

8650A
SERIES
UNIVERSAL
POWER
METERS



8650A

Giga-tronics

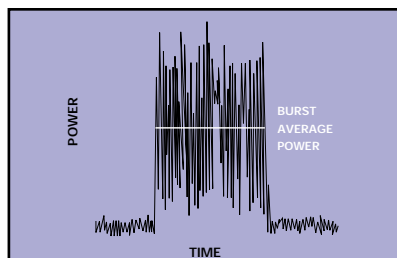
8650A SERIES UNIVERSAL POWER METERS

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-



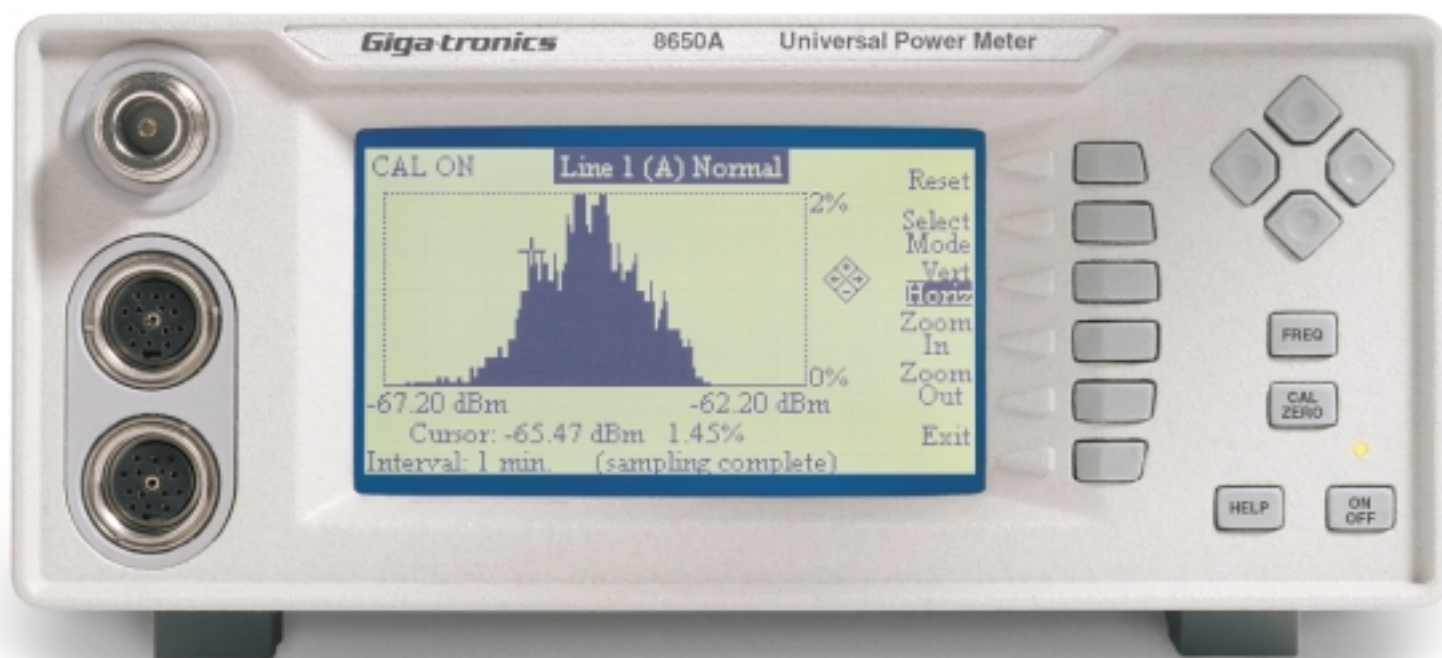
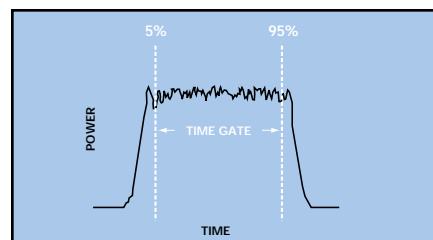
tude modulated during the pulse 'on' period — such as TDMA signals.

