Data Sheet

4530
RF Power Meter

Taking performance to a new peak

4530 Series RF Power Meters: Accuracy & Speed for Production Test

Boonton's 4530 Series RF power meters combine the accuracy of a laboratory-grade instrument with the speed required for production test. They employ proprietary measurement techniques that accurately measure digitally-modulated signals. Whether you're measuring CW power or the peak power of W-CDMA or HDTV signals, Boonton's single-channel Model 4531 and dual-channel Model 4532 are the logical choice for high-volume production test.

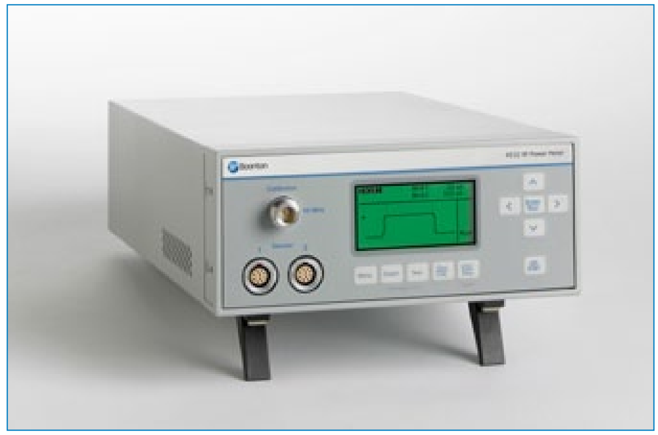
More Than Power Alone

The 4530 is more than a simple RF power meter. It measures CW power, peak power, voltage, and performs statistical power analysis (CDF and PDF) as well. The 4530 is compatible with a wide variety of Boonton RF power and voltage sensors, from coaxial dual-diode types, to thermal sensors, for measurements up to 40 GHz. Sensor set-up is easy and accurate too, since calibration and set-up data are automatically downloaded from the sensor, as soon as it's plugged in.

The 4530 provides seamless CW power measurement over its broad dynamic range—without the interruptions and non-linearities caused by range changes required by lesser power meters. Our thermal and peak-power sensors never need range switching, and even our CW diode sensors—with 90 dB dynamic range—use only two widely overlapping ranges.

Future Perfect

The 4530 measures the precise peak and average power of today's complex digitally-modulated carriers. Modulation bandwidths up to 20 MHz are within the range of the 4530, which makes it a good choice for measuring CDMA, W-CDMA, CDMA2000, TDMA, GSM, GSM-EDGE, GPRS, OFDM, HDTV, and UMTS. The 4530 displays periodic and pulse waveforms in graphical format, and a host of automatic measurements characterize the time and power profiles of the pulse. Powerful triggering, effective sampling rates up to 50 MSamples/sec. and programmable cursors give you instantaneous power measurements at precise time delays from the pulse edge. With an internal or external trigger you can perform time-gated or power-gated peak and average power measurements as well. Triggering can be synchronous or asynchronous. Display can be adjusted to pre-trigger or post-trigger to view any portion of the waveform.



Features

- Peak Power
- Frequency Range: 50 MHz To 40 GHz
- Dynamic Range: >60 dB
- Bandwidth: 20 MHz
- CW Power
- Frequency Range: 10 kHz To 40 GHz
- Dynamic Range: 90 dB

For CDMA or other spread-spectrum signals, the 4530's statistical analysis mode allows full profiling of power probability at all signal levels. The 4530 makes even these complex measurements fast, thanks to sustained acquisition rates above 1 MSample/sec. and smooth, range-free operation that allows a representative population to be acquired and analyzed rapidly.

Relief For Amplifier Designers

The random and infrequent nature of power peaks makes them almost impossible to detect and measure with conventional power meters. That means you'll never know how an amplifier will perform in the field when driven into compression by these fleeting peaks–until it's too late. The 4530 gives you this critical information by analyzing the probability-of-occurrence near the point of absolute peak power, then detecting and analyzing the data with the high accuracy required to realistically evaluate an amplifier's performance. And with its wide video bandwidth, the 4530 detects even narrow peaks.

