8003 Precision Scalar Analyzer

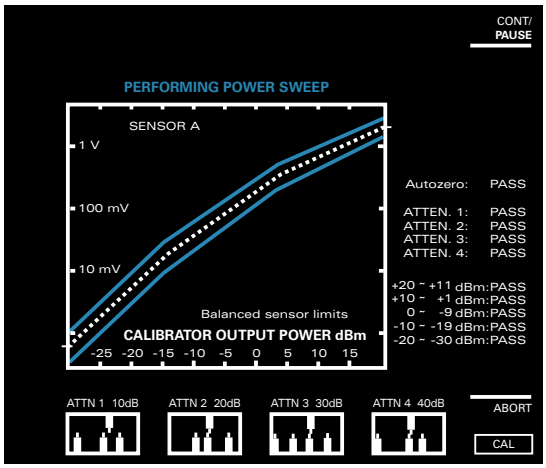
The Giga-tronics Model 8003 Precision Scalar Analyzer combines a 90 dB wide dynamic range with the accuracy and linearity of a power meter in a single instrument.

WIDE DYNAMIC RANGE

The Model 8003 Precision Scalar Analyzer can make accurate, single sensor power measurements over a frequency range of 10 MHz to 40 GHz with a dynamic range of –70 to +20 dBm.

This wide dynamic range results from our unique use of switched linear gain stages, with a maximum gain of more than 100 dB, rather than the log amplifiers typically used in scaler analyzers.

In addition to wide dynamic range, our approach also delivers extremely accurate low level measurements all the way down to –70 dBm.



The Model 8003 incorporates a unique, built-in power sweep calibrator.

POWER METER LINEARITY

The Model 8003 also incorporates a unique, built-in power sweep calibrator that linearizes the sensor's diode response in the non-square-law region, from –30 to +20 dBm. The calibration system uses the inherent linearity and stability of an ovenized thermistor to accurately calibrate the high-speed diode sensors from 0 to 50°C, ambient.

The result is a linearity specification of ± 0.02 dB (0.5 %) over any 20 dB span and ± 0.04 dB (1%) over the entire 90 dB

The Giga-tronics Model 8003 combines wide dynamic range, accuracy and linearity.

dynamic range to ensure accurate ratio or relative measurements.

ABSOLUTE POWER MEASUREMENTS

The same built-in calibrator that linearizes the sensor provides a 1 mW signal accurate to within ±0.7%, stable over temperature and time, and traceable to NIST.

And each Giga-tronics power sensor contains an EEPROM programmed with the frequency calibration factors measured at the factory, or in your cal lab. When you key in the frequency at which power is being measured, the meter automatically applies the correct cal factor from the sensor EEPROM.

The combination of an accurate, traceable calibration reference and an accurate frequency response curve for each power sensor ensures absolute power measurements with power meter accuracy.

POWER SENSORS TO MEET YOUR APPLICATION

Giga-tronics offers an extensive line of power sensors for the Model 8003 to address a variety of power measurement applications. This includes standard CW power sensors, low VSWR CW power sensors, true RMS sensors, and our unique triggerable pulse sensors.

The 80340 Series triggerable pulse sensors let you display the response from a pulsed source. You can choose between two modes of operation — measure with either a pulsed fixed frequency (CW mode), or with a pulsed swept frequency (start/stop mode) signal from a sweeper. The sensors can also be used to display the response of devices with no pulse modulation on the signal generator.

SWEEPER CONTROL

The Model 8003 Precision Scalar Analyzer can control all Giga-tronics sweepers as well as most sweepers from HP, Wiltron and Marconi.

The 80340 Series triggerable pulse sensors let you display the response from a pulsed source.

SYSTEM SPECIFICATIONS

Specifications describe the instrument's warranted performance, and apply when using 80300A Series Power Sensors and 80500A Series Bridges.

Frequency Range: 10 MHz to 40 GHz in coax using the Giga-tronics 80300 Series power sensors and 80500 Series bridges.

Power Range: +30 to -70 dBm, see power sensor specifications.

System Dynamic Range:

CW Measurements: 90 dB

Peak Measurements: 40 dB

Swept Measurements: AC Mode 90 dB

DC Mode 80 dB

Inputs: Three identical inputs, A, B and C, accept detected outputs from the Giga-tronics power sensors and bridges.

DISPLAY

CRT: Full color display. Each channel can be assigned a different color. Graticule color is selectable (default green). Menus for soft keys use color.

Display resolution: 608 X 430 points.

