Taking performance to a new peak

4540 Series
RF Power Meter
The Boonton 4540 Series RF Power Meter is the instrument of choice for capturing, displaying and analyzing RF signals. Applications include pulsed RF signals like RADAR or GSM based technologies, as well as pseudorandom, noise-like signals such as CDMA, EVDO, WLAN, WiMAX, UMTS, HSPA, LTE, OFDM or HDTV. The 4540 Series offers Pulse, Modulated/CW, and Statistical operating modes, making it well suited for all requirements of R&D, manufacturing and control operations. Single channel versions (4541) and dual channel versions (4542) are available.

**Features**

- 200 ps time resolution
- 7 ns rise time
- Video bandwidth up to 70 MHz
- 17 default presets plus storage for 25 user defined presets
- Fast statistical analysis including CCDF
- Text view of up to 14 out of 28 parameters per channel simultaneously (power / voltage, time, statistics, channel math)
- Bright, clear 4” color LCD display
- GPIB, LAN, USB device (B-type connector) interfaces
- High bandwidth, wide dynamic range sensors available

Both 4541 and 4542 power meters command powerful pulse recognition and analysis systems. Parameters like pulse-width, rise time, fall time, power distribution and many others are automatically detected, measured and presented.
Modulated Mode measurements are possible with cost effective CW sensors, or with fast Peak Power sensors. Using Peak Power sensors, the 4540 Series can measure true average power of modulated waveforms, while providing important information about the instantaneous peak power value. Large digits allow clear, legible measurement reading.

**Pulsed Mode**
Analysis of fast single pulses or pulses with high pulse repetition interval (PRI) requires an instrument with sophisticated trigger and data acquisition capability. This provides accuracy and high definition trace detail of the measured signal. A variety of trigger settings, including pre and post trigger in combination with a high sampling rate allow the 4540 Series to capture any pulse. High level of signal detail is essential when short pulses, signal edges, signal overshoots, filters, high gain amplifiers, delay lines and such have to be analyzed.

**Statistical Mode**
Non-periodic signals, such as HDTV, EVDO, UMTS or LTE are noise-like and consist of varying magnitude peaks randomly distributed over the channel. These random events do not serve as a trigger for consistent measurements. Amplifier designs require fast peak measurement capability from a power meter to detect signal clipping and compression due to overload. The Complementary Cumulative Distribution Function, or CCDF, displayed by the 4540 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. Up to 4 GSamples of data can be collected, compiled and analyzed by the 4540 Series.
Effective Random Sampling

The 4540 Series RF Power Meter offers an impressively detailed representation of measured signals. As a result, signals can be analyzed thoroughly and anomalies can be detected immediately. High signal definition is achieved with two powerful features: a time resolution of 200ps, unprecedented in a power meter of this class, and a technique called Repetitive Random Sampling. For repetitive signals, the 4540 Series offers an effective sampling rate of up to 5 GSamples / second.

Autoset/Preset

For accurate, repeatable measurements, power meters require diligently chosen trigger and timing settings. Finding the correct trigger settings is often more difficult than performing the actual measurement – not so with the 4540 Series. Our instruments are equipped with an “AutoSet” feature. This feature analyzes incoming signals and presets the instrument’s timing and trigger settings in a way that allows for immediate measurements. Presets are available for many common wireless formats.

RF-Voltage Measurements

In some cases it is necessary to measure RF voltage without terminating or significantly loading the source. The 4540 Series supports voltage measurements with different Boonton voltage probes (also known as voltage sensors). Boonton’s high impedance voltage probes are available for frequencies from 10 Hz to 1.2 GHz. Voltage probes are designed to measure CW voltage to 10 V, but they can also be used to measure the root mean square (RMS) value of a fluctuating or modulated signal up to 20 mV (2 V with 1:100 divider). Linearity correction factors are stored in the sensor adapter, so voltage measurements can be taken immediately.

