frequency (GHz)	Standard Without Attenuator (dBm)	Optional (option 26) With Attenuator (dBm)
0.1 to 2.0	+13	+13
2.0 to 8.0 ¹	+15	+15
8.0 to 15.0	+14	+13
15.0 to 20.0	+13	+11

Incremental Level Range: -20 to +20 dBm

Resolution: 0.01 dB, entry and display to -99.99 dBm (display is 0.1 dB at ≤ -100.0 dBm)

Minimum Output Level: -10 dBm (-20 dBm typical); -120 dBm with Option 26

RF Off: Typically attenuates a 0 dBm signal to <-140 dBm at the output connector

Output Accuracy (Internally levelled, CW or frequency sweep mode, SCAN/Linear AM off):

± 2 dB (-10 to maximum specified power output), add ± 0.1 dB/10 dB of attenuation with attenuator (Option 26)

Output Flatness: ± 2 dB

Output Switching Time: Typically <1 ms (20 ms with attenuator change—Option 26 only)

Output Impedance: 50 Ω , nominal

Output SWR: $<2:1$

External Leveling: Output power may be externally levelled by positive or negative ZBS detectors or power meters

SPECTRAL PURITY

Harmonics measured at +6 dBm:

<-65 dBc, 2 to 20 GHz; <-50 dBc, 0.1 to 2 GHz;

<-40 dBc, 0.01 to 0.1 GHz

Subharmonics: None

Nonharmonics: <-55 dBc

SSB Phase Noise (dBc/Hz, CW Mode, All Power Levels):

Frequency (GHz)	Offset from Carrier				
	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
0.5	-97	-95	-95	-127	-135
2.0 ²	-90 (-83)	-91 (-85)	-90 (-84)	-125 (-118)	-130 (-130)
6.0	-80	-83	-81	-115	-130
10.0	-75	-80	-80	-105	-128
20.0	-72	-75	-75	-105	-120

Residual FM (Hz, rms; CW Mode):

Frequency Range (GHz)	Post-detection Bandwidth	
	0.3 to 3 kHz	0.05 to 15 kHz
0.01 to <0.5	10	75
0.5 to 2.0	5	25
>2.0 to <8.0 ¹	20	100
8.0 to 20.0	30	300

¹ Specifications applies from 2 GHz for models GT 9000/2 and GT 9000S/2-20.

² Specifications in parentheses are for models GT 9000/2-20 and GT 9000S/2-20.

MODULATION PARAMETERS AND OPERATIONAL MODES

Modulation specifications apply in the CW mode, and are operable in the sweep modes. Option 24 provides two functions generators for internally generating amplitude and frequency modulation envelope waveforms. Option 27 provides scan modulation plus linear AM.

PULSE / SQUARE WAVE MODULATION (PM)

Specifications apply with Scan/AM and FM off. PM may be operated simultaneously with Scan/AM and FM.

PM Envelope Parameters

- On/Off Ratio: >80 dB
- Rise/Fall Times: <10 ns
- Overshoot, Undershoot and Ringing: ± 2 dB, maximum
- Settling Time (to within 1 dB): <100 ns
- Leveled Pulsed Output Power (Referenced to leveled CW output power): ± 0.5 dB, typical ≥ 100 ns pulse width; ± 1 dB typical, at <100 ns pulse width

Internally Generated PM Envelope

- Repetition Rate: 1 Hz to 3 MHz
- Repetition Rate Resolution:

Range	Resolution
1 Hz to 1 kHz	1 Hz
1 kHz to 10 kHz	10 Hz
10 kHz to 100 kHz	100 Hz
100 kHz to 1 MHz	1 kHz
1 MHz to 3 MHz	10 kHz

Accuracy: $\pm 0.02\%$ of range maximum value

Jitter: Same as instrument time base

Pulse Delay (Referenced to sync output)

Range: 0 to 2 s

Resolution: 10 ns

Accuracy: $\pm 1\%$ of setting or 20 ns, whichever is greater

Jitter: 0.01% of setting or 100 ps, whichever is greater

Pulse Width:

Range: 50 ns to 2 s

Resolution: 10 ns

Accuracy: $\pm 1\%$ of setting or 20 ns, whichever is greater

Jitter: 0.01% of setting or 100 ps, whichever is greater

Externally Triggered PM Envelope

One PM envelope produced by each trigger supplied.