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

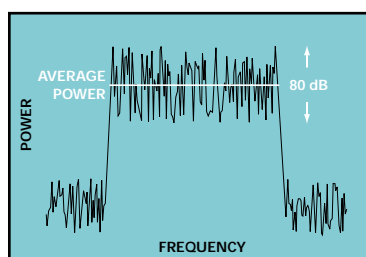


The Giga-tronics 8650A Series combines the speed, range and capabilities needed to test today's sophisticated communications systems.

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.

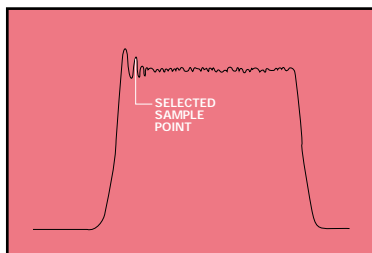
CDMA

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

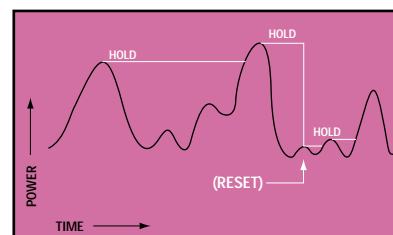
The peak hold feature of the

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 |

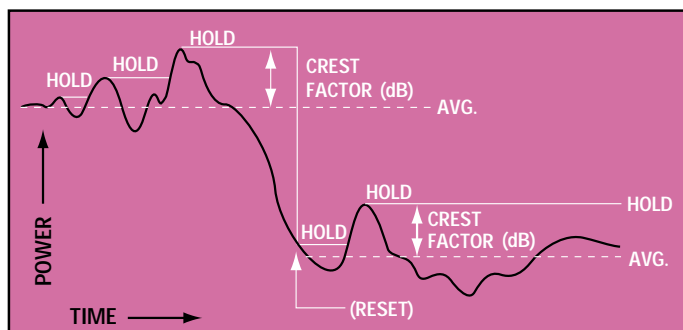
8650A lets you display the highest instantaneous power measured from the time the feature is enabled until it is reset.

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.

reduce processor overhead and capture over 26,000 readings per second.

Incredible speed for CW and modulated measurements results from an asynchronous

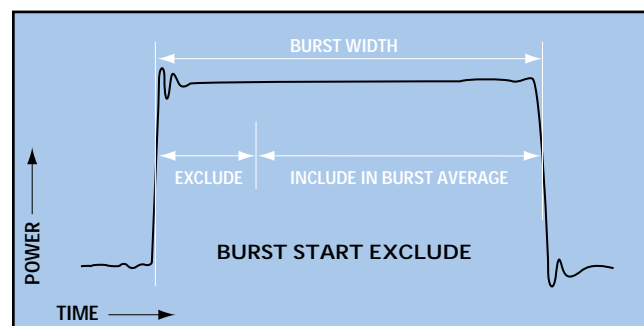
sampling rate of 2.5 to 5 MHz, that minimizes the aliasing effects of signals to produce faster average power measurements.

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

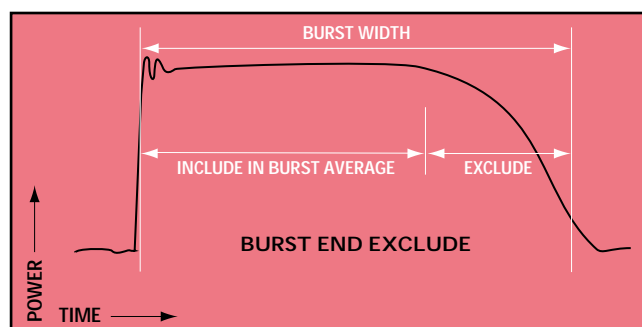
Or use our exclusive fast buffered mode to further

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

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 | ± 0.0000005% | ± 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 |

enter new calibration factors. You not only avoid measurement errors; you also save yourself test time.