Channels: Four channels can be used to select and simultaneously display inputs from A, B and C sensors in single channel or ratio mode.

DISPLAY MODES

Graph/Readout: Graph mode displays swept frequency response on CRT. Readout mode displays power level at cursor frequency or CW power levels in digital format on CRT.

Graph Mode:

dBm: single channel power measurement.

dB: relative power measurement (ratio or relative to trace memory).

Display Mode	Display Scale Resolution	Display Range	Vertical Resolution
dBm/dB	0.1 dB to 20 dB/div (1, 2, 5 sequence)	-99.99 to +99.99	0.01

Readout Mode:

dBm: single channel power measurement

dB: relative power measurement

Lin: nW, µW, mW and Watts: signal channel measurement. %: dual channel measurement. % Rel: dual channel measurement relative to a reference.

Channel Offset: -90 dB to +90 dB in .01 dB increments.

Autoscale: Automatically sets the scale factor, reference level and reference position to provide optimum display of active channel.

Averaging: 2, 4, 8, 16, 32, 64, 128, or 256 successive traces (swept) or readings (CW) can be averaged to reduce effects of noise on measurement.

Smoothing: Provides a linear moving average of adjacent data points. The smoothing aperture defines the trace width (number of data points) to be averaged. The smoothing aperture can be set from 0.1% to 20% of the trace width.

Trace Memory: Ten traces can be individually labeled and stored in non-volatile memory and recalled. Stored traces can be displayed, and trace differences from any measurement can be displayed.

Adaptive Path Calibration (Normalization): Traces are stored in non-volatile memory and normalized with the highest resolution, independent of display scale/division or offset. Up to 4,096 points for each trace are stored over the full frequency range of the sweeper or any user selected frequency range. Normalization data is automatically interpolated for ranges within the original normalized range.

Settings Store/Recall: Allows up to nine front panel setups, plus a power down last instrument state, to be stored and recalled from non-volatile memory.

Limit Lines: Horizontal, sloped, and/or single point lines for each trace can be set as go/no-go data limits. Limit lines are stored in non-volatile memory. Complex limit lines can be entered through the front panel or via GPIB interface.

CURSOR AND MARKERS

Cursor: The cursor can be positioned with the tuning knob or via the numeric keypad. The frequency and amplitude test data at the cursor on all active channels is digitally displayed.

Cursor Delta: Displays differences in dB and frequency between the reference cursor and the main cursor.

Cursor Min/Max: Automatically moves the cursor to the minimum or maximum value of test data.

Cursor "x" dB: Automatically moves the cursor to the point on the trace equal to the value of "x" in dB or dBm.

Cursor "x" Bandwidth: Automatically displays cursors right and left of the cursor at the frequencies where the test data is equal to the value of "x" dB, and displays the bandwidth between the cursors.

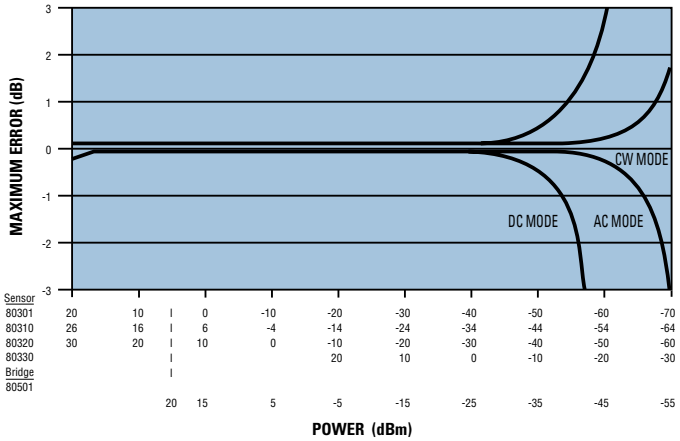
Ref to Cursor: Automatically changes the Ref Level to the level at the cursor.

Markers: Displays up to 10 markers generated by the 8003. The cursor can be moved directly to any marker or moved sequentially through the markers.

ACCURACY

Transmission Loss or Gain Measurement: Transmission loss or gain measurements are made relative to a 0 dB reference point established during calibration. Therefore, frequency response errors of the source, sensors, and signal splitting device are removed. The remaining elements of uncertainty are mismatch error, instrument linearity (Fig. 1) and noise uncertainty given in the absolute power accuracy section.