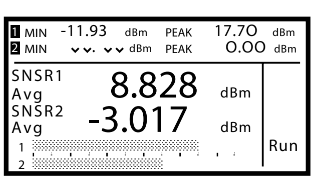
The 4530's dual-processor architecture enables comprehensive measurements with high speed and performance. It eliminates the speed tradeoffs between data acquisition and output via GPIB that are a fact of life with other power meters. A high-speed, floating-point digital signal processor (DSP) performs the measurements, gathers and processes the power samples from the sensors, timestamps the measurements, and provides linearity correction, gain adjustment and filtering—all in less than a microsecond.

The processed measurements are then passed to a dedicated, 32-bit I/O processor that sends them to the LCD display and over RS-232 or GPIB interfaces when formatted measurements are required. Programming is easier as well, thanks to comprehensive use of the industry standard SCPI command syntax.

Modulated Average Power, Peak Power and More

Using Boonton Peak Power sensors, the 4530 Series can measure the true average power of modulated waveforms, while providing important information about the instantaneous peak power missing in other power meters using "universal" power sensors.

The absolute peak power and crest factor are available, plus the held minimum and maximum average powers for viewing long-term trends.

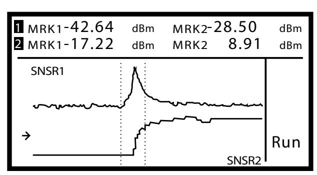


The MODULATED mode text display, showing the true average power for both channels, plus their tracking instantaneous peak and minimum values.

And Boonton's exclusive peak tracking mode allows short term crest factor measurements to be made on real signals without the need to manually reset the held peak every time the signal level changes. A flexible text display shows the measurements for one or both channels, and a "chart recorder" display of average power may be displayed graphically.

Continuous or Pulse Measurements

In many of today's digital modulation formats, the data is transmitted in short bursts, and the RF carrier is then switched off to allow other users to occupy the same channel (often known as time division multiple access, or TDMA). In these signals, there are important restrictions not only on the power of the burst, but also on the edge positions within a data frame and the slopes of those transitions.



The PULSE mode graph display allows the measured waveforms to be shown in a real-time "oscilloscope" format, which can be zoomed or panned as desired.

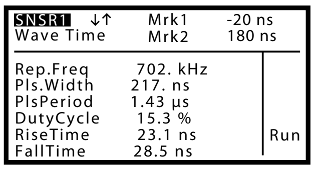
The 4530's Pulse Mode provides an affordable solution today's engineers need for characterizing all types of communication signals where not only the RF power, but the timing of that power is important.

Pulse Mode is designed to feel familiar to most engineers and technicians — the instrument can be operated in much the same way as a digital oscilloscope. Flexible timebase and triggering capabilities allow you to quickly view and measure pulse or burst waveforms.

Common pulse power and timing measurements can be set up and performed automatically by the instrument, or can be defined manually for optimum flexibility.

Two programmable cursors can be used to measure instantaneous power at two time offsets relative to the trigger, or to define a time interval, also known as a ''time gate'' over which average and peak power measurements may be made.

The pulse average and peak power, width, frequency, and edge transition times are just a few of the many automatic measurements performed.



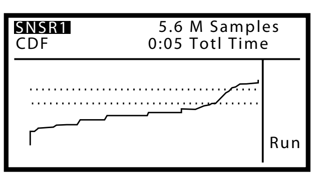
The PULSE mode text display can page through a series of automatic measurements of commonly needed pulse parameters.

High-Speed Statistical Measurements

In addition to its industry-leading performance with pulse and burst modulated signals, the 4530 Series offers the only true solution for characterizing nonperiodic signals such as CDMA and HDTV. These wideband signals are often noise-like, with many brief peaks that vary in magnitude and frequency of occurrence.

Measuring the average power of a spread spectrum signal does little to indicate how well an amplifier is coping with these peaks. Even adding a crest factor display only gives information about the highest peak (which by definition, only occurs once, and is of little value in predicting error rate).

The only way to accurately characterize these signals is to build a very large population of power samples in a short time, and analyze the statistical probability of occurrence of each power level.



The Cumulative Distribution Function (CDF) plots the probability of occurence of all power levels in a group of power samples.

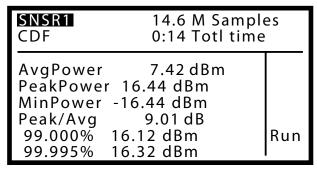
The Cumulative Distribution Function, or CFD, displayed by the 4530 plots the probability that the power will be at or below a specified level. By examining the areas close to 100% probability, it is possible to see how often the highest peaks occur. It is easy to see amplifier compression under actual operating conditions, and to predict the effect on error rate that this may have.

