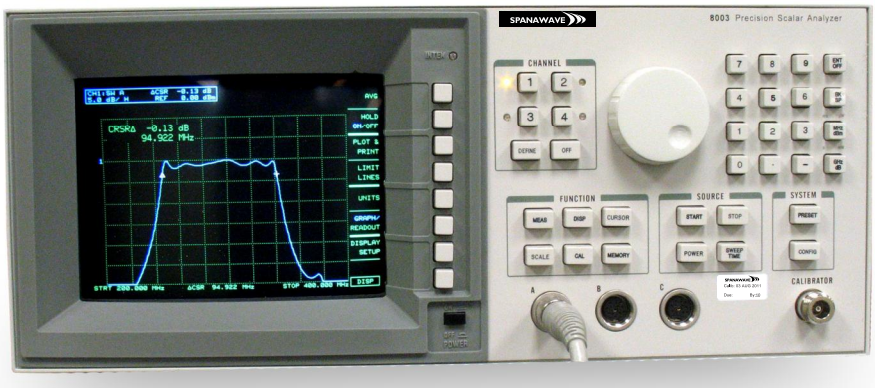
Technical Datasheet

Scalar Network Analyzer

Model 8003 - 10 MHz to 40 GHz



The Spanawave Model 8003 Precision Scalar Network Analyzer combines a 90 dB wide dynamic range with the accuracy and linearity of a power meter in a signal instrument.

SPANAWAVE

8003 Precision Scalar Network Analyzer

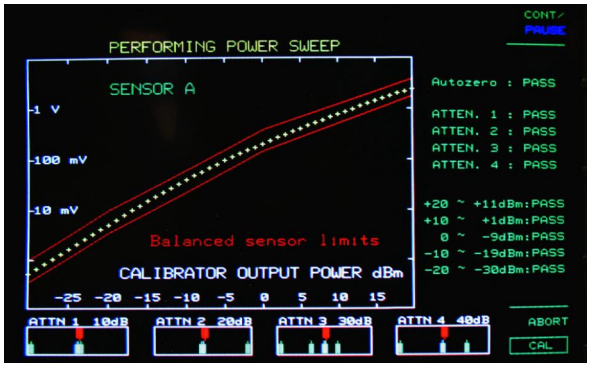
Wide Dynamic Range

The Model 8003 Precision Scalar Network 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 other scalar analyzers. In addition to wide dynamic range, our approach also delivers extremely accurate low level measurements all the way down to –70 dBm.

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°C to 50°C. 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 dynamic range to ensure accurate ratio or relative measurements.



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

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. Each Spanawave 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 calibration 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

Spanawave offers an extensive line of power sensors for the Model 8003 to address a variety of power measurement

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

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 (swept signal generator). The sensors can also be used to display the response of devices with no pulse modulation on the signal generator.

8003 Technical Specifications

System Specifications

Specifications describe the instrument's warranted performance, and apply when using 8030XA Series Power Sensors and 8050X Series Bridges.

Frequency Range: 10 MHz to 40 GHz in coax using the Spanawave 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 Spanawave power sensors and bridges.

Display

Screen: 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: Three 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 screen. Readout mode displays power level at cursor frequency or CW power levels in digital format on screen.

Graph Modes:
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/div to 20 dB/div (1, 2, 5 sequence)	-99.99 to +99.99	0.01

Readout Modes:
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.

Cursors 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.

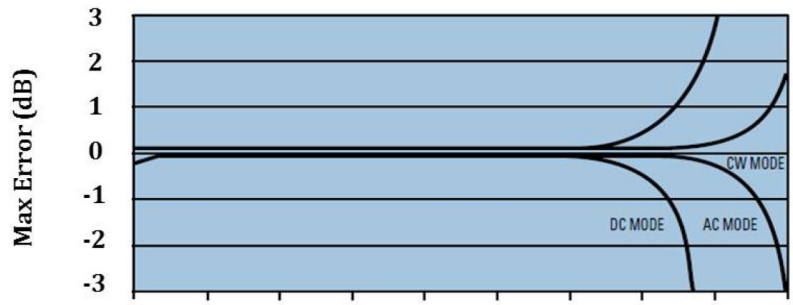
Ref to Cursor: Automatically changes the Ref Level to the level at the cursor.

