8650A
SERIES
UNIVERSAL
POWER
METERS

8650A

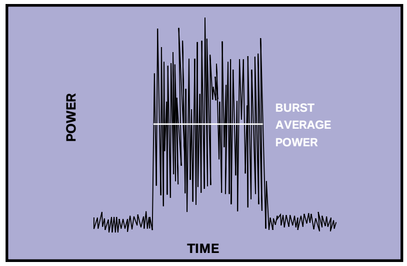
Giga-tronics

The Capabilities to Test Today's Sophisticated Communications Systems

The Giga-tronics 8650A Series Universal Power Meters have the extensive measurement capabilities and unique features required to test today's sophisticated communications systems faster and more accurately.

TDMA

The 8650A can automatically measure the average power of pulse modulated signals or pulse signals that are ampli-

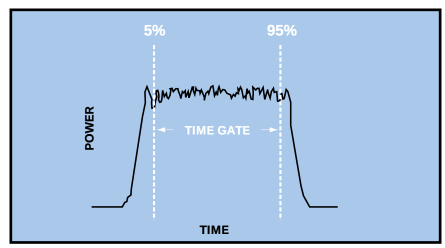


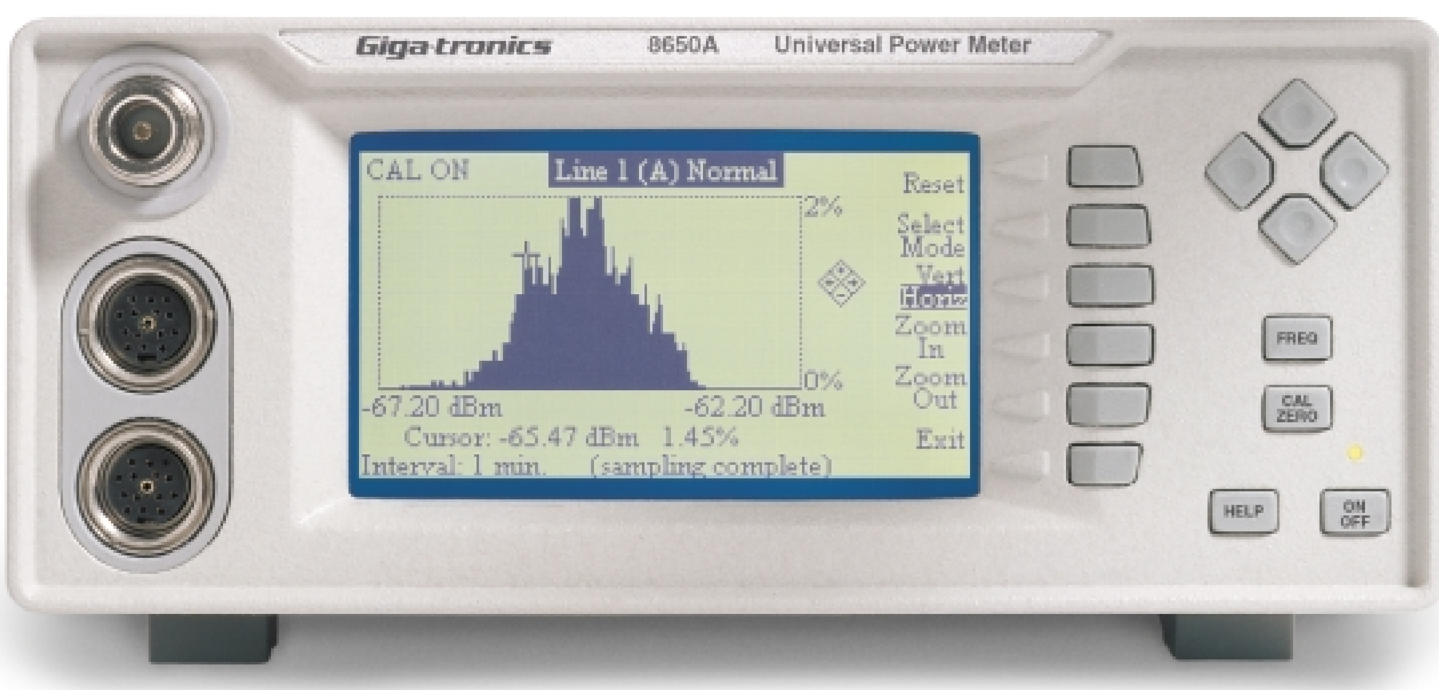
tude modulated during the pulse 'on' period — such as TDMA signals.

Using the exclusive Burst Average Power mode (BAP), the average power reading in the pulse burst is automatically measured between the 3 dB points. Therefore, the duty cycle can change in time without affecting the accuracy of the meter reading. This method eliminates the need to manually set time gating, which can add errors if the gate is not set accurately.

GSM

The Time Gating feature of the 8650A lets you program





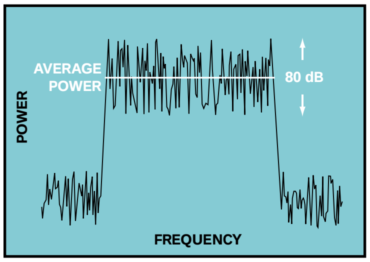
The Giga-tronics 8650A Series combines the speed, range and capabilities needed to test today's sophisticated communications systems.

Giga-tronics 8650A Features and Specifications	
GPIB CW Measurement Speed (rdgs/s)	
Normal Mode	>300
Swift Mode	>1,750
Fast Buffered Mode	>26,000
GPIB Modulated Measurement Speed (rdgs/s)	
Normal Mode	>150
Swift Mode	>800
Fast Modulated Mode	>800
Asynchronous Sample Rate	2.5–5 MHz
Maximum Diode Sensor Video Bandwidth	20 MHz
Maximum Instrument Video Bandwidth	10 MHz
Maximum Single Sensor CW Dynamic Range	90 dB
Maximum Single Sensor Modulation Dynamic Range	
TDMA/GSM	60–80 dB
CDMA (IS-95)	80 dB
Wideband CDMA (10 MHz bandwidth)	80 dB
Maximum Peak Power Sensor Rise Time	100 ns
Automatic Time Gate Setting	Yes
Direct Crest Factor Measurement	Yes
Statistical Power Measurement Analysis	Yes

a measurement start time and duration to measure the average power during a specific time period of a GSM burst signal. The graphic display provides visual feedback if you prefer to set the gate manually. And, of course, there is the ability to use the TTL signal for automatically setting the time gate control.