The 4530's Statistical Mode allows you to place one or two vertical or horizontal cursors on the plot, and read the percent probability for a particular power level, or the power at a probability. And of course the accumulated average, peak and minimum powers for the entire population may be displayed.

As with all measurement modes, the graph display includes complete pan and zoom ability, and can present the data in CDF, CCDF or distribution (histogram bar) formats.

Wideband CDMA Power

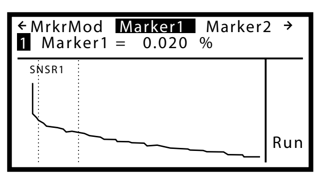
The 4530's wide bandwidth, high speed sampling and digital signal processing speed allows fast and accurate characterization of current and future CDMA2000 and W-CDMA formats.



The 4530 Series' Statistical Mode displays the full set of statistical calculations for the entire population.

Boonton's sensor architecture allows measurement of the *entire* dynamic range of a signal without range switching and its associated bandwidth limiting as the signal level changes. This allows modulated and peak measurements of wide dynamic range signals, but is doubly important for statistical measurements, since changing the range and bandwidth for a portion of samples would invalidate the statistical properties of the entire sample population, and render the measurements meaningless.

In addition to bandwidth, the 4530's high sustained sampling and processing speed ensures that few of the narrow peaks of wideband signals will fall between samples, and a representative population can be acquired in seconds.

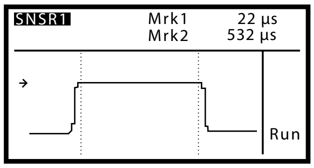


Viewing statistical data in the CCDF presentation allows close examination of the probability of very infrequent peaks that approach the absolute peak power.

GSM and Beyond

The standard GSM signal uses a digitally modulated burst to transmit data. Each user is allocated one of eight timeslots and must only transmit within its assigned timeslot. In addition to controlling power when on, an on/off ramp profile must be carefully followed to avoid interference with other users.

The 4530's pulse mode is ideal for measuring all power and timing parameters of current and future GSM formats. With trigger delay and holdoff, it is possible to synchronize on difficult bursts, and measure power at any instant or over any interval, whether pre- or post-trigger.



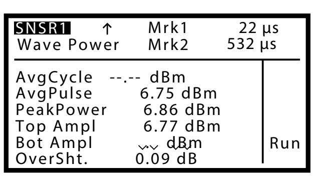
Screen cursors can be easily positioned over the active portion of a single GSM timeslot, allowing measurement of average power and crest factor during this interval.

Two programmable cursors allow power measurements on the active portions of each timeslot, while excluding the transition intervals between, or can be used to examine the ramp profile during timeslot transition intervals. Interval (or ìtime gatedî) measurements include average as well as peak and minimum power.

Automatic Time Gating

For measurement of single bursts such as the GSM reverse link, the 4530's automatic time gated pulse measurements can be used to quickly measure the "on" power during the active portion of the burst while excluding the edge transitions.

For example, the time gating may be set to measure the burst between the 3% and 97% time points. For a GSM burst (on time about 564 µS) this means that the leading and trailing 17 µS will be excluded, and the reading will be the average power of the burst during the middle 530 µS.



As an alternative to manual cursors, the automatic time gating feature locates the burst start and stop times from the edge transitions, and performs the measurement over a user-defined portion of this time interval.

Specifications

Sensor Inputs (Performance depends upon sensor model selected)	
Channels	Single (4531) and dual (4532) channel versions available
RF Frequency Range	Determined by sensor 10 Hz to 40 GHz
Peak Power Measurement Range	-40 to +20 dBm
CW Measurement Range	-70 to +20 dBm
Relative Offset Range	±99.99 dB
Video Bandwidth	20 MHz
Pulse Repetition Rate	1.8 MHz max

Calibration Sources

Internal Calibrator	
Output Frequency	50.025 MHz ±0.1%
Level	-60 to +20 dBm
Resolution	0.1 dB steps
Source SWR (Refl. Coeff.)	1.05 (0.024)
Accuracy 0° to 20°C, (NIST traceable):	+20 to -39.9 dBm ±0.06 dB (1.4%) -40 to -60 dBm ±0.09 dB (2.1%)
RF Connector	Type N