Repetition Rate: 5 Hz to 5 MHz

Pulse Delay: Set by internal delay control

Pulse Width: Set by internal width control

Input Trigger Required: Positive or negative-going TTL level trigger pulse, >25 ns wide

Externally Generated PM Envelope

One PM envelope produced by each pulse supplied.

Repetition Rate: 5 Hz to 5 MHz, leveled output; dc to 10 MHz, unleveled output

Pulse Delay (Output envelope leading edge referenced to input pulse leading edge): 50 ns, typical

Input Pulse Required: Positive or negative-going TTL level pulse, ≥ 50 ns wide (leveled output); ≥ 20 ns wide (unleveled output)

AMPLITUDE MODULATION (AM)

Specifications apply when Option 27 is not installed. AM may be operated simultaneously with FM.

AM Envelope Parameters

- Modulation depth: 0 to 90%, typical at 0 dBm output power
- Modulation bandwidth: dc to 30 kHz, ± 3 dB, typical at 0 dBm out
- Input sensitivity (AM depth vernier set to 100%): 1 V_{p-p}, for (50 \pm 10)% depth, at 1 kHz rate

Internally Generated AM Envelope (Option 24)

Waveform: Sine, square or triangle wave

Rate: 1 Hz to 100 kHz

Accuracy: ± 0.01 Hz

SCAN/LINEAR AMPLITUDE MODULATION (Option 24)³

Scan/Linear AM may be operated simultaneously with FM and PM (May degrade the maximum output level by as much as 2 dB when not activated, and by as much as 7 dB when activated).

Envelope Parameters

Scan Mode:

Range: 0 to 60 dB

Sensitivity: -10 dB/V

Step response: <1 μ s for 50 dB change

Frequency response: dc to 150 kHz sine wave

Linearity (at cal points): ± 0.6 dB (0-20 dB), 1 dB (20-60 dB)

Input impedance: 50 Ω , nominal

Linear AM Mode:

Depth: 0 to 90%

Frequency response: 10 Hz to 50 kHz, ± 3 dB BW

Input sensitivity: 1 V_{p-p} for 50%, $\pm 10\%$ depth at 1 kHz

Input impedance: 50 Ω , ± 10 Ω

Internally Generated Scan/Linear AM Envelope (Option 24)

Same as specifications as internally generated AM envelope.

FREQUENCY MODULATION (FM)

Specifications apply with Scan/AM and PM off. FM may be operated simultaneously with Scan/AM or PM.

FM Envelope Parameters

Max Deviation (Wide Mode): 10 MHz, peak, at >2 GHz; 2.5 MHz, peak, at ≤ 2 GHz

Flatness: ± 2 dB for rates from 10 Hz to 1 MHz; ± 3 dB from 1 to 5 MHz

Residual FM (50 Hz to 15 kHz post-detection bandwidth): 0.01 to 2 GHz, <750 Hz; >2 GHz, <3 kHz¹

Max Deviation (Narrow Mode): The lesser of $100 \times F_{\text{mod}}$ or 10 MHz, peak, at >2 GHz¹; the lesser of $25 \times F_{\text{mod}}$ or 2.5 MHz, peak, at ≤ 2 GHz

Flatness: ± 2 dB for rates from 20 kHz to 1 MHz; ± 3 dB from 1 to 5 MHz

Residual FM: Same as CW

Readout: 6 digits

Accuracy: $\pm 5\%$ at maximum deviation, 1 kHz modulation rate

Distortion: <5%

Incidental AM: $\leq \pm 0.2\%$ /MHz of deviation

¹ Specifications applies from 2 GHz for models GT 9000/2 and GT 9000S/2-20.

³ Standard AM is not available with Option 27.

Internally Generated FM Envelope (Option 24)

Waveform: Sine, square or triangle wave
 Rate: 10 Hz to 1 MHz
 Resolution: 1 Hz
 Accuracy: ± 0.01 Hz
 Deviation increments: 625 Hz, ≤ 2 GHz; 2.5 kHz, > 2 GHz¹

Externally Supplied FM Envelope

Waveform: Any waveform compatible with bandwidth considerations
 Rate: 10 Hz to 5 MHz
 Sensitivity: 1 V, peak, for maximum deviation
 Input Impedance: 50 Ω , nominal
 Deviation increments: 625 Hz, ≤ 2 GHz; 2.5 kHz, > 2 GHz¹

ANALOG FREQUENCY SWEEP (GT 9000S)

Continuous sweep, self-generated within the instrument, phase-lock corrected at each start and at band crossings. May be operated simultaneously with digital or analog power sweep.

