

7100 SERIES SYNTHESIZED MICROWAVE SWEEPER

The 7100 Series Sweeper gives you an unequalled combination of speed, precision, accuracy and reliability. Perform analog or digital sweep of both frequency and output power—individually, simultaneously or alternately. Add to that built-in digital AM, FM and PM generators, plus a fast scan modulator for creating more complex modulation patterns, and you've got an ideal source of signals for the frequency and power response testing of sophisticated micro-wave components and systems.

The 7100 Series of instruments is available in six models covering different frequency ranges from 10 MHz to 40 GHz. And all models use a two-loop, indirect synthesis technique to attain high resolution frequency with optimum accuracy, stability and spectral purity.

A digital keypad, self-illuminating push-buttons and entry menu prompts allow easy, front panel access to all of the power, features and functions of the 7100 Series instruments, while the IEEE-488 bus gives you ATE compatibility.

For twelve years, Giga-tronics has provided thousands of reliable microwave test instruments

to military and commercial customers for use in testing radar, electronic warfare, satellite and telecommunications systems. In design, manufacturing, installation and service applications, Giga-tronics instruments have achieved MTBF greater than 10,000 hours, and 7100 Series instruments meet MIL-T-28800E, Type III, Class 5, Style E specifications.

FEATURES:

- Available in six frequency ranges
 - 10 MHz to 20.0 GHz
 - 10 MHz to 26.5 GHz
 - 10 MHz to 40.0 GHz
 - 2 GHz to 20.0 GHz
 - 2 GHz to 26.5 GHz
 - 2 GHz to 40.0 GHz
- 1 Hertz frequency resolution
- 1 Hz/GHz/day accuracy and stability
- Leveled output power from +10 to -130 dBm controllable in .01 dB increments
- Analog or digital sweeps of frequency and power—individually, simultaneously or alternately
- Five sweep modes
 - Start/Stop
 - Center/ Δ
 - Δ /Marker
 - Start/ Δ
 - Start/Steps
- Built-in AM, FM and PM generators option
- Fast scan modulation option for simulating dynamic operating conditions
- Easy operation control via front panel keypad
- IEEE-488 interface for ATE applications
- Self-illuminating push-buttons indicate which parameters and modes are in use
- Entry menu prompts guide you through initial set-ups as well as continued operation
- Store up to 10 front panel set-ups for quick and easy recall
- Compatible with all major manufacturers' scalar network analyzers
- MTBF greater than 10,000 hours



Giga-tronics

ORDERING INFORMATION

MODEL NUMBERS AND FREQUENCY RANGES:

Frequency Range
10 MHz to 20.0 GHz
10 MHz to 26.5 GHz
10 MHz to 40.0 GHz
2 GHz to 20.0 GHz
2 GHz to 26.5 GHz
2 GHz to 40.0 GHz

AVAILABLE OPTIONS:

- Option 11: Allows external time base of 5 MHz in addition to the standard 10 MHz.
- Option 17: Provides Fast Scan Modulation*
- 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 a built-in pulse generator and two built-in function generators for generating AM, FM and PM envelopes

AVAILABLE ACCESSORIES:

- Accessory A001: Cable Kit consisting of 2 low loss cables (18 and 72 inch lengths) and 2 output connector adaptors (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 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.

* Not available for instruments to 40 GHz

SPECTRAL PURITY

Harmonics (up to maximum frequency): < -55 dBc, 0.05 to 40 GHz; < -25 dBc (< -20 dBc in instruments to 40 GHz); 0.01 to 0.05 GHz
 Subharmonics: None in instruments to 20 or 26.5 GHz (< -55 dBc, 20 to 40 GHz, in instruments to 40 GHz)
 Nonharmonics: < -55 dBc (< -49 dBc, 20 to 40 GHz, in instruments to 40 GHz)

Power Line/Fan Rotation Related (dBc, CW Mode):

Frequency Range (GHz)	Offset from Carrier		
	< 300 Hz	300 Hz to 1 kHz	> 1 kHz
0.01 to < 2	-45	-55	-55
2 to < 8	-50	-55	-55
8 to < 20	-45	-55	-55
20 to 26.5	-40	-50	-55
20 to 40	-39	-49	-49