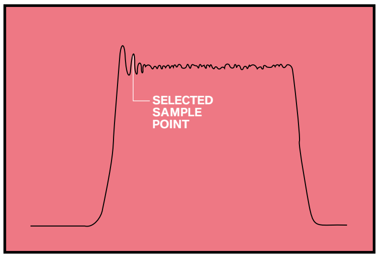
CDMA

The 8650A has the wide, 80 dB single sensor dynamic range required for CDMA signal open-loop tests, the speed you need to quickly measure power during closed-loop tests, and the 10 MHz bandwidth needed to test third-generation CDMA signals.



INSTANTANEOUS PEAK POWER

You can also measure the instantaneous peak power level of a pulse modulated signal with the 8650A.

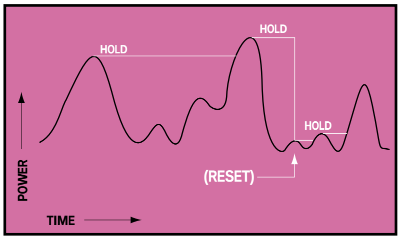


A built-in delay line lets you trigger a few nanoseconds ahead of the pulse for rising edge measurements. While a built-in time base gives you sample delay control up to 100 ms after the trigger point with 0.5 ns resolution. And you can view the profile and see the exact measurement point on the pulse.

MAXIMUM PEAK POWER

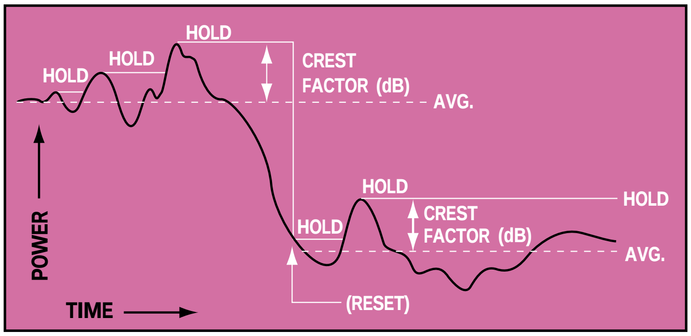
The peak hold feature of the 8650A lets you display the highest instantaneous power measured from the time the feature is enabled until it is reset.

The display value tracks the measured value only



when it is rising to a new maximum; when the measured value falls, the display value holds at the maximum.

The Features to do the Job
Faster, Easier and More Accurately



CREST FACTOR

The crest factor capability of the 8650A displays the ratio of the maximum peak power (peak hold) measurement to the average power measurement (in dB) from the time the feature is enabled until it is reset.

The crest factor capability operates in the same manner as the peak hold capability: the display value holds at the maximum until it is reset.

INCREDIBLE SPEED AND STATISTICAL ANALYSIS

No other meter delivers the measurement speed available from the 8650A.

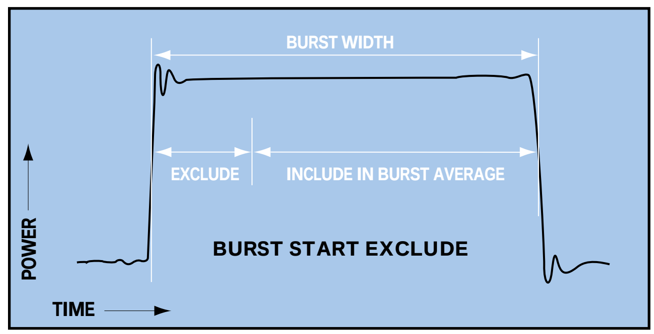
Achieve over 1,750 readings per second over GPIB. Or use our exclusive fast buffered mode to further reduce processor overhead and capture over 26,000 readings per second.

Incredible speed for CW and modulated measurements results from an asynchronous sampling rate of 2.5 to 5 MHz, that minimizes the aliasing effects of signals to produce faster average power measurements.

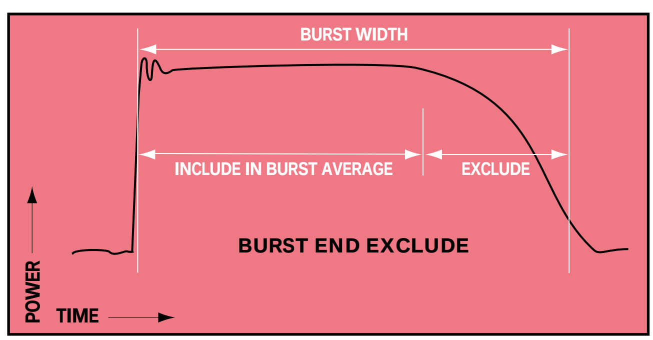
And the 8650A features a wide variety of statistical power measurement analysis, to evaluate communications system efficiency.

BURST START AND END EXCLUDE

The exclusive burst start and end exclude capabilities of the 8650A allow you to exclude the beginning or end of a burst when measuring the average burst power.



Masking the beginning or the end of a burst signal, in order to exclude overshoot or other distortions, can be desirable or even required for certain types of power measurements.



Unrivaled Accuracy and Built-In Calibration

Giga-tronics uses diode sensors exclusively to provide speed, range, capability and accuracy unavailable from any other power meter.

ACCURACY OVER A 90 dB RANGE

Giga-tronics has solved the problem that limited the use of diode sensors to below –20 dBm — the 'square law' region — by utilizing a patented built-in power sweep calibration system.