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



The Secret is the Sensors

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 | Sensor Model | | | | | |
| | 80301A | 80350A | 80401A | 80601A | 80701A | |
| 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 | ≤ 40 kHz, –60 to +20 dBm > 40 kHz, –60 to –20 dBm | ≤ 1.5 MHz, –60 to +20 dBm > 1.5 MHz, –60 to –20 dBm | ≤ 10 MHz, –60 to +20 dBm > 10 MHz, –60 to –20 dBm | |
| Pulse Modulation | N/A | > 350 ns Pulse Width | > 200 μ s Pulse Width | > 300 μ s Pulse Width | > 100 μ s Pulse Width | |
| Burst with Modulation <small>f_m = modulation rate</small> | N/A | N/A | $f_m \leq 40$ kHz, > 200 μ s Pulse Width; –40 to +20 dBm $f_m > 40$ kHz, > 200 μ s Pulse Width; –40 to –20 dBm | $f_m \leq 1.5$ MHz, > 300 μ s Pulse Width; –40 to +20 dBm $f_m > 1.5$ MHz, > 300 μ s Pulse Width; –40 to –20 dBm | $f_m \leq 10$ MHz, > 100 μ s Pulse Width; –30 to +20 dBm $f_m > 10$ MHz, > 100 μ s 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



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.



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.



Displays of Intelligence

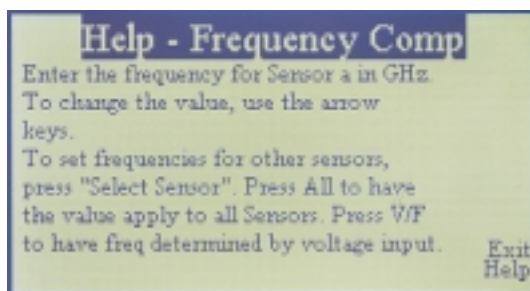
SEE FOR YOURSELF

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.

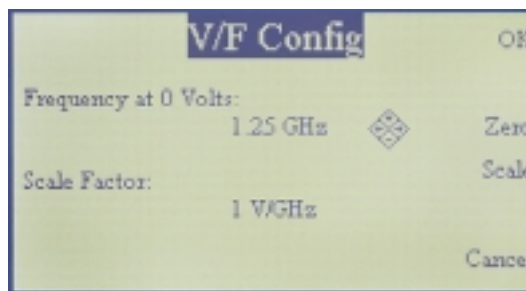
The large display lets you see more information. And the display works in tandem with the meter controls to let you view menu selections and see your input data as you enter it.

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

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

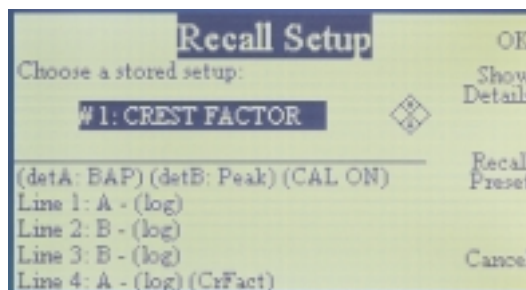
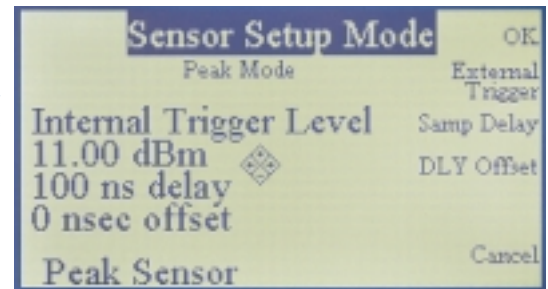


Each sensor uses an EEPROM to store values of cal factor. Entering the measurement frequency automatically calls up the correct cal factor. If the measurement frequency is between cal factor points, the meter automatically enters an interpolated value.

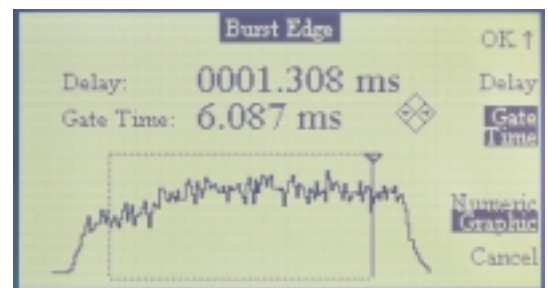


A volts per frequency input is available to set the cal factor when connected to an RF source. As the source frequency is modified the V/F output will automatically set the power meter to the correct cal factor, thereby eliminating the need for manual input.