Single-Sideband Phase Noise (dBc/Hz Noise Bandwidth, CW Mode, All Power Levels):

Frequency Range (GHz)	Offset from Carrier				
	30 Hz	100 Hz	1 kHz	10 kHz	100 kHz
0.01 to < 2	-60	-75	-80	-75	-100
2 to < 8	-65	-75	-80	-80	-105
8 to < 20	-60	-65	-75	-75	-100
20 to 26.5	-55	-65	-70	-70	-95
20 to 40	-54	-59	-69	-69	-94

Residual FM (Hz, rms; CW Mode):

Frequency Range (GHz)	Post-detection Bandwidth	
	3 to 3 kHz	0.5 to 1.5 kHz
0.01 to < 2	30	200
2 to < 8	20	150
8 to < 20	40	300
20 to 26.5	60	450
20 to 40	80	600

RF FREQUENCY PARAMETERS AND OPERATIONAL MODES

All variable RF frequency parameter values may be set via the GPIB or from the front panel by keyboard, digi-dial or up/down push-button entry. Frequency sweep may be operated simultaneously or alternately with power sweep.

CW OPERATION

- Range: 0.01 or 2 to 20, 26.5 or 40 GHz (see Ordering Information)
- Resolution: 1 Hz (2 Hz above 20 GHz in instruments to 40 GHz)
- Accuracy and Stability: Identical to time base oscillator
 - Time Base (Internal): 10 MHz
 - Aging Rate: < 1×10^{-9} /day after 72 hours continuous operation
 - Temperature Stability: < $\pm 2 \times 10^{-10}$ /°C (0 to +50°C)
 - Time Base (External): 10 MHz (5 or 10 MHz, switchable, with Option 11) $\pm 1 \times 10^{-6}$ or better
- Switching Time: < 50 msec (20 msec, typical) to within specified frequency accuracy

DIGITAL FREQUENCY SWEEP

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: FA (minimum frequency of the instrument) to FB (maximum frequency of the instrument)
- Step Size: Any increment within the instrument's frequency resolution
- Dwell Time: May be set in 10 msec increments from approximately 10 msec to 200 sec
- Accuracy and Stability: Same as in CW when locked at each step during dwell time

Sweep Modes:

- START/STOP (FA ≤ F1 ≠ F2 ≤ FB): Sweeps up or down from a preset start frequency (F1) to a preset stop frequency (F2)
- START/Δ (FA ≤ F1 ± ΔF ≤ FB): Sweeps up or down from a preset start frequency (F1) through a preset sweep width (ΔF)
- CTR/Δ (FA ≤ CF ± (ΔF/2) ≤ FB): Sweeps up or down through a preset sweep width (ΔF) centered symmetrically about a preset center frequency (CF)
- ΔMKR (FA ≤ M_n ≠ M₁ ≤ FB): Sweeps up or down from any preset marker (M_n) to any other preset marker (M₁)
- START/STEPS (FA ≤ F1 ± (Step Size × Number of Steps) ≤ FB): Sweeps up or down from a preset start frequency (F1) through a preset number of frequency steps

Sweep Functions:

- AUTO: Continuous recycle of preset sweep
- SINGLE: A single cycle of preset sweep or (with STOP activated) a single preset step, initiated by manual operation of a front panel push-button
- EXT: A single cycle of preset sweep or (with STOP activated) a single preset step, initiated by each trigger from an external source
- EXT STOP (External Step): A single step of a preset sweep initiated by each trigger from an external source
- STOP/RESET: Stops sweep when activated by front panel push-button to allow manual tuning of frequency at any point in the sweep. Second depression of push-button resets sweep to initial conditions.

ANALOG FREQUENCY SWEEP

Fast, continuous analog frequency sweep is self-generated within the instrument. It is phase-lock corrected at each start and band-crossing frequency.

Sweep Range: FA (minimum frequency of the instrument) to FB (maximum frequency of the instrument)

Sweep Time (Any Sweep Mode): 2 msec to 200 sec in five ranges. Minimum sweep time is determined by the sweep width swept and the maximum sweep speed.