Sweep Range: Minimum to maximum frequency of the instrument
 Sweep Time (Any Sweep Mode): 2 ms to 200 s, minimum sweep time is determined by the sweep width and the maximum sweep speed

Range	Resolution
2 ms to 20 ms	10 μ s
20 ms to 200 ms	100 μ s
200 ms to 2 s	1 ms
2 s to 20 s	10 ms
20 s to 200 s	100 ms

Minimum Sweep Width: 1 MHz
 Maximum Sweep Speed: 600 MHz/ms
 Band Crossing Dead Time (at 2 and 8 GHz): 50 ms, nominal
 Sweep Width Resolution (Any sweep mode): 0.1% of sweep width
 Start Frequency Accuracy (Any sweep mode): ± 0.5 MHz
 Sweep Linearity (Relative to a linear RAMP OUT voltage, sweep time ≥ 100 ms, any sweep mode): $\pm 1\%$ of sweep width or ± 50 MHz, whichever is less

Sweep Modes:

START/STOP: Sweeps up or down from a preset start frequency to a preset stop frequency
 START/ Δ : Sweeps up or down from a preset start frequency through a preset sweep width
 CTR/ Δ : Sweeps up or down through a preset sweep width centered symmetrically about a preset center frequency
 Δ /MKR: Sweeps up or down from any preset marker to any other preset marker

Sweep Functions: AUTO, SINGLE, EXT, and STOP/RESET

Frequency Markers: Eight intensity or amplitude markers, individually selected — manual or GPIB

Resolution: Sweep width/4,000

Accuracy: Same as sweep linearity except the marker may vary ± 25 mV relative to the linear 0 to +10 V RAMP OUT

Amplitude Markers: Approximately -3 dB change in RF output power during analog frequency sweep markers

DIGITAL FREQUENCY SWEEP (GT 9000S)

A precision digital (step and dwell) frequency sweep acquires a lock at each discrete frequency step. Step size and dwell time are selectable.

Sweep Range: Minimum to maximum frequency of the instrument
 Step Size: Any increment within the instrument's frequency resolution
 Dwell Time: May be set in 1 ms increments from approximately

1 ms to 200 s

Set Up time/Step: 25 ms typical

Accuracy and Stability: Same as in CW when locked at each step during dwell time

Sweep Modes:

START/STOP: Sweeps up or down from a preset start frequency to a preset stop frequency

START/ Δ : Sweeps up or down from a preset start frequency through a preset sweep width

CTR/ Δ : Sweeps up or down through a preset sweep width centered symmetrically about a preset center frequency

Δ /MKR: Sweeps up or down from any preset marker to any other preset marker

START/STEPS: Sweeps up or down from a preset start frequency through a preset number of frequency steps

Sweep Functions: AUTO, SINGLE, EXT, EXT STEP and STOP/RESET

ANALOG POWER SWEEP (GT 9000S)

Continuous sweep, self-generated within the instrument. May be operated simultaneously with digital or analog frequency sweep.

Sweep Range: 20 dB maximum, up or down, within incremental level range (maximum output power to -10 dBm)

Sweep Time: (Any Sweep Mode): 2 ms to 200 s, minimum sweep time is determined by the sweep width and the maximum sweep speed

Sweep Time Resolution:

Range	Resolution
2 ms to 20 ms	10 μ s
20 ms to 200 ms	100 μ s
200 ms to 2 s	1 ms
2 s to 20 s	10 ms
20 s to 200 s	100 ms

Minimum Sweep Width: 0.01 dB

Maximum Sweep Speed: 1 dB/ms

Sweep Level Resolution (Any sweep mode): 0.01 dB

Start Level Accuracy (Any sweep mode): ± 1 dB (-10 to +11 dBm)

Sweep Level Linearity (Any sweep mode): $\pm 5\%$ of sweep width

Sweep Modes:

START/STOP: Sweeps up or down from a preset start frequency to a preset stop frequency

START/ Δ : Sweeps up or down from a preset start frequency through a preset sweep width

CTR/ Δ : Sweeps up or down through a preset sweep width centered symmetrically about a preset center frequency

Sweep Functions: AUTO, SINGLE, EXT, EXT STEP and STOP/RESET

¹ Specifications applies from 2 GHz for models GT 9000/2 and GT 9000S/2-20.