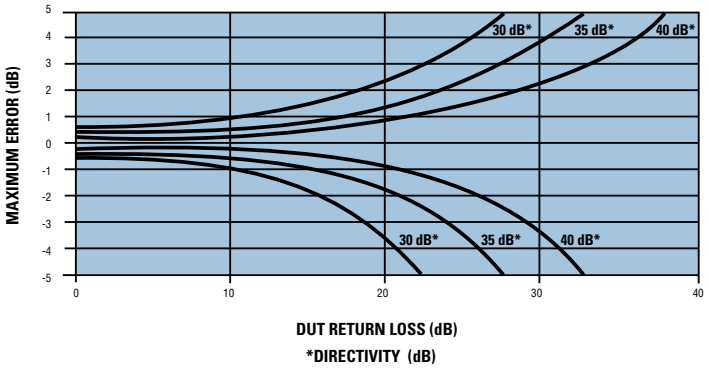
Figure 1 – LINEARITY PLUS ZERO vs INPUT POWER



Transmission Accuracy = Instrument Accuracy + Mismatch Uncertainty

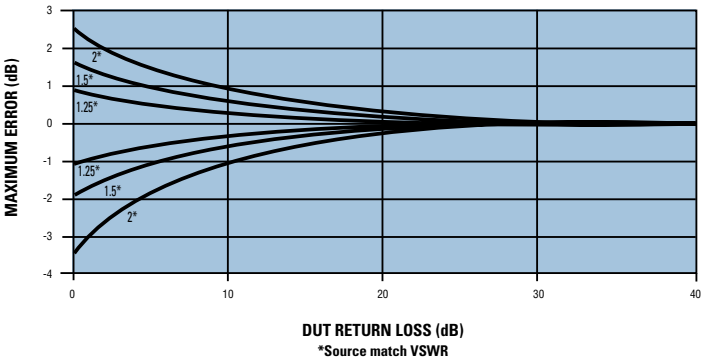
Reflection Measurements: When measuring devices with high return loss (>10 dB), reflection accuracy is typically dominated by the effective system directivity (Fig. 2), instrument linearity errors, and noise uncertainty. With low return loss devices (<10 dB), reflection accuracy is typically dominated by source match (Fig. 3). Calibration with an open and short effectively removes uncertainties due to frequency response of the source, sensors, and signal splitting device.

Figure 2 – REFLECTION UNCERTAINTY vs DIRECTIVITY



Reflection Accuracy = Instrument Accuracy + Reflection Bridge Accuracy

Figure 3 – REFLECTION UNCERTAINTY vs SOURCE MATCH



Absolute Power Measurement Accuracy: The absolute power measurement accuracy is determined by a number of factors including calibrator accuracy, noise, sensor calibration factor error, and the mismatch uncertainty between sensor and device under test.

Calibrator: Provides a 50 MHz calibration signal at 51 very accurately controlled levels from +20 to -30 dBm to dynamically linearize the sensors.

Frequency: 50 MHz nominal

Connector: Type N(f) precision connector, 50 Ω.

Settability: The 1.00 mW level in the power sweep is factory set to ±0.7% traceable to the National Institute of Standards and Technology.

Accuracy: ±1.2% worst case for one year, over temperature range 15 to 35° C.

VSWR: <1.05 (Return Loss >33 dB)

Instrument plus Power Sensor Linearity:

Standard Sensors:

CW Mode:

±0.02 dB (±0.5%) over any 20 dB range from +16 to -70 dBm

±0.02 dB + (+0 dB, -0.05 dB/dB) from +16 to +20 dBm

±0.04 dB (±1.0%) from +16 to -70 dBm

Swept Mode:

±0.03 dB (±0.7%) over any 20 dB range from +16 to -70 dBm

±0.03 dB + (+0 dB, -0.05 dB/dB) from +16 to +20 dBm

±0.06 dB (±1.4%) from +16 to -70 dBm

Low VSWR Sensors:

-64 to +20 dBm: Same as for Standard Sensors.

+20 to +30 dBm: Same as for Standard Sensors, plus an additional *±0.13 dB*.

High Power Sensors:

-60 to +20 dBm: Same as for Standard Sensors.

+20 to +30 dBm: Same as for Standard Sensors, plus an additional *±0.13 dB*.

True RMS Sensors:

CW Mode:

±0.02 dB (±0.5%) over any 20 dB range from +20 to -30 dBm

±0.04 dB (±1.0%) from +20 to -30 dBm

Swept Mode:

±0.03 dB (±0.7%) over any 20 dB range from +20 to -30 dBm

±0.06 dB (±1.4%) from +20 to -30 dBm

Temperature Coefficient of Linearity: <0.3% /°C temperature change after calibration

Zeroing Accuracy:

(CW Mode, Averaging Factor = 32):

Zero set: ±50 pW

Zero drift: <*±200 pW* in 1 hour at constant temperature after at 24 hour warmup.