Range	Resolution
2 msec to 20 msec	10 μ sec
20 msec to 200 msec	100 μ sec
200 msec to 2 sec	1 msec
2 sec to 20 sec	10 msec
20 sec to 200 sec	100 msec

Minimum Sweep Width: 1 MHz

Maximum Sweep Speed: 600 MHz/msec

Band Crossing Dead Time (at 2, 8, 20 and 28 GHz): 50 msec, nominal

Start Level Accuracy (Any Sweep Mode): ± 0.5 MHz

Sweep Width Resolution (Any Sweep Mode): 0.1% of sweep width (0.2% above 20 GHz in instruments to 40 GHz)

Sweep Linearity (Relative to Linear RAMP OUT Voltage, Sweep Time ≥ 100 msec, Any Sweep Mode): $\pm 1\%$ of sweep width or ± 50 MHz ($\pm 2\%$ or ± 100 MHz in instruments to 40 GHz), whichever is less

Markers: 8 frequency identifying markers (intensity or amplitude) individually selectable from the front panel or via the GPIB

Marker Resolution: Sweep width/4,000

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

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

Sweep Modes: Same as Frequency Digital Sweep Modes except the START/STEPS mode is deleted

Sweep Functions: Same as Frequency Digital Sweep Functions

RF OUTPUT POWER PARAMETERS AND OPERATIONAL MODES

All variable RF output power parameter values may be set via the GPIB or from the front panel by keyboard, digi-dial or up/down push-button entry. Power sweep may be operated simultaneously or alternately with frequency sweep.

RF OUTPUT POWER

Maximum Leveled Output: +10 dBm (in instruments to 40 GHz: +10 dBm, 0.01 to 20 GHz; +5 dBm, 20 to 35 GHz; +2 dBm, 35 to 40 GHz)

Incremental Level Range: -20 to $+15$ dBm

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

Minimum Output Level: -130 dBm (-110 dBm in instruments to 26.5 or 40 GHz)

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

Output Accuracy (Internally Leveled, CW or frequency sweep mode, AM Off): ± 1 dB to 20 GHz, ± 2 dB to 40 GHz (± 0.1 dB per 10 dB attenuation step)

Output Flatness: Included in accuracy
Output Switching Time: Typically < 1 msec (20 msec with attenuator change)

Output Impedance: 50 ohms, nominal
Output SWR: $< 2:1$

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

DIGITAL POWER SWEEP

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: LA (minimum output level of the instrument) to LB (maximum output level of the instrument)

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

Dwell Time: May be set in 10 msec increments from approximately 10 msec to 200 sec

Accuracy: Same as in non-swept mode when leveled at each step during dwell time

Sweep Modes:

START/STOP (LA \leq L1 \neq L2 \leq LB): Sweeps up or down from a preset start level (L1) to a preset stop level (L2)

START/ Δ (LA \leq L1 $\pm \Delta$ L \leq LB): Sweeps up or down from a preset start level (L1) through a preset sweep width (Δ L)

CTR/ Δ (LA \leq CL $\pm (\Delta$ L/2) \leq LB): Sweeps up or down through a preset sweep width (Δ L) centered symmetrically about a preset center level (CL)

START/STEPS (LA \leq L1 \pm (Step Size \times Number of Steps) \leq LB): Sweeps up or down from a preset start level (L1) through a preset number of level steps

Sweep Functions: Same as Frequency Digital Sweep Functions

ANALOG POWER SWEEP

Fast, continuous analog power sweep is self-generated within the instrument.

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

Sweep Time (Any Sweep Mode): 2 msec to 200 sec in five ranges. Minimum sweep time is determined by the sweep width swept and the maximum sweep speed.

Range	Resolution
2 msec to 20 msec	10 μ sec
20 msec to 200 msec	100 μ sec
200 msec to 2 sec	1 msec
2 sec to 20 sec	10 msec
20 sec to 200 sec	100 msec

Minimum Sweep Width: 0.01 dB

Maximum Sweep Speed: 1 dB/msec

Start Level Accuracy (Any sweep mode): ± 0.5 dB
Sweep Level Resolution (Any sweep mode): 0.01 dB

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

Sweep Modes: Same as Output Power Digital Sweep Modes except there is no START/STEPS mode

Sweep Functions: Same as Frequency Analog Sweep Functions

MODULATION PARAMETERS AND OPERATIONAL MODES

Modulation parameter values may be set via the GPIB or from the front panel by keyboard, digi-dial or up/down push-button entry. Modulation specifications apply in the CW mode and are operable in the sweep modes.