Trigger (Pulse mode only, signal inputs)

Modes	Pre-trigger and post-trigger
Internal Trigger Level Range	Equivalent to -30 to +20 dBm pulse amplitude range
External Trigger Level Range	±5 volts, ±50 volts with 10:1 divider probe
External Trigger Input	1 megohm in parallel with approximately 15pF, dc coupled
Connector type	BNC
Trigger time resolution	20 ns
Trigger Delay Range ±900 microseconds for timespans 5µs and faster ±4 milliseconds for timespans 10µs to 50µs ±(80 * timespan) for timespans 50µs to 2ms ±(30 * timespan) for timespans 5ms and slower	
Trigger Holdoff Range	10 microseconds to 1 second
Trigger Holdoff Resolution	1 microsecond

Sampling Characteristics

Effective sampling rate	50 Megasamples per second (each channel, pulse mode)
Sustained sampling rate	2.5 Megasamples per second (each channel, pulse mode)
Measurement Technique	Continuous and triggered (burst) sampling

Measurement Characteristics

Measurements

- Average Power*
- Maximum Average Power*
- Minimum Average Power*
- Maximum Instantaneous Peak Power*
- Minimum Instantaneous Power*
- Peak to Average Power Ratio*
- Cumulative Distribution Functions: CDF, 1-CDF
- Probability Distribution (histogram)
- Power at a percent statistical probability
- Statistical probability at a power level
- CW Power
- RF Voltage

Channel Math

Displays the sum or difference between channels or between a channel and a reference measurement (Modulated and CW modes only)

Trace Averaging	1 to 4096 samples per data point
Panel setup storage	4 complete setups

Measurement rate (via GPIB)

Greater than 200 two-channel measurements per second, neglecting bus master overhead, or 500 single-channel measurements per second

Interface

Video Output	Detected logarithmic RF envelope for external oscilloscope monitor
GPIB Interface	Complies with IEEE-488.1, Implements AH1, SH1,T6, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1

RS-232 Interface

Accepts GPIB commands (except bus dependent commands), provide for user software updates, remote programming: SCPI-like and Native Mode commands via GPIB or RS-232 interfaces

Software Drivers	LABVIEW drivers available

Environmental Specifications

General	Manufactured to the intent of MIL-T28800E, Type III, Class 5, Style E
CE Mark	Conforms to European Community (EU) specifications: EN 61010-1(90)(+A1/92)(+A2/95) EN 61010-2-031 EN 61326-1(97) EN 55022(94)(A2/97)ClassB
Display	Graphic type LCD, LED backlighted, text and trace displays
Operating Temperature	0 to 50°C
Ventilation	Fan cooled
Altitude	Operation up to 15,000 feet
Storage Temperature	-40 to 75°C
Humidity	0-95% (non-condensing)
Power Requirements	90 to 260 VAC, 47 to 63 Hz, <50 VA, <30 Watts, no voltage switching required

Physical Specifications

Dimensions

3.5 inches (8.9 cm) high, 8.4 inches (21.3 cm) wide, approx 13.5 inches (34.3 cm) deep, not including feet and connector clearances

Weight	7lbs (3.2kg)
Connector location option	Sensor input(s) and calibrator connector: Front or rear panel

Construction

Surface mount, multi-layer printed circuit boards mounted to rigid aluminum frame and front extrusion/casting with aluminum sheet metal enclosure

* All measurements marked with an asterisk (*) may be performed continuously, or in a synchronous, triggered mode. When triggered, these measurements may be made at a single time offset relative to the trigger, or over a defined time interval. The time offset or interval may be before or after, or may span the trigger interval.