(Swept Mode, Averaging Factor = 32):

Zero set: ±50 pW (AC Detection)
±800 pW (DC Detection)

Zero drift: *2 nW* (DC detection), typical, in 1 hour at constant temperature after 24 hour warmup. Zero drift not applicable in AC detection.

Noise Uncertainty: <*50 pW*, typical, at constant temperature, measured over a 1 minute interval, two standard deviations.

Cal Factor Correction: Manual or automatic correction to power readings to compensate for frequency response variations of the power sensors and bridges.

Manual: Cal Factor, Cal Frequency, Off

Auto: Sweeper

GPIB

Interface: Operates according to IEEE-488.2 and IEC-625 interface standards, A private line GPIB is used to connect the analyzer to firmware supported sweepers.

Programmable Functions: All front panel functions, except power on/off are programmable.

Interrupts: SRQ's are generated for these conditions:

- Power Up
- Front panel key pressed
- Operation complete
- Illegal command
- Instrument self-test error
- Limit test failed

REAR PANEL INPUTS/OUTPUTS

Sweep In (Sweep Voltage Requirements): (BNC connector). 0 to +10 V nominal.

Blanking Input: (BNC connector) Used to blank the sweep oscillator band switching points on the 8003 display.

Voltage level: Blanked >*2 V*; Unblanked <*0.8 V*

Input 1: (BNC connector) TTL levels, used with some sweepers to provide synchronization.

AC Modulation Output: (BNC connector) Provides drive to modulation input on sweeper or external modulator for use in AC detection mode.

Bias Output: (BNC connector). Programmable output voltage used to display family of curves.

Voltage range: +/-10 V

Current compliance: Source or sink 150 mA max

System GPIB: (GPIB connector) Used to connect 8003 to GPIB system controller.

Private GPIB: (GPIB connector) Used to connect 8003 to dedicated signal source, plotter or printer.

RS232 Port: Serial Communications Interface for driving an HP Laserjet printer.