The power sweep calibrator uses a 50 MHz amplitude controlled oscillator to step from –30 to +20 dBm in 1 dB increments. Each step is set using an internal thermistor — the standard for accuracy and traceability.

Giga-tronics gives you thermistor accuracy plus diode speed for measuring signals over a full 90 dB power range.

BUILT-IN FREQUENCY RESPONSE CALIBRATION

Configuring the meter for measurements is easy with calibration factors programmed into the sensor.

When the measurement frequency is entered, the meter automatically applies the correct calibration factor from the sensor EEPROM. And the meter automatically reads a new set of cal factors when a sensor is changed.

This avoids the chance of measurement error from using invalid calibration factors when you change sensors, or from forgetting to enter new calibration factors. You not only avoid measurement errors; you also save yourself test time.

Accuracy Audit

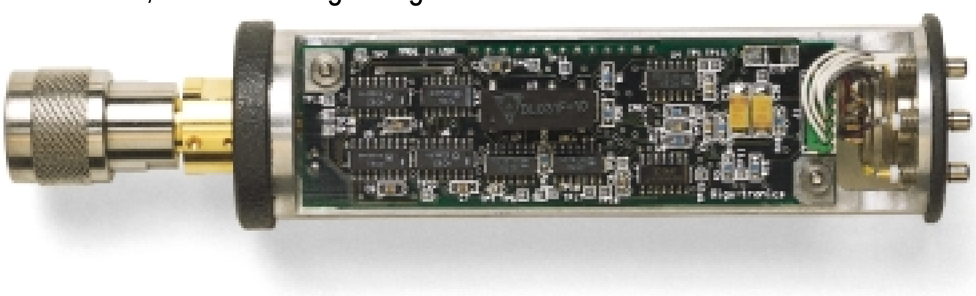
The Accuracy Audit table lists the significant uncertainties of an absolute power measurement. The accuracy of the 8650A combined with the 80301A sensor is compared to a typical thermocouple sensor/meter combination at +20 dBm, 0 dBm, and –30 dBm (the dynamic limit of the thermocouple sensor). The uncertainty comparison at –30 dBm illustrates the accuracy advantage of a wide dynamic sensor, even when the full 90 dB dynamic range is not utilized.

+20 dBm Frequency = 1 GHz; Source Match = 1.5:1	8650A with 80301A	Typical Thermocouple Meter/Sensor
Instrumentation Uncertainty	±5.2%	+ 2.5% –4.5%
Sensor Power Linearity (>8 GHz)	± 0%	± 0%
Calibrator Uncertainty	± 1.2%	± 1.2%
Calibrator/Sensor Mismatch	± 0.28%	± 0.23%
Calibration Factor Uncertainty	± 1.04%	± 1.6%
Zero Set	± 0.00000005%	± 0.00005%
Noise	± 0.00000005%	± 0.0001%
Mismatch (Sensor/Source)	± 2.25%	± 2.0%
% Total Uncertainty	**±9.97%**	**+ 7.53 –9.53%**
dB Total Uncertainty	**± 0.41 dB**	**+ 0.316 – 0.4 dB**

0 dBm Frequency = 1 GHz; Source Match = 1.5:1	8650A with 80301A	Typical Thermocouple Meter/Sensor
Instrumentation Uncertainty	± 0.5%	± 0.5%
Sensor Power Linearity (>8 GHz)	± 0%	± 0%
Calibrator Uncertainty	± 1.2%	± 1.2%
Calibrator/Sensor Mismatch	± 0.28%	± 0.23%
Calibration Factor Uncertainty	± 1.04%	± 1.6%
Zero Set	± 0.000005%	± 0.005%
Noise	± 0.000005%	± 0.01%
Mismatch (Sensor/Source)	± 2.25%	± 2.0%
% Total Uncertainty	**± 5.27%**	**± 5.54%**
dB Total Uncertainty	**± 0.22 dB**	**± 0.23 dB**

–30 dBm Frequency = 1 GHz; Source Match = 1.5:1	8650A with 80301A	Typical Thermocouple Meter/Sensor
Instrumentation Uncertainty	± 0.925%	± 0.5%
Sensor Power Linearity (>8 GHz)	± 0%	± 0%
Calibrator Uncertainty	± 1.2%	± 1.2%
Calibrator/Sensor Mismatch	± 0.28%	± 0.23%
Calibration Factor Uncertainty	± 1.04%	± 1.6%
Zero Set	± 0.005%	± 5%
Noise	± 0.005%	± 10%
Mismatch (Sensor/Source)	± 2.25%	± 2.0%
% Total Uncertainty	**± 5.71%**	**± 20.53%**
dB Total Uncertainty	**± 0.24 dB**	**± 0.8 dB**

An EEPROM in all Giga-tronics sensors automatically applies the correct cal factor, so you save time and avoid measurement errors.



Giga-tronics power meter architecture provides for a broad choice of functional sensors. Just by changing a sensor, you can measure CW power, pulse power, and the peak and average power of TDMA, GSM and CDMA signals faster, more accurately, and over a wider range.

THE FASTEST CW MEASUREMENTS

Giga-tronics 80300A Series CW Power Sensors let you measure CW power from 10 MHz to 40 GHz at more than 1,750 readings per second over GPIB.

Measure up to 90 dB with a single sensor, and select from a variety of high power sensors, up to 50 W.

PULSE POWER MEASUREMENTS

Attach a Giga-tronics 80350A Series Peak Power Sensor to an 8650A meter and directly measure the instantaneous peak power level of a pulse modulated signal.

Use the ‘sample delay’ function to set the desired measurement point on the waveform. And an external scope can be used to view the profile and see the exact measurement point on the pulse.