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 versus Input Power



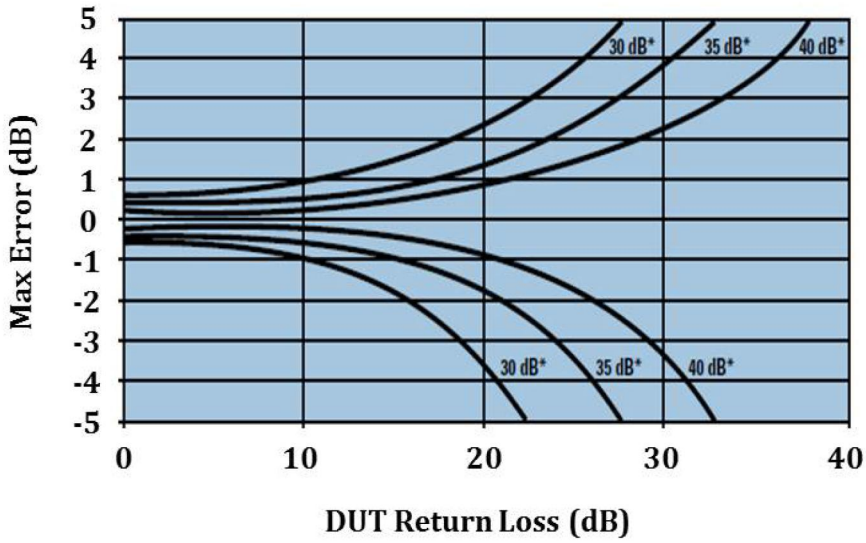
Sensor										
80301	20	10	0	-10	-20	-30	-40	-50	-60	-70
80310	26	16	6	-4	-14	-24	-34	-44	-54	-64
80320	30	20	10	0	-10	-20	-30	-40	-50	-60
80330					20	10	0	-10	-20	-30
Bridge										
80501			15	5	-5	-15	-25	-35	-45	-55

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 Uncertainly versus Directivity

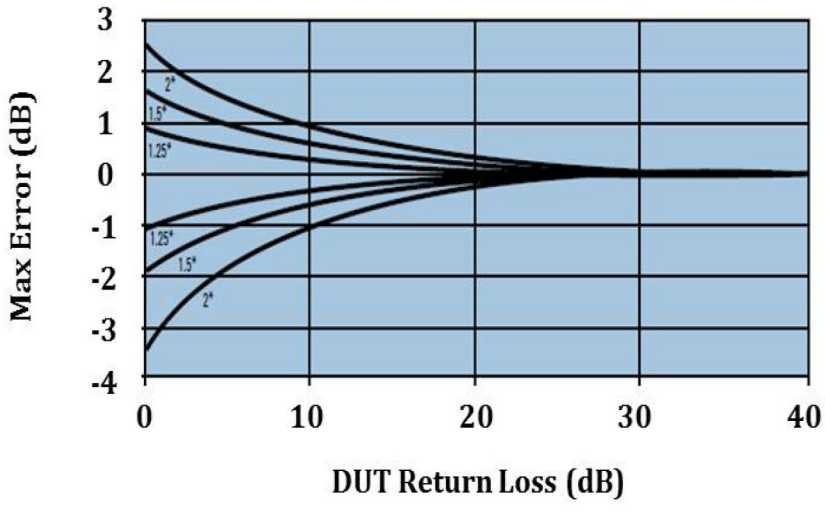
Directivity = 30, 35 and 40 dB



Reflection Accuracy = Instrument Accuracy + Reflection Bridge Accuracy

Figure 3 Reflection Uncertainly versus Source Match

VSWR = 1.25:1, 1.5:1 and 2:1



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.

Calibrator Frequency: 50 MHz nominal

Calibrator 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 (NIST).

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

Calibrator VSWR: < 1.05:1 (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
Standard Sensors, 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 (typical).

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 (typical).

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
True RMS Sensors, 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 (typical) in 1 hour at constant temperature after at 24 hour warm-up.

Zeroing Accuracy, (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 warm-up. 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

Automatic: Sweeper

General Specifications

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

8003 Technical Specifications

Rear Panel Inputs and Outputs

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

Blanking Input: (BNC connector) Used to blank the sweep oscillator (swept signal generator) band switching points on the 8003 display. Voltage level: Blanked > 2 V; Un-blanked < 0.8 V (typical)

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

AC Modulation Output: (BNC connector) Provides drive to modulation input on sweeper (swept signal generator) 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 generator, plotter or printer.

RS232 Port: Serial Communications Interface for driving legacy serial printers and plotters.

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.

Bridge Frequency Response: Calibrated return loss measurements using the 8003 can be frequency compensated using the standard calibration kit 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: Thru,Open,Short and Load (TOSL) are included for establishing the 0 dB return loss reference during path calibration.