DIGITAL POWER SWEEP (GT 9000S)

A precision digital (step and dwell) power sweep acquires a level at each discrete power step. Step size and dwell time are selectable.

Sweep Range: Minimum to maximum level of the instrument

Step Size: Any multiple of 0.01 dB up to maximum sweep range

Dwell Time: May be set in 1 ms increments from approximately 1 ms to 200 s

Accuracy and Stability: Same as in CW when leveled at each step during dwell time

Sweep Modes:

START/STOP: Sweeps up or down from a preset start frequency to a preset stop frequency

START/ Δ : Sweeps up or down from a preset start frequency through a preset sweep width

CTR/ Δ : Sweeps up or down through a preset sweep width centered symmetrically about a preset center frequency

START/STEPS: Sweeps up or down from a preset start frequency through a preset number of frequency steps

Sweep Functions: AUTO, SINGLE, EXT, EXT STEP and STOP/RESET

GENERAL SPECIFICATIONS

Remote Interface: IEEE STD 488-1978 — All parameters except AC power on/off

Operating Temperature: 0 to 50°C

Environmental: Complies with MIL-T-28800E, Type III, Class 5, Style E

Power: 100/120/220/240 Vac \pm 10%, 47-440 Hz, 250 W, nominal

Weight and Dimensions: 20.5 kg (45 lb)

Size: 13.3 cm H x 42.5 cm W x 60.9 cm D (5.25 in x 16.75 in x 24 in)

INPUTS/OUTPUTS

All connectors are type BNC unless otherwise stated.

Front Panel

RF OUT: Generator's RF output signal SMA connector (Option 22 moves the RF output connector to the rear panel)

SWP TRIG IN⁴: TTL level, \geq 50 ns wide trigger input to initiate sweep or step

RAMP OUT⁴: 0 to +10 V ramp out, proportional to frequency between set sweep limits

AM IN: Input signal for external amplitude modulation or SCAN/ Linear AM

FM IN: Input signal for external frequency modulation

PM IN: Input signal for external pulse modulation

Rear Panel

ALC IN: Signal input for remote leveling of output power by positive or negative ZBS detectors, or by applicable power meters

Range: 500 μ V to 2 V

Loop Bandwidth: 50 kHz, nominal (ZBS detector); 0.7 Hz, nominal (power meter)

Input Impedance: 10 k Ω , nominal

REF IN: External time base input signal, 5 or 10 MHz \pm 1 \times 10⁻⁶ or better, 0.5 to 5 Vp-p, overrides internal time base

Input Impedance: 100 k Ω nominal

REF OUT: Buffered time base output, 10 MHz, 2 Vp-p, into 50 Ω sine wave derived from internal or external time base

5–6 MHz IN: 2 Vp-p, input for controlling frequency of the signal generator

Input impedance: 50 Ω nominal

STOP SWEEP IN/OUT⁴: TTL level signal, low input to stop frequency sweep or output to indicate that sweep has been stopped

LOCK/LEVEL OUT: TTL high indicating that frequency is phase-locked and output power is leveled

PENLIFT OUT⁴: Low during sweep, high impedance during retrace

PM VIDEO OUT: TTL level (approximately 1 V into 50 Ω) pulse modulation envelope waveform

PM SYNC OUT: TTL level (approximately 1 V into 50 Ω) 50 ns wide trigger pulse out coincident with leading edge of pulse modulation envelope waveform

AM SIG OUT: 2 Vp-p, amplitude modulation waveform output

FM SIG OUT: 2 Vp-p, frequency modulation waveform output

BLANK/MKR OUT: +5 V during band changes, filter changes and retrace, -5 V during markers

NEG BLANK OUT⁴: 0 V during sweep, -5 V during band changes, filter changes and retrace

.5 V/GHz OUT⁴: Signal directly proportional to the output frequency

SWEEP TRIGGER⁴: TTL level, \geq 50 ns wide trigger input to initiate sweep or step.

RAMP OUT⁴: 0 to +10 V ramp out, proportional to frequency

PM⁴: Input signal for external pulse modulation

AM⁴: Input signal for external amplitude modulation

FM⁴: Input signal for external frequency modulation

⁴ GT 9000S only



Giga-tronics Incorporated
4650 Norris Canyon Road
San Ramon, California 94583
Telephone: 800 726 4442 or
925 328 4650

Telefax: 925 328 4700

Web Site: www.gigatronics.com