Sensor Measurement Capabilities

Signal Type	80301A	80350A	80401A	80601A	80701A
			Sensor Model		
CW Power Level	–70 to +20 dBm	–30 to +20 dBm	–67 to +20 dBm	–67 to +20 dBm	–64 to +20 dBm
Amplitude Modulation Rate, Power Range	N/A	N/A	$f_m \leq$ 40 kHz, –60 to +20 dBm $f_m >$ 40 kHz, –60 to –20 dBm	$f_m \leq$ 1.5 MHz, –60 to +20 dBm $f_m >$ 1.5 MHz, –60 to –20 dBm	$f_m \leq$ 10 MHz, –60 to +20 dBm
Two-Tone Maximum Separation Between Carriers	N/A	N/A	$\leq$ 40 kHz, –60 to +20 dBm > 40 kHz, –60 to –20 dBm	$\leq$ 1.5 MHz, –60 to +20 dBm > 1.5 MHz, –60 to –20 dBm	$\leq$ 10 MHz, –60 to +20 dBm > 10 MHz, –60 to –20 dBm
Pulse Modulation	N/A	> 350 ns Pulse Width	> 200 µs Pulse Width	> 300 µs Pulse Width	> 100 µs Pulse Width
Burst with Modulation f_m = modulation rate	N/A	N/A	$f_m \leq$ 40 kHz, > 200 µs Pulse Width; –40 to +20 dBm $f_m >$ 40 kHz, > 200 µs Pulse Width; –40 to –20 dBm	$f_m \leq$ 1.5 MHz, > 300 µs Pulse Width; –40 to +20 dBm $f_m >$ 1.5 MHz, > 300 µs Pulse Width; –40 to –20 dBm	$f_m \leq$ 10 MHz, > 100 µs Pulse Width; –30 to +20 dBm $f_m >$ 10 MHz, > 100 µs Pulse Width; –30 to –20 dBm

MODULATED POWER MEASUREMENTS

The Giga-tronics 80400A Series Modulated Power Sensors let you measure the average power of amplitude modulated, burst modulated and other complex modulated signals — such as TDMA signals — at bandwidths up to 40 kHz.

The Giga-tronics 80600A Series Modulated Power Sensors provide bandwidth up to 1.5 MHz to measure the peak and average power of CDMA signals.

And the Giga-tronics 80701A Modulated Power Sensor operating with the 8650A power meter, provides system bandwidth up to 10 MHz to measure the peak and average power of wide band, third-generation CDMA signals over an 80 dB range.

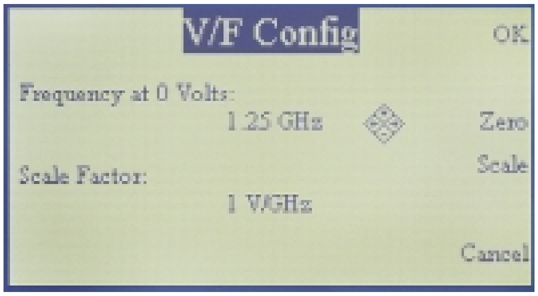
SEE FOR YOURSELF

The 8650A incorporates a 3.72” wide by 2.15” high Liquid Crystal Display (LCD) with 240 x 120 dot resolution, 0.38 mm dot pitch, and Cold Cathode Fluorescent Lamp (CCFL) back light for maximum detail and optimum viewing.

The large display lets you see more information. And the display works in tandem with the meter controls to let you view menu selections and see your input data as you enter it.

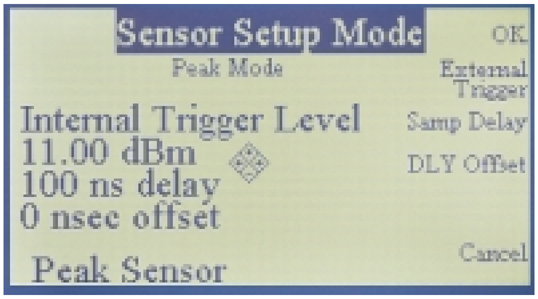
You can view calibration information, select a standard mode, setup and recall pre-configured, custom modes, and set measurement points and durations.

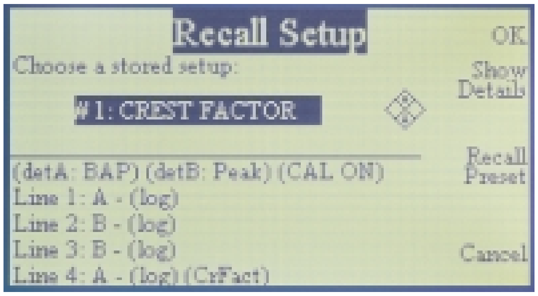
Each sensor uses an EEPROM to store values of cal factor. Entering the measurement frequency automatically calls up the correct cal factor. If the measurement frequency is between cal factor points, the meter automatically enters an interpolated value.



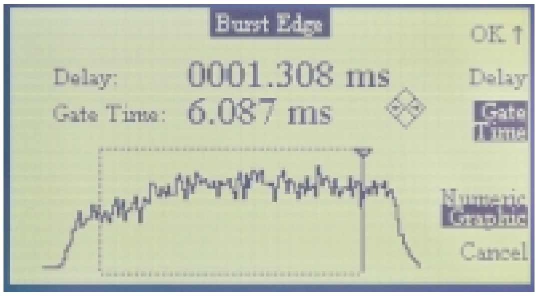
A volts per frequency input is available to set the cal factor when connected to an RF source. As the source frequency is modified the V/F output will automatically set the power meter to the correct cal factor, thereby eliminating the need for manual input.

Peak (Pulse) power sensors can be set to the desired measurement point of a pulse signal. The trigger point can be set using an internal power level or a TTL signal.

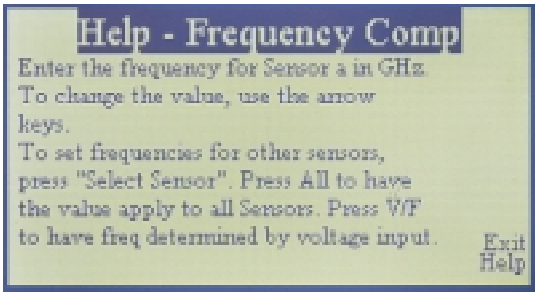




Recall setup can be used to pre-configure measurement modes for later use. Full descriptive details help to clearly identify the settings before recall.