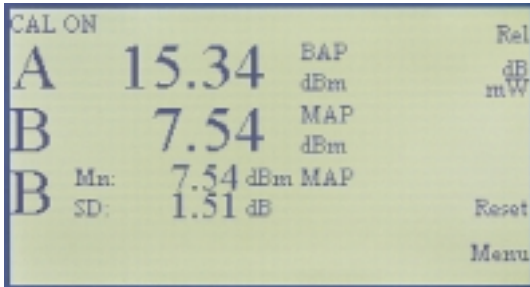
Peak (Pulse) power sensors can be set to the desired measurement point of a pulse signal. The trigger point can be set using an internal power level or a TTL signal.



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.



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.

STATISTICAL ANALYSIS

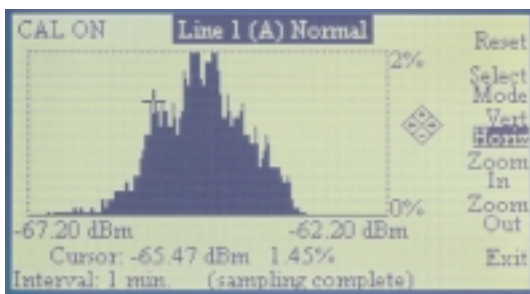
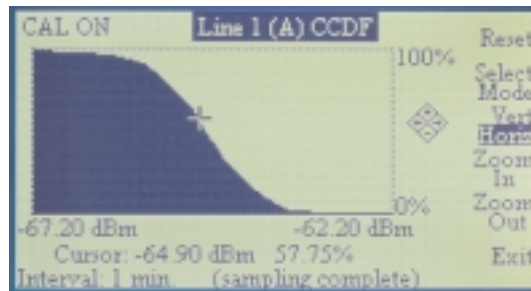
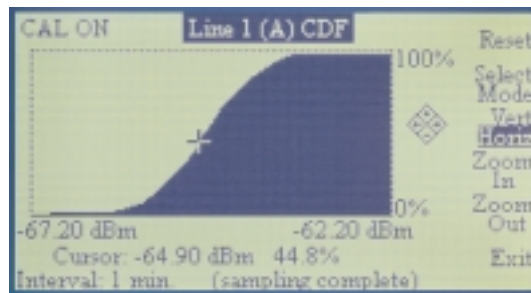
Excessive cost can prove as detrimental to the success of communications equipment as inadequate performance.

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.

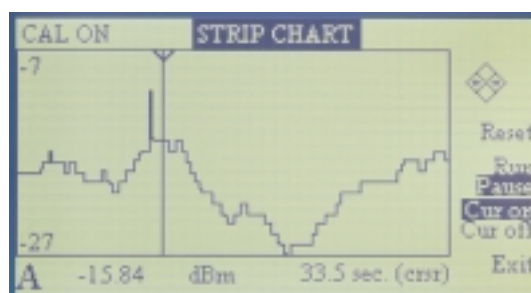
Combined, they make the 8650A the most advanced power meter available for communications systems design.

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

| | Frequency Range/ Power Range | 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 |
| 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) | 1.29: 12.4 - 18 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) ¹ 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 |
| 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 50 Ω | 114.5 mm (4.5 in) | 32 mm (1.25 in) | 0.18 kg (0.4 lb) | 1.38: 12.4 - 18 GHz 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) ¹ 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 |
| 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 +6 dBm: ± 0.2 dB/10 dB | | | | | 1.50: 26.5 - 40 GHz |
| 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 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 |
| 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 |
| 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) 50 Ω | 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) 50 Ω | 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) 50 Ω | 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

| | Frequency Range/ Power Range | Maximum Power | Power Linearity ¹ (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) 50 Ω | 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 |
| 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 50 Ω | 165 mm (6.5 in) | 37 mm (1.25 in) | 0.3 kg (0.7 lb) | 1.50: 18 - 26.5 GHz 1.92: 26.5 - 40 GHz |
| 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 50 Ω | 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) 50 Ω | 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) 50 Ω | 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) 50 Ω | 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

| | 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) 50 Ω | Type N(f) 50 Ω | 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) 50 Ω | APC-7(f) 50 Ω | 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) 50 Ω | SMA(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 |