8003 Technical Specifications

Spanawave CW Power Sensor Selection Guide

	Frequency Range / Power Rangee	Maximum Power	Power Linearity [1] (Frequency > 8 GHz)	RF Connector	Length	Diameter	Weight	VSWR
200 mW 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) 50 Ω	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 1.29 : 12.4 - 18 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 50 Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	
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] 50 Ω	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 1.38 : 12.4 - 18 GHz 1.43 : 18 - 26.5 GHz 1.92 : 26.5 - 40 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] 50 Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	
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] 50 Ω	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 1.23 : 12 - 18 GHz 1.29 : 18 - 26.5 GHz 1.50 : 26.5 - 40 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					
80314A	10 MHz to 40 GHz -64 to +6 dBm	+29 dBm (800 mW)	-64 to -14 dBm: ±0.00 dB -14 to +6 dBm: ±0.2 dB/10 dB					
1 W 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] 50 Ω	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 1.18 : 12 - 18 GHz 1.22 : 18 - 26.5 GHz 1.36 : 26.5 - 40 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					
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					

Spanawave True RMS Power Sensors Selection Guide (f_m > 1.5 MHz)

	Frequency Range / Power Range	Maximum Power	Power Linearity [1] (Frequency > 8 GHz)	RF Connector	Length	Diameter	Weight	VSWR
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] 50 Ω	152 mm (6.0 in)	32 mm (1.25 in)	0.27 kg (0.6 lb)	1.12 : 0.01 - 2 GHz 1.15 : 12 - 18 GHz 1.18 : 18 - 26.5 GHz 1.29 : 26.5 - 40 GHz

[1] Includes System Linearity.
[2] The K connector is electrically and mechanically compatible with the APC-3.5 and SMA connectors. Note: Use a Type N(m) to SMA(f) adapter (part no. 29835) for calibration of power sensors with Type K(m) connectors.

8003 Technical Specifications

Spanawave Triggerable Pulse Power Sensors Selection Guide

	Frequency Range / Power Range	Maximum Power	Power Linearity [1] (Frequency > 8 GHz)	RF Connector	Length	Diameter	Weight	VSWR
200 mW 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 lb)	1.12 : 0.5 - 2 GHz 1.22 : 2 - 12.4 GHz 1.37 : 12.4 - 18 GHz 1.50 : 18 - 26.5 GHz 1.92 : 26.5 - 40 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 lb)	
80344A	50 MHz to 40 GHz -20 to +0.0 dBm (Triggered) -30 to +0.0 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 lb)	

Spanawave Bridge Selection Guide

	Frequency Range / Power Range	Maximum Power	Power Linearity [1] (Frequency > 8 GHz)	Input	Test Port	Directivity	Weight	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) 50 Ω	Type N(f) 50 Ω	38 dB	0.340 kg	<1.17:0.01 - 18 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) 50 Ω	APC-7(f) 50 Ω	40 dB	0.340 kg	<1.13:0.01 - 8 GHz <1.22:8 - 18 GHz
80503B	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	3.5mm(f) 50 Ω	3.5mm(f) 50 Ω	35 dB	0.340 kg	<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) 50 Ω	Type K(f) 50 Ω	30 dB	0.198 kg	<1.35:0.01 - 26.5 GHz <1.44:26.5 - 40 GHz

Sensor Calibration Factor Uncertainties

Frequency (GHz)		Root Sum of Squares (RSS) Uncertainties (%) [3]				
			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

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

Swept Signal Generator Control

The Model 8003 Precision Scalar Network Analyzer can control several swept microwave signal generators from various manufacturers.

Compatible Signal Generators

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 band switching.

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

Ordering Information

Spanawave has a network of RF and Microwave instrumentation sales engineers and a staff of factory support personnel to help you find the best, most economical instrument for your specific applications. In addition to helping you select the best instrument for your needs, our staff can provide quotations, assist you in placing orders, and do everything necessary to ensure that your business transactions with Spanawave are handled efficiently.

Model Number	Description
8003	Microwave Scalar Network Analyzer (includes Qty 3 of 20954-001 sensor cables)
Options for 8003	
Option 01	Model 8003 Rack Mount Kit with Rack Slides (P/N 20692)
Option 03	BNC/GPIB Cable Kit (48" BNC Coax Cable,24" BNC Coax Cable,IEEE-488/GPIB Cable,2m) (P/N 21003)
Option 04	Model 8003 Rack Mount Kit without Rack Slides (P/N 20692-001)
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)
Recommended Accessories:	
21044	18 GHz Attenuator Calibration Kit (80501,80301A,21045,Wooden Case)
21049B	26.5 GHz Attenuator Calibration Kit (80503B,80313A Qty 2,21045 Qty 2,JRAA-00202,Wooden Case)
Optional Accessories:	
JRNA-00000	Type – N (f) to (f) Adapter
JRNC-00000	Type – N (f) to (m) Adapter
JRNT-00050	Type – N (M) 50 Ohm Termination
JRAA-00202	SMA(m) – SMA (m) 27 GHz Adapter
JRXA-00600	3.5mm (m) - 3.5mm (m) 34 GHz Adapter
21045	Precision N (f) to APC 3.5 (f) Adapter

Spanawave Support Services

At Spanawave, we understand the challenges you face. Our support services begin from the moment you call us. We help you achieve both top-line growth and bottom-line efficiencies by working to identify your precise needs and implement smart and result orientated solutions. We believe and commit ourselves in providing you with more than our superior test solutions. For technical support, contact:

Toll free: 1-866-202-9262 Fax: 1-916-405-3488

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