The graphic display provides visual feedback as you set the measurement start time and duration of the time gate to measure the average power during a specific time period.



An extensive list of help panels provide assistance in setting up special features and guidance in making the measurement.

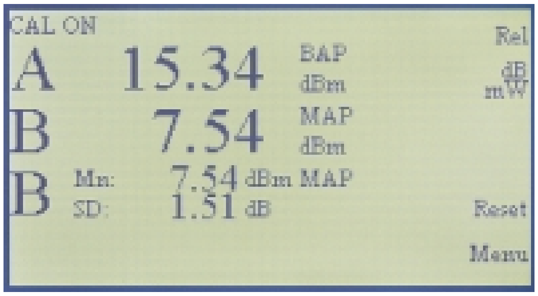
STATISTICAL ANALYSIS

Excessive cost can prove as detrimental to the success of communications equipment as inadequate performance.

The 8650A provides a range of statistical power measurement analysis features that help you optimize your designs to prevent inadequate performance due to under design or excessive cost due to over design.

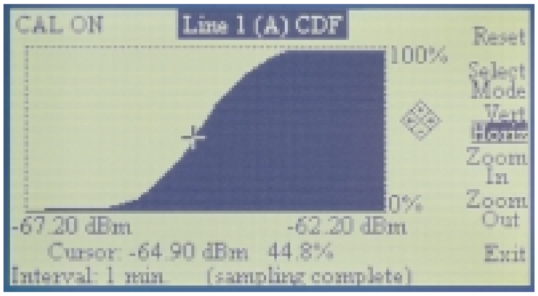
These features include crest factor, standard deviation, strip chart, CDF/CCDF, and histogram, and they let you view and thoroughly analyze the power signal over a selected period of time.

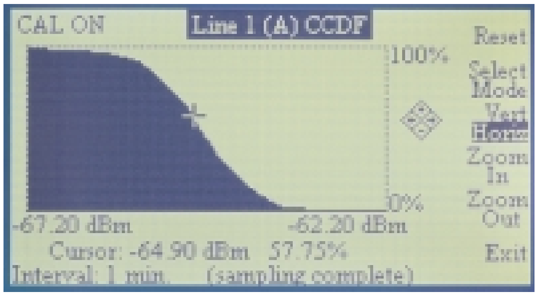
Combined, they make the 8650A the most advanced power meter available for communications systems design.

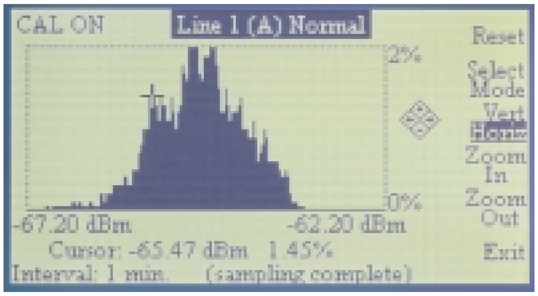


View the mean power and standard deviation of the modulated signal over a time period of interest. Standard deviation offers an alternative descriptive analysis of the power variation when compared to the traditional crest factor.

The Cumulative Distribution Function (CDF) shows the percentage of time a signal is below a selected power level. The x axis displays the amount of power at the selected level, measured in dBm, and the y axis displays the percentage of time the power is at or below the power specified by the x axis. The Complementary Cumulative Distribution Function (CCDF) reorients the CDF curve in accordance with the equation CCDF = 1-CDF for more accustomed viewing of a descending slope. Moving a cursor along the slope of the curve displays the power level in dBm and the corresponding percentage of time the signal is above that level.

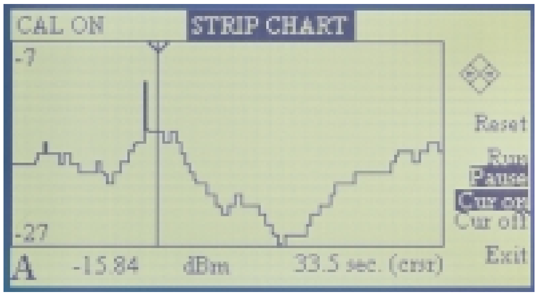






The histogram function allows you to view a power range distribution over a period of time. The x axis displays the minimum to maximum power levels measured during the interval time period, and the y axis displays the percent of time each power level is measured. A zoom feature lets you view smaller segments of the power range to better analyze the percentage of time a specific power level has occurred.

The strip chart function allows you to view the varying power levels of a signal over a period of time. The x axis displays time from the start of the measurement to a selectable period of 1 to 200 minutes, and the y axis displays the minimum to maximum power levels measured during the selected period. Moving a cursor along the x axis displays time and the corresponding power level.



Giga-tronics CW Power Sensor Selection Guide

Model	Frequency Range/ Power Range	Maximum Power	Power Linearity [4] (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) 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 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 50Ω	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) [1] 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 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) [1] 50Ω	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) [1] 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 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 +6dBm: ±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) [1] 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 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					
5 W CW Power Sensor [2]								
80321A	10 MHz to 18 GHz –50 to +37 dBm	+37 dBm (5 W)	–50 to 0 dBm: ±0.00 dB 0 to +37 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	150 mm (5.9 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.20: 0.01 - 6 GHz 1.25: 6 - 12.4 GHz 1.35: 12.4 - 18 GHz
25 W CW Power Sensor [3]								
80322A	10 MHz to 18 GHz –40 to +44 dBm	+44 dBm (25 W)	–40 to +10 dBm: ±0.00 dB +10 to +44 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	230 mm (9.0 in)	104 mm (4.1 in)	0.3 kg (0.6 lb)	1.20: 0.01 - 6 GHz 1.30: 6 - 12.4 GHz 1.40: 12.4 - 18 GHz
50 W CW Power Sensor [3]								
80325A	10 MHz to 18 GHz –40 to +47 dBm	+47 dBm (50 W)	–40 to +10 dBm: ±0.00 dB +10 to +47 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	230 mm (9.0 in)	104 mm (4.1 in)	0.3 kg (0.6 lb)	1.25: 0.01 - 6 GHz 1.35: 6 - 12.4 GHz 1.45: 12.4 - 18 GHz