AMPLITUDE MODULATION (AM)

Amplitude Modulation specifications apply for waveforms whose envelope peak is at least 1 dB below maximum specified output power when the instrument is internally leveled, FM and PM off. AM may be operated simultaneously with FM.

AM Envelope Parameters:

Depth:

- Range: 0 to at least 90%
- Resolution: 0.1% increments
- Accuracy: $\pm 5\%$
- Readout: 3 digits
- Resolution: 0.1%

Bandwidth (30% depth): DC coupled, 3 dB points > 50 kHz

Frequency Response (Flatness relative to 1 kHz rate at 30% depth): ± 0.2 dB (0.5 dB for instruments to 40 GHz), DC to 10 kHz

Harmonic Distortion (Relative to externally supplied AM envelope): 2% (1% typical), $\leq 50\%$ depth, ≤ 1 kHz rate; 10%, $\leq 50\%$ depth, ≤ 50 kHz rate

Incidental Phase Modulation (Rates ≤ 10 kHz, 30% depth, 50 Hz to 15 kHz measurement bandwidth): < 0.2 radians, peak, typical

Incidental FM: Incidental Phase Modulation X AM rate

Externally Supplied AM Envelope

Waveform: Any waveform compatible with bandwidth considerations

Rate: DC to 100 kHz

Sensitivity: 1 V, peak, for 100% depth

Input Impedance: 600 ohms, nominal

Internally Generated AM Envelope (Option 24)

Waveform: Sine, square or triangle wave

Rate: 1 Hz to 100 kHz

Resolution: 1 Hz

Accuracy: ± 0.01 Hz

FREQUENCY MODULATION (FM)

Frequency Modulation specifications apply with AM and PM off. FM may be operated simultaneously with AM or PM.

FM Envelope Parameters

Max Deviation (Wide Mode): 10 MHz, peak (20 MHz, peak, above 20 GHz in instruments to 40 GHz)

Flatness: ± 1 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): < 3 kHz rms, typical (< 6 kHz rms, typical, above 20 GHz in instruments to 40 GHz)

Max Deviation (Narrow Mode): The lesser of $100 \times F_{MOD}$ or 10 MHz, peak ($200 \times F_{MOD}$ or 20 MHz, peak, above 20 GHz in instruments to 40 GHz)

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

Residual FM: Same as CW (see Spectral Purity)

Accuracy: $\pm 5\%$

Readout: 3 digits

Resolution: 10 kHz

Distortion: $< 5\%$

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

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 ohms, nominal

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

PULSE/SQUARE WAVE MODULATION (PM)

Pulse modulation specifications apply with AM and FM off. PM may be operated simultaneously with FM.

PM Envelope Parameters

On/Off Ratio: > 80 dB

Rise/Fall Times: < 10 nsec

Overshoot, Undershoot and Ringing: ± 2 dB, maximum

Settling Time (to within 1 dB): < 100 nsec

Leveled Pulsed Output Power (Referenced to leveled CW output power): ± 0.5 dB, typical, ≥ 100 nsec width; ± 1 dB, typical, < 100 nsec width

Externally Supplied 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 nsec, typical

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

Internally Generated PM Envelope (Option 24)

Repetition Rate

Range	Resolution
5 Hz to 100 Hz	0.1 Hz
100 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

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

Jitter: Same as instrument time base

Pulse Delay (Referenced to sync output)

Range: 0 to 2 sec

Resolution: 10 nsec

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

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

Pulse Width

Range: 50 nsec to 2 sec

Resolution: 10 nsec

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

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

Externally Triggered PM Envelope (Option 24)

One PM envelope produced by each trigger supplied

Repetition Rate: 5 Hz to 5 MHz

Pulse Delay: Set by internal delay control (see above)

Pulse Width: Set by internal width control (see above)

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

FAST SCAN MODULATION (FSM) – OPTION 17 (Instruments to 20 or 26.5 GHz only)

The fast scan modulator, a digitally controlled and linearized PIN diode attenuator inserted between the instrument's leveling loop and output attenuator, allows the independent, simultaneous control of AM and PM.