Power Sensor Selection Guide

	Frequency Range/ Power Range	Maximum Power	Power Linearity [3] (Frequency > 8 GHz)	RF Connector	Length	Diameter	Weight	VSWR
CW Power Sensors								
80301A	10 MHz to 18 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to -20 dBm: ±0.00 dB -20 to +20 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	1.12: 0.01 - 2 GHz 1.22: 2 - 12.4 GHz
80302A	10 MHz to 18 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to -20 dBm: ±0.00 dB -20 to +20 dBm: ±0.05 dB/10 dB	APC-7(m) 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	1.29: 12.4 - 18 GHz 1.12: 0.01 - 2 GHz
80303A	10 MHz to 26.5 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to -20 dBm: ±0.00 dB -20 to +20 dBm: ±0.1 dB/10 dB	Type K(m) [2] 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	1.22: 2 - 12.4 GHz 1.38: 12.4 - 18 GHz
80304A	10 MHz to 40 GHz -70 to 0 dBm	+23 dBm (200 mW)	-70 to -20 dBm: ±0.00 dB -20 to 0 dBm: ±0.2 dB/10 dB	Type K(m) [2] 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	1.43: 18 - 26.5 GHz 1.92: 26.5 - 40 GHz
Low VSWR CW Power Sensors								
80310A	10 MHz to 18 GHz -64 to +26 dBm	+29 dBm (800 mW)	-64 to -14 dBm: ±0.00 dB -14 to +26 dBm: ±0.05 dB/10 dB	Type K(m) [2] 50Ω	127 mm (5.0 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.13: 0.01 - 2 GHz 1.16: 2 - 12 GHz
80313A	10 MHz to 26.5 GHz -64 to +26 dBm	+29 dBm (800 mW)	-64 to -14 dBm: ±0.00 dB -14 to +26 dBm: ±0.1 dB/10 dB					1.23: 12 - 18 GHz 1.29: 18 - 26.5 GHz
80314A	10 MHz to 40 GHz -64 to +6 dBm	+29 dBm (800 mW)	-64 to -14 dBm: ±0.00 dB -14 to +6dBm: ±0.2 dB/10 dB					1.50: 26.5 - 40 GHz
1W CW Power Sensors								
80320A	10 MHz to 18 GHz -60 to +30 dBm	+30 dBm (1 W)	-60 to -10 dBm:±0.00 dB -10 to +30 dBm: ±0.05 dB/10 dB	Type K(m) [2] 50Ω	127 mm (5.0 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.11: 0.01 - 2 GHz 1.12: 2 - 12 GHz
80323A	10 MHz to 26.5 GHz -60 to +30 dBm	+30 dBm (1 W)	-60 to -10 dBm: ±0.00 dB -10 to +30 dBm: ±0.1 dB/10 dB					1.18: 12 - 18 GHz 1.22: 18 - 26.5 GHz
80324A	10 MHz to 40 GHz -60 to +10 dBm	+30 dBm (1 W)	-60 to -10 dBm: ±0.00 dB -10 to +10 dBm: ±0.2 dB/10 dB					1.36: 26.5 - 40 GHz
True RMS Sensors (-30 dBm to +20 dBm)								
80330A 80333A 80334A	10 MHz to 18 GHz 10 MHz to 26.5 GHz 10 MHz to 40 GHz	+33 dBm (2 W)	-30 to +20 dBm: ±0.00 dB	Type K(m) [2] 50Ω	152 mm (6.0 in)	32 mm (1.25 in)	0.27 kg (0.6 lb)	1.12: 0.01 - 12 GHz 1.15: 12 - 18 GHz 1.18: 18 - 26.5 GHz 1.29: 26.5 - 40 GHz
Triggerable Pulse Power Sensors								
80340A	50 MHz to 18 GHz -20 to +20 dBm (Triggered) -30 to +20 dBm (Free Run)	+23 dBm (200 mW)	±0.13 db, 0 dBm to -30 dBm ±0.13 dB, ±0.01 dB dB/dB from 0 dBm to +20 dBm	Type N(m)	14.6 cm (5.75 in)	3.7 cm (1.44 in)	0.3 kg (0.7 lbs)	1.12: 0.5 - 2 GHz 1.22: 2 - 12.4 GHz 1.37: 12.4 - 18 GHz
80343A	50 MHz to 26.5 GHz -20 to +20 dBm (Triggered) -30 to +20 dBm (Free Run)	+23 dBm (200 mW)	±0.13 db, 0 dBm to -30 dBm ±0.13 dB, ±0.01 dB dB/dB from 0 dBm to +20 dBm	Type K(m)	14.6 cm (5.75 in)	3.7 cm (1.44 in)	0.3 kg (0.7 lbs)	1.50: 18 - 26.5 GHz 1.92: 26.5 - 40 GHz
80344A	50 MHz to 40 GHz -20 to 0 dBm (Triggered) -30 to 0 dBm (Free Run)	+23 dBm (200 mW)	±0.13 db, 0 dBm to -30 dBm	Type K(m)	14.6 cm (5.75 in)	3.7 cm (1.44 in)	0.3 kg (0.7 lbs)	

[2]The K connector is electrically and mechanically compatible with the APC-3.5 and SMA connectors. [3]For frequencies above 8 GHz, add power linearity to system linearity.

Bridge Selection Guide

	Frequency Range/ Power Range	Maximum Power	Power Linearity [4] (Frequency > 8 GHz)	Input	Test Port	Directivity	Weight	Dimensions	VSWR
Precision CW Return Loss Bridges									
80501	10 MHz to 18 GHz -35 to +20 dBm	+27 dBm (0.5 W)	-35 to +10 dBm: ±0.1 dB +10 to +20 dBm: ±0.1 dB ±0.005 dB/dB	Type N(f) 50Ω	Type N(f) 50Ω	38 dB	0.340 kg (12 oz.)	7.6 X 5 X 2.8 cm (3 X 2 X 1.125 in)	< 1.17: 0.01 - 8 GHz < 1.27: 8 - 18 GHz
80502	10 MHz to 18 GHz -35 to +20 dBm	+27 dBm (0.5 W)	-35 to +10 dBm: ±0.1 dB +10 to +20 dBm: ±0.1 dB ±0.005 dB/dB	Type N(f) 50Ω	APC-7(f) 50Ω	40 dB	0.340 kg (12 oz.)	7.6 X 5 X 2.8 cm (3 X 2 X 1.125 in)	< 1.13: 0.01 - 8 GHz < 1.22: 8 - 18 GHz
80503	10 MHz to 26.5 GHz -35 to +20 dBm	+27 dBm (0.5 W)	-35 to +10 dBm: ±0.1 dB +10 to +20 dBm: ±0.1 dB ±0.005 dB/dB	SMA(f) 50Ω	SMA(f) 50Ω	35 dB	0.340 kg (7 oz.)	1.9 X 3.8 X 2.9 cm (.75 X 1.5 X 1.125 in)	< 1.22: 0.01 - 18 GHz < 1.27: 18 - 26.5 GHz
80504	10 MHz to 40 GHz -35 to +20 dBm	+27 dBm (0.5 W)	-35 to +10 dBm: ±0.1 dB +10 to +20 dBm: ±0.1 dB ±0.005 dB/dB	Type K(f) 50Ω	Type K(f) 50Ω	30 dB	0.198 kg (7 oz.)	1.9 X 3.8 X 2.9 cm (.75 X 1.5 X 1.125 in)	< 1.35: 0.01 - 26.5 GHz < 1.44: 26.5 - 40 GHz