Giga-tronics Peak Power Sensor Selection Guide

Model	Frequency Range/ Power Range	Maximum Power	Power Linearity [4] (Frequency > 8 GHz)	RF Connector	Length	Diameter	Weight	VSWR
200 mW Peak Power Sensors								
80350A	45 MHz to 18 GHz –20 to +20 dBm, Peak –30 to +20 dBm, CW	+23 dBm (200 mW) CW or Peak	–30 to –20 dBm: ±0.00 dB –20 to +20 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	165 mm (6.5 in)	37 mm (1.25 in)	0.3 kg (0.7 lb)	1.12: 0.045 - 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
80353A	45 MHz to 26.5 GHz –20 to +20 dBm, Peak –30 to +20 dBm, CW	+23 dBm (200 mW) CW or Peak	–30 to –20 dBm: ±0.00 dB –20 to +20 dBm: ±0.1 dB/10 dB	Type K(m) [1] 50Ω	165 mm (6.5 in)	37 mm (1.25 in)	0.3 kg (0.7 lb)	
80354A	45 MHz to 40 GHz –20 to +0.0 dBm, Peak –30 to +0.0 dBm, CW	+23 dBm (200 mW) CW or Peak	–30 to –20 dBm: ±0.00 dB –20 to 0.0 dBm: ±0.2 dB/10 dB	Type K(m) [1] 50Ω	165 mm (6.5 in)	37 mm (1.25 in)	0.3 kg (0.7 lb)	
5 W Peak Power Sensor [5,7]								
80351A	45 MHz to 18 GHz 0 to +40 dBm, Peak –10 to +37 dBm, CW	CW: +37 dBm (5 W Average) Peak: +43 dBm	–10 to +0 dBm: ±0.00 dB 0.0 to +40 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	200 mm (7.9 in)	37 mm (1.25 in)	0.3 kg (0.7 lb)	1.15: 0.045 - 4 GHz 1.25: 4 - 12.4 GHz 1.35: 12.4 - 18 GHz
25 W Peak Power Sensor [6,7]								
80352A	45 MHz to 18 GHz +10 to +50 dBm, Peak 0.0 to +44 dBm, CW	CW: +44 dBm (25 W Average) Peak: +53 dBm	0.0 to +10 dBm: ±0.00 dB +10 to +50 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	280 mm (11.0 in)	104 mm (4.1 in)	0.3 kg (0.7 lb)	1.20: 0.045 - 6 GHz 1.30: 6 - 12.4 GHz 1.40: 12.4 - 18 GHz
50 W Peak Power Sensor [6,7]								
80355A	45 MHz to 18 GHz +10 to +50 dBm, Peak 0.0 to +47 dBm, CW	CW: +47 dBm (50 W Average) Peak: +53 dBm	0.0 to +10 dBm: ±0.00 dB +10 to +50 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	280 mm (11.0 in)	104 mm (4.1 in)	0.3 kg (0.7 lb)	1.25: 0.045 - 6 GHz 1.35: 6 - 12.4 GHz 1.45: 12.4 - 18 GHz

Giga-tronics Bridge Selection Guide

Model	Frequency Range/ Power Range	Maximum Power	Power Linearity [4] (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) 50Ω	Type N(f) 50Ω	38 dB	0.340 kg	< 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	< 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	< 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	< 1.35: 0.01 - 26.5 GHz < 1.44: 26.5 - 40 GHz

Giga-tronics Modulation Power Sensor Selection Guide ($f_m \leq$ 40 kHz)

	Frequency Range/ Power Range	Maximum Power	Power Linearity [4] (Frequency > 8 GHz)	RF Connector	Length	Diameter	Weight	VSWR
200 mW Modulation Power Sensors								
80401A	10 MHz to 18 GHz –67 to +20 dBm	+23 dBm (200 mW)	–67 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 1.29: 12.4 - 18 GHz
80402A	10 MHz to 18 GHz –67 to +20 dBm	+23 dBm (200 mW)	–67 to –20 dBm: ±0.00 dB –20 to +20 dBm: ±0.05 dB/10 dB	APC-7 50Ω				
Low VSWR Modulation Power Sensor								
80410A	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 [1](m) 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 1.23: 12 - 18 GHz
1 W Modulation Power Sensor								
80420A	10 MHz to 18 GHz –57 to +30 dBm	+30 dBm (1 W)	–57 to–10 dBm: ±0.00 dB –10 to +30 dBm: ±0.05 dB/10 dB	Type K [1](m) 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 1.18: 12 - 18 GHz
5 W Modulation Power Sensor [2]								
80421A	10 MHz to 18 GHz –47 to +37 dBm	+37 dBm (5 W)	–47 to 0 dBm: ±0.00 dB 0 to +37 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	150 mm (5.9 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.20: 0.01 - 6 GHz 1.25: 6 - 12.4 GHz 1.35: 12.4 - 18 GHz
25 W Modulation Power Sensor [3]								
80422A	10 MHz to 18 GHz –37 to +44 dBm	+44 dBm (25 W)	–37 to +10 dBm: ±0.00 dB +10 to +44 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	230 mm (9.0 in)	104 mm 4.1 in)	0.3 kg (0.6 lb)	1.20: 0.01 - 6 GHz 1.30: 6 - 12.4 GHz 1.40: 12.4 - 18 GHz
50 W Modulation Power Sensor [3]								
80425A	10 MHz to 18 GHz –34 to +47 dBm	+47 dBm (50 W)	–34 to +10 dBm: ±0.00 dB +10 to +47 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	230 mm (9.0 in)	104 mm (4.1 in)	0.3 kg (0.6 lb)	1.25: 0.01 - 6 GHz 1.35: 6 - 12.4 GHz 1.45: 12.4 - 18 GHz