Peak Power Sensors

Model	Frequency Range	Dynamic Range	Risetime / Bandwidth Sensor		Maximum SWR	
Impedance RF Connector	(Low Bandwidth setting)	Peak Power Range Internal Trigger Range	Fast Risetime (Bandwidth)	Slow Risetime (Bandwidth)	Frequency	SWR
57318	0.5 to 18 GHz	-24 to +20 dBm	<15 ns	<15 µs	0.05 to 2 GHz	1.15
50Ω	(0.05 to 18 GHz)	-34 to +20 dBm	(35 MHz)	(35 MHz)	2 to 16 GHz	1.28
N(M)		-10 to +20 dBm			16 to 18 GHz	1.34
57340	0.5 to 40 GHz	-24 to +20 dBm	<15 ns	<10 µs	0.05 to 4 GHz	1.25
50Ω	(0.05 to 40 GHz)	-34 to +20 dBm	(35 MHz)	(350 KHz)	4 to 38 GHz	1.65
K(M)					38 to 40 GHz	2.00
57518	0.1 to 18 GHz	-40 to +20 dBm	<100 ns	<10 µs	0.05 to 2 GHz	1.15
50Ω	(0.05 to 18 GHz)	-50 to +20 dBm	(6 MHz)	(350 KHz)	2 to 16 GHz	1.28
N(M)		-27 to +20 dBm			16 to 18 GHz	1.34
57540	0.1 to 40 GHz	-40 to +20 dBm	<100 ns	<10 µs	0.05 to 4 GHz	1.15
50Ω	(0.05 to 40 GHz)	-27 to +20 dBm	(6 MHz)	(350 KHz)	4 to 38 GHz	1.65
K(M)					38 to 40 GHz	2.00
56318*	0.5 - 18 GHz	-24 to +20 dBm	<15 ns	<200 ns	0.5 - 2 GHz	1.15
50 Ω		-34 to +20 dBm	(35 MHz)	(1.75 MHz)	2 - 16 GHz	1.28
N (M)		-10 to +20 dBm			16 - 18 GHz	1.34
56326*	0.5 - 26.5 GHz	-24 to +20 dBm	<15 ns	<200 ns	0.5 - 2 GHz	1.15
50 Ω		-34 to +20 dBm	(35 MHz)	(1.75 MHz)	2 - 4 GHz	1.20
k(M)		-10 to +20 dBm			18 - 26.5 GHz	1.50
56518*	0.5 - 18 GHz	-40 to +20 dBm	<100 ns	<300 ns	0.5 - 2 GHz	1.15
50 Ω		-50 to +20 dBm	(6 MHz)	(1.16 MHz)	2 - 6 GHz	1.20
k(M)		-27 to +20 dBm			16 - 18 GHz	1.34

* Requires 2530 Calibrator

CW Power Sensors

Model	Frequency Range	Dynamic Range	Overload Rating	Maximum SWR	
Impedance RF Connector			Pulse Continuous	Frequency	SWR
51075A	500 kHz to 18 GHz	-70 to +20 dBm	1 W for 1 µs	500 kHz to 2 GHz	1.15
50Ω			300 mW	2 GHz to 6 GHz	1.20
N(M)				6 GHz to 8 GHz	1.40
51077A	500 kHz to 18 GHz	-60 to +30 dBm	10 W for 1 µs	500 kHz to 2 GHz	1.15
50Ω			3 W	2 GHz to 6 GHz	1.20
N(M)				6 GHz to 18 GHz	1.40
51079A	500 kHz to 18 GHz	-50 to +40 dBm	100 W for 1 µs	500 kHz to 2 GHz	1.15
50Ω			25 W	2 GHz to 6 GHz	1.20
N(M)				6 GHz to 18 GHz	1.40
51071A	10 MHz to 26.5 GHz	-70 to +20 dBm	1 W for 1 µs	10 MHz to 2 GHz	1.15
50Ω			300 mW	2 GHz to 4 GHz	1.20
K(M)				4 GHz to 18 GHz	1.45
				18 GHz to 26.5 GHz	1.50
51072A	30 MHz to 40 GHz	-70 to +20 dBm	1 W for 1 µs	30 MHz to 4 GHz	1.25
50Ω			300 mW	4 GHz to 38 GHz	1.65
K(M)				38 GHz to 40 GHz	2.00

RF Voltage Probe Kits

Model	Frequency Range	Dynamic Range	Overload Rating	Maximum SWR
952063	10 kHz to 1.2 GHz	200 µV to 10 V	63 VDC or Peak AC 10 VRMS AC continuous	N/A
952064	10 Hz to 100 MHz	200 µV to 10 V	63 VDC or Peak AC 10 VRMS AC continuous	N/A

Ordering Information

4531	Single Channel, GPIB, RS-232 10 kHz - 40 GHz
4532	Dual Channel, GPIB, RS-232 10 kHz - 40 GHz

Options

-01	Rear panel input
-02	Rear-mount calibrator
-30	3 year warranty

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Note: Specifications, terms and conditions are subject to change without prior notice.