Scan Mode (DC coupled):

Dynamic Range: 40 dB, minimum

Linearity (at cal points): ± 0.6 dB (0 to 20 dB), ± 1 dB (20 to 50 dB). Unless otherwise requested, cal points are 1, 4, 8, 12, 14, 16, 18 and 20 GHz.

Frequency Response: DC to 150 kHz, sine wave

Rise/Fall Time Response to Step Input: 0.5 μ sec up to 40 dB step

Delay Time: 0.5 μ sec, typical

Sensitivity: 0.1 V/dB (10 dB/V)

Input Impedance: 50 ohms, nominal

AM Mode (AC coupled):

Modulation Depth: 0 to 90%

RF Output Level: Approx. 11 dB below generator setting

Frequency Response: 10 Hz to 50 kHz

Total Harmonic Distortion: 5%, max (2% typical) at 80% modulation; 10%, max (5% typical) at 30% modulation

Input Sensitivity: 1 V, p-p, for 50% modulation at 1 kHz

Input Impedance: 50 ohms, nominal

Insertion Loss: 5 dB, max (3 dB typical), by-passed when not in use

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: 100/120/220/240VAC \pm 10%, 50–400 Hz, 350 Watts, nominal
 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. (76.7 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:	65 lb. (29.6 kg.)	80 lb. (36.3 kg.)

SPECIAL FUNCTIONS

Special functions are available to the operator via a SHIFT key and the data entry keyboard.

STORE/RECALL: Stores up to 10 complete front-panel set-ups of frequency, frequency sweep, output level, power sweep, PM, AM and FM in the instrument's non-volatile memory for recall at any time

ADRS: Allows setting of the instrument's IEEE 488 bus address via the data entry keyboard and displays it at the entry menu

LOCAL: Returns control of all parameters to the instrument's front panel

RESET: Initializes all parameters

ALT: Alternates between any two or more stored sweeps

ATTEN: Disables the step attenuator at any attenuator setting and lets it be operated over the incremental level range of -20 dB to the maximum power capability of the output oscillator

TEST: Initiates instrument's self test routines

ALC: Allows setting of external conditions of leveling (detector or power meter) or unleveled internal operation

MULT: Allows division of the instrument's frequency by any integer to provide proper signals for external frequency multipliers

OFFSET: Allows frequency readout to be offset from output frequency

SPECIAL: Allows user defined and/or future special functions and features

INPUTS/OUTPUTS

All connectors are type BNC unless otherwise stated

Front Panel

RF OUT: Generator's RF output signal on type SMA connector (2.92 mm connector on instruments to 40 GHz) (Option 22 for rear panel output)

SWP TRIG IN: TTL level, ≥ 50 nsec wide trigger input to initiate sweep or step.

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

AM IN: Input signal for external amplitude modulation

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 polarity 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 kohm, nominal

REF IN: External time base input signal, 10 MHz $\pm 1 \times 10^{-6}$ or better, 0.5 to 5 V, p-p, overrides internal time base. Input impedance is 100 ohms, nominal

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

5–6 MHz IN: 2 V, p-p, input for controlling frequency of the signal generator. Input impedance is 50 ohms, nominal. Allows fine frequency resolution control from an external synthesized source

STOP SWEEP IN/OUT: TTL level signal 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 OUT: Low during sweep, high impedance during retrace

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

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

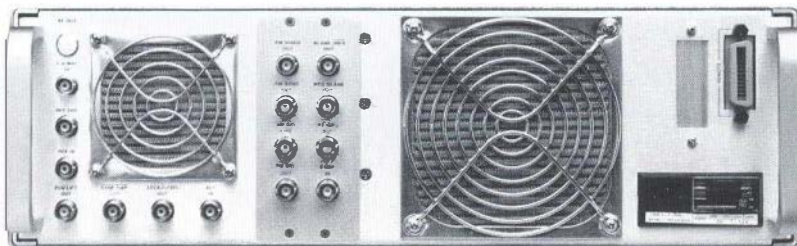
AM SIG OUT: 2 V, p-p, amplitude modulation waveform output

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

BLANK/MKR OUT: +5 V during band change, filter change and retrace, 0 V during sweep and -5 V during markers

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

5 V/GHz OUT: Signal directly proportional to output frequency (.25 V/GHz in instruments to 40 GHz)



Rear Panel