Giga-tronics Modulation Power Sensor Selection Guide ($f_m \leq$ 1.5 MHz)

	Frequency Range/ Power Range	Maximum Power	Power Linearity [4] (Frequency > 8 GHz)	RF Connector	Length	Diameter	Weight	VSWR
200 mW Modulation Power Sensors								
80601A	10 MHz to 18 GHz –67 to +20 dBm, CW	+23 dBm (200 mW)	–67 to –20 dBm: ±0.00 dB –20 to +20 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	137 mm (5.39 in)	41 mm (1.62 in)	0.23 kg (0.5 lb)	1.12: 0.01 - 2 GHz 1.22: 2 - 12.4 GHz 1.29: 12.4 - 18 GHz
5 W Modulation Power Sensor [5,7]								
80621A	10 MHz to 18 GHz –47 to +37 dBm	+37 dBm (5 W)	–47 to 0 dBm: ±0.00 dB 0 to +37 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	175 mm (6.90 in)	41 mm (1.62 in)	0.28 kg (0.6 lb)	1.20: 0.01 - 6 GHz 1.25: 6 - 12.4 GHz 1.35: 12.4 - 18 GHz

Giga-tronics Modulation Power Sensor Selection Guide ($f_m \leq$ 10 MHz)

	Frequency Range/ Power Range	Maximum Power	Power Linearity [4]	RF Connector	Length	Diameter	Weight	VSWR
200 mW Modulation Power Sensor								
80701A (Requires Option 12)	50 MHz to 18 GHz –64 to +20 dBm, CW 250 MHz to 18 GHz –60 to +20 dBm, Modulation	+23 dBm (200 mW)	**Frequency >8 GHz** –60 to –20 dBm: ±0.00 dB –20 to +20 dBm: ±0.05 dB/10 dB **Frequency <500 MHz** –60 to –20 dBm: ±0.00 dB –20 to +20 dBm: ±0.05 dB/10 dB	Type N(m) 50Ω	120 mm (4.72 in)	27 mm (1.06 in)	0.10 kg (0.2 lb)	1.12: 0.01 - 2 GHz 1.22: 2 - 12.4 GHz 1.29: 12.4 - 18 GHz

Giga-tronics True RMS Sensors Selection Guide (f_m > 1.5 MHz)

	Frequency Range/ Power Range	Maximum Power	Power Linearity [4] (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) [1] 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

Sensor Calibration Factor Uncertainties

Frequency (GHz)		Root Sum of Squares (RSS) Uncertainties(%) [8]						
Lower	Upper	80301A 80302A 80350A 80401A 80402A 80601A 80701A	80303A 80304A 80353A 80354A	80310A 80313A 80314A 80410A	80320A 80323A 80324A 80420A	80321A[9] 80322A[9] 80325A[9] 80421A[9] 80422A[9] 80425A[9] 80621A[9]	80330A 80333A 80334A	80351A[9] 80352A[9] 80355A[9]
Min	1	1.04	1.64	1.58	1.58	4.54	1.58	4.92
1	2	1.20	1.73	1.73	1.73	4.67	1.73	5.04
2	4	1.33	1.93	1.91	1.91	4.89	1.90	7.09
4	6	1.41	2.03	2.02	2.01	5.01	2.01	7.17
6	8	1.52	2.08	2.07	2.06	5.12	2.06	7.25
8	12.4	1.92	2.55	2.54	2.53	5.56	2.53	7.56
12.4	18	2.11	2.83	2.80	2.79	5.89	2.78	12.37
18	26.5	—	3.63	3.68	3.62	—	3.59	—
26.5	40	—	6.05	5.54	5.39	—	5.30	—

[1] 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. [2] Power coefficient equals <0.01 dB/Watt. [3] Power coefficient equals <0.015 dB/Watt. [4] For frequencies above 8 GHz, add power linearity to system linearity. [5] Power coefficient equals <0.01 dB/Watt (Average). [6] Power coefficient equals <0.015 dB/Watt (Average). [7] Peak operating range above CW maximum range is limited to <10% duty cycle. [8] Square root of the sum of the individual uncertainties squared (RSS). [9] Cal Factor numbers allow for 3% repeatability when reconnecting an attenuator to a sensor and 3% for attenuator measurement uncertainty and mismatch of sensor/pad combination.

Specifications describe the instrument's warranted performance, and apply when using the 80300A, 80400A, 80600A, and 80700A Series Sensors.

METER

Frequency Range: 10 MHz to 40 GHz [10]
Power Range: -70 dBm to +47 dBm (100 pW to 50 Watt) [10]
Single Sensor Dynamic Range: [10]

CW Power Sensors:	90 dB
Peak (Pulse) Power Sensors:	40 dB, Peak
	50 dB, CW
Modulation Power Sensors:	87 dB, CW
	80 dB, MAP/PAP [11]
	60 dB, BAP [11]

Display Resolution: User selectable from 1 dB to 0.001 dB in Log mode, and from 1 to 4 digits of display resolution in Linear mode.

Meter Functions

Measurement Modes (Sensors):
CW (80300A, 80350A, 80400A, 80600A, and 80700A Series)
Peak (80350A Series)
MAP/PAP/BAP [11] (80400A, 80600A, and 80700A Series)

Averaging: User selectable, auto-averaging or manual from 1-512 readings. Timed averaging from 20 ms to 20 seconds.

dB Rel and Offset: Power display can be offset by -99.999 to +99.999 dB to account for external loss/gain.

Configuration Storage Registers: Allows up to 20 front panel setups.