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

| | Frequency Range/ Power Range | Maximum Power | Power Linearity ¹ (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) 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 |
| 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 50 Ω | | | | |
| 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) 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 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) 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 |
| 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) 50 Ω | 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) 50 Ω | 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) 50 Ω | 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 ¹ (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) 50 Ω | 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) 50 Ω | 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 ¹ | 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) 50 Ω | 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 ¹ (Frequency > 8 GHz) | RF Connector | Length | Diameter | Weight | VSWR |
|--|---------------------------------|------------------|---|---------------------------------------|--------------------|--------------------|---------------------|--|
| True RMS Sensors (-30 dBm to +20 dBm) | | | | | | | | |
| 80330A | 10 MHz to 18 GHz | +33 dBm (2 W) | -30 to +20 dBm: ± 0.00 dB | Type K(m) ¹ 50 Ω | 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 |
| 80333A | 10 MHz to 26.5 GHz | | | | | | | |
| 80334A | 10 MHz to 40 GHz | | | | | | | |

Sensor Calibration Factor Uncertainties

| Frequency (GHz) | | Root Sum of Squares (RSS) Uncertainties(%) ⁸ | | | | | | | |
|-----------------|-------|---|--------|--------|--------|---------------------|--------|---------------------|--|
| | | 80301A | | | | 80321A ⁹ | | | |
| | | 80302A | | | | 80322A ⁹ | | | |
| | | 80350A | | | | 80325A ⁹ | | | |
| | | 80401A | 80303A | 80310A | 80320A | 80421A ⁹ | | | |
| | | 80402A | 80304A | 80313A | 80323A | 80422A ⁹ | 80330A | 80351A ⁹ | |
| | | 80601A | 80353A | 80314A | 80324A | 80425A ⁹ | 80333A | 80352A ⁹ | |
| Lower | Upper | 80701A | 80354A | 80410A | 80420A | 80621A ⁹ | 80334A | 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.

8650A Series Universal Power Meter Specifications

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 μ s 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: $\pm 1.2\%$ 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: $\pm 1.2\%$ 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: $\pm 0.05\%$

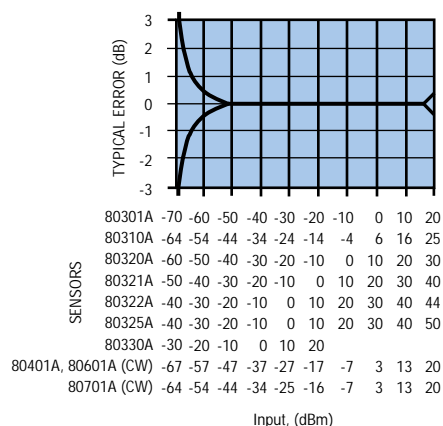
Instrumentation Linearity:

± 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.



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

Temperature Coefficient of

Linearity: $< 0.3\%/^{\circ}\text{C}$ temperature change following Power Sweep calibration. 24 hour warm-up required.

Zeroing Accuracy: (CW)

Zero Set: $< \pm 50$ pW, $< \pm 100$ pW with 80400A and 80600A Series Modulation Power Sensors. $< \pm 200$ pW with 80700A Series Sensors.

Zero Drift: $< \pm 100$ pW during 1 hour, $< \pm 200$ pW with 80400A and 80600A Series Sensors, $< \pm 400$ pW with 80700A Series Sensors.

Noise: $< \pm 50$ pW, $< \pm 100$ pW with 80400A and 80600A Series Modulation Power Sensors.

$< \pm 200$ 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.

GPIO 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 $\pm 10\%$,

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

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

Telefax: 925 328 4700

Web Site: www.gigatronics.com