[4]For frequencies above 8 GHz, add power linearity to system linearity.

Sensor Calibration Factor Uncertainties

Frequency (GHz)		Probable Uncertainties (%) [5]				
			80303A			
		80301A	80304A	80310A	80320A	80330A
		80302A	80343A	80313A	80323A	80333A
Lower	Upper	80340A	80344A	80314A	80324A	80334A
0.1	1	1.04	1.64	1.58	1.58	1.58
1	2	1.20	1.73	1.73	1.73	1.73
2	4	1.33	1.93	1.91	1.91	1.90
4	6	1.41	2.03	2.02	2.01	2.01
6	8	1.52	2.08	2.07	2.06	2.06
8	12.4	1.92	2.55	2.54	2.53	2.53
12.4	18	2.11	2.83	2.80	2.79	2.78
18	26.5	—	3.63	3.68	3.62	3.59
26.5	40	—	6.05	5.54	5.39	5.30

[5] Square root of sum of the individual uncertainties squared (RSS).

DIRECTIONAL BRIDGES

The 80500 Series of Directional Bridges are designed specifically for use with the 8003 to measure the return loss of a test device. The bridges can be used in AC or DC detection mode. Each bridge includes an EEPROM which has been programmed with identification data for that bridge. Alternatively, an adapter is available to allow Wiltron Directional Bridges (SWR Autotesters) to be used with the 8003.

Bridge Frequency Response: Calibrated return loss measurements using the 8003 can be frequency compensated using the standard "Open/Short" supplied with the bridge.

Insertion Loss: 6.5 dB nominal from input port to test port.

Detector Polarity: Negative

Maximum Input Power: +27 dBm (0.5 W)

Directional Bridge Accessories: Open/Short is included for establishing the 0 dB return loss reference during path calibration.

SIGNAL SOURCES

System Integrated: The 8003 can be system integrated (sweeper control using the 8003) with all Giga-tronics sweepers and the following sweepers:

Marconi 6310 Series Programmable Sweep Generators
HP8350A & B Sweep Oscillator with RF plug-in
(HP83500 Series or HP 86200 Series with HP11869A adapter)
HP8340A/B or HP8341B Synthesized Sweeper
HP8360 Series Synthesized Sweepers
Wiltron 6600B Sweep Generators
Wiltron 6700A Swept Frequency Synthesizers

Operator Integrated: The 8003 is compatible with any signal source meeting the following requirements:

Horizontal Ramp: Provides 0 to +10 V nominal ramp signal.

Blanking Signal: Provides a TTL level during retrace and bandswitching.

Modulation:

AC Detection Mode: A square wave is provided by the analyzer to modulate the signal source.

Frequency: 1 KHz nominal

On/Off ratio: >30 dB

GENERAL SPECIFICATIONS

Temperature Range: Operating: 0 to 50° C, Storage: -40 to 70° C

Power Requirements:

100/120/220/240 V ±10%, 48 to 440 Hz, *200 VA*

Physical Characteristics:

Dimensions: 45.1 cm (17.76 in) wide, 17.8 cm (7.00 in) high, 48.3 cm (19.00 in) deep
Weight: 16.6 Kg (36.5 lbs)

ORDERING INFORMATION

8003 Precision Scalar Analyzer

Options for 8003:
01 Rack Mount
02 RGB Interface

Power Sensor Options

20954-001 1.5 meter cable (5 feet)
20954-002 3.0 meter cable (10 feet)
20954-003 7.6 meter cable (25 feet)
20954-004 15.2 meter cable (50 feet)

8003 Accessories

PC Board Extender Kit P/N 20641
Bridge Adapter for use with Wiltron 560 Series Bridges P/N 20779

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