Power Measurements and Display Configurations: Any two of the following channel configurations, simultaneously: A, B, A/B, B/A, A-B, B-A, DLYA, DLYB

Number of Display Lines: 4

Sampling:
CW and Modulation Mode: 2.5 to 5 MHz asynchronous

Analog Bandwidth:
CW Mode: ≥3 kHz
Modulation Mode: >10 MHz

Time Gating:
Trigger Delay: 0 to 327 ms
Gate Time: 10 µs to 327 ms
Holdoff Time: 0 to 327 ms

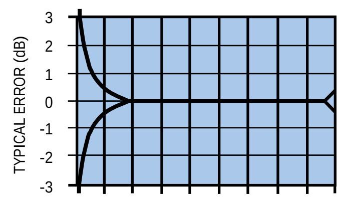
ACCURACY

50 MHz Calibrator: (Standard)
Calibrator: +20 dBm to -30 dBm power sweep calibration signal to dynamically linearize the power sensors.
Connector: Type N, 50 Ω
Frequency: 50 MHz, nominal
0.0 dBm Accuracy: ±1.2% worst case for one year, over temperature range of 5° to 35°C.
VSWR: <1.05 (Return Loss >33 dB) @ 0 dBm.

1 GHz Calibrator: (Option 12)
Required for 80700A Series Sensors.
Calibrator: +20 dBm to -30 dBm power sweep calibration signal to dynamically linearize power sensors.
Connector: Type N, 50 Ω
Frequency: (Switchable): 1 GHz, nominal; 50 MHz, nominal
0.0 dBm Accuracy: ±1.2% worst case for one year, over temperature range of 5° to 35°C.
VSWR: <1.07 (Return Loss >30 dB) @ 0 dBm.

800 MHz - 1 GHz Synthesizer Specifications: (Option 12)
Power Range: +15 dBm to -30 dBm, settable in 1 dB steps.
Frequency: 800 MHz to 1 GHz, settable in 1 MHz steps.
Power Stability: <0.1 dB/Hour
Frequency Accuracy: ± 0.05%

Instrumentation Linearity:
±0.02 dB over any 20 dB range from -70 to +16 dBm. [15]
±0.02 dB + (±0.05 dB/dB) from +16 to +20 dBm.
±0.04 dB from -70 to +16 dBm.



SENSORS										
80301A	-70	-60	-50	-40	-30	-20	-10	0	10	20
80310A	-64	-54	-44	-34	-24	-14	-4	6	16	25
80320A	-60	-50	-40	-30	-20	-10	0	10	20	30
80321A	-50	-40	-30	-20	-10	0	10	20	30	40
80322A	-40	-30	-20	-10	0	10	20	30	40	44
80325A	-40	-30	-20	-10	0	10	20	30	40	50
80330A	-30	-20	-10	0	10	20				
80401A, 80601A (CW)	-67	-57	-47	-37	-27	-17	-7	3	13	20
80701A (CW)	-64	-54	-44	-34	-25	-16	-7	3	13	20

Input, (dBm)

Graph shows linearity plus worst case zero set, and noise versus input power

Temperature Coefficient of Linearity: <0.3%/°C temperature change following Power Sweep calibration. 24 hour warm-up required.

Zeroing Accuracy: (CW)
Zero Set: [12] <±50 pW, <±100 pW with 80400A and 80600A Series Modulation Power Sensors. <±200 pW with 80700A Series Sensors.
Zero Drift: [12] <±100 pW during 1 hour, <±200 pW with 80400A and 80600A Series Sensors, <±400 pW with 80700A Series Sensors.
Noise: <±50 pW, <±100 pW with 80400A and 80600A Series Modulation Power Sensors. <±200 pW with 80700A Series Sensors. Measurable over any 1 minute interval after zeroing, 3 standard deviations.

REMOTE INPUTS/OUTPUTS

V Prop F Input (BNC): Sets calibration factors using source VpropF output. [13]
Analog Output (2) (BNC): Provides an output voltage of 0 to 10V for Channels 1 and 2 in either Lin or Log units. [13] Does not operate in Swift or Buffered modes.
Trigger Input (BNC): TTL trigger input signal for Swift and Fast Buffered modes.
GPIB Interface: IEEE-488 and IEC-625 remote programming
RS232 Interface: Programmable serial interface, DB-9 connector

GENERAL SPECIFICATIONS

Temperature Range:
Operating: 0° to 55°C (+32° to +131°F)[14]
Storage: -40°C to 70°C (-40° to +158°F)
Power Requirements:
100/120/220/240V ±10%,
48 to 440 Hz, 25VA typical
Physical Characteristics:
Dimensions: 215 mm (8.4 in) wide, 89 mm (3.5 in) high, 368 mm (14.5 in) deep
Weight: 4.55 kg (10lbs)

ORDERING INFORMATION

POWER METERS

8651A	Single Input Universal Power Meter (includes 1 sensor cable)
8652A	Dual Input Universal Power Meter (includes 2 sensor cables)

ACCESSORIES

One manual, one power cord.

POWER METER OPTIONS

01	Rack mount kit
03	8651A Rear Panel Sensor and Calibrator Connections
04	8652A Rear Panel Sensor and Calibrator Connections
05	Soft Carry Case
07	Side Mounted Carrying Handle
08	Transit Case, (Includes Soft Carry Case)
09	Dual Rack Mount Kit (with assembly instructions)
10	Dual Rack Mount Kit (factory assembled)
12	1 GHz, 50 MHz Switchable Calibrator
13	8651A Rear Panel Input Connector
14	8652A Rear Panel Input Connectors

[10] Depending on sensor used. [11] MAP (Modulated Average Power), PAP (Pulse Average Power), BAP (Burst Average Power). [12] Specified performance applies with maximum averaging and 24 hour warm-up at constant temperature. [13] Operates in Normal Mode only. [14] Display contrast reduces above 50° C. [15] Does not apply to 80701A Sensor below 500 MHz.

Specifications subject to change without notice.

Giga-tronics

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