Firmware Updates

Boonton strives to provide the best products to our customers, hence the 4540 Series can be easily field-updated with new firmware. New firmware versions are released periodically and available at the Boonton website. The download package comes with a loader that handles the proper update of the 4540 Series via a PC. Advantages of firmware updates are obvious: features added – for free.
4540 Series Specifications

Acquisition and Measurement System

Measurement Technique
Random repetitive sampling system providing pre and post-trigger data and statistical histogram accumulation

Sampling Rate
50 Ms/s / second on each channel simultaneously

Effective Sampling Rate
5 GSa /second on each channel simultaneously

Memory depth
262,144 samples at max sampling rate

Vertical Resolution
0.008%, 14-bit A/D Converter DSP 32 bit floating point

Time resolution
200 ps

Sensor Inputs

RF channels
1 or 2 (4541 / 4542)

RF Frequency Range
10 kHz to 40 GHz*

Pulse Meas. Range
-50 to +20 dBm*

Modulated Meas. Range
-55 to +20 dBm*

CW Pwr Range
-70 to +44 dBm*

Relative Offset Range
±200.00 dB

Video BW
70 MHz*

Risetime
< 7 ns*

Single Shot Bandwidth
5 MHz (based on 10 samples/pulse)

* Sensor Dependent, Calibrator Dependent

Vertical Scale

Logarithmic
0.1 to 50 dBm/div in 1-2-5 sequence
0.1 to 50 dBV/div in 1-2-5 sequence
0.1 to 50 dBMV/div in 1-2-5 sequence
0.1 to 50 dBuV/div in 1-2-5 sequence

Linear
1 nW/div to 50 MW/div in 1-2-5 sequence
1 nV/div to 50 MV/div in 1-2-5 sequence

Trigger (continued)

Internal Level Range
-40 to +20 dBm (sensor dependent)

External Level Range
±5 volts (±50 volts with 10:1 divider probe)

External Input Impedance
1 MOhm (13 pF DC Coupled)

Slope
+ or –

Hold-off
0.0 - 1.0 sec (10 ns resolution)

Min Trigger Pulse Width
15 ns

Max Trigger Rate
30 MHz

Time Base

Time Base Resolution
200 ps

Time Base Range
10 ns/div to 1 hr/div

Time Base Accuracy
0.01%

Time Base Display
Sweeping or Roll Mode

Trigger Delay Range

Timebases 10 ns to 500 ns: -4 ms to +100 ms
Timebases 1 us to 10 ms: ±4000 divisions
Timebases 20 ms to 3600 s: -40 s to +100 s

Trigger Delay Resolution
0.02 divisions

Pulse Mode Operation

Automatic Measurements
Pulse width
Pulse rise-time
Pulse fall-time
Pulse period
Pulse repetition frequency
Pulse duty cycle
Pulse off-time
Peak power
Pulse “on” power
Pulse overshoot (dB or %)
Waveform Average power
Top level power (IEEE spec)
Bottom level power (IEEE spec)
Edge delay
Edge skew (2 channel instruments only)

Marker Measurements
Markers (vertical cursors)
Settable in time relative to the trigger position
Markers independently
Average, minimum, peak power at a single time offset
Pair of Markers
Average, minimum, peak power over the interval between markers, power ratio between markers

Acquisition Mode
Discontinuous triggered sample acquisition

Trace Display
Power versus time swept trace (rolled trace for slow time bases)

Trace Averaging
1 to 16384 samples per sweep data point, exponential
Modulated Mode Operation

Automatic Measurements
- Average power
- Peak power
- Peak to Average ratio
- Dynamic range
- Minimum power

Signal Filtering
- “Sliding window” filter; 0.002 to 16.0 seconds (fixed) or auto-filter

Acquisition Mode
- Continuous (un-triggered) sample acquisition

Trace Display
- Power versus time rolled trace

Channel Math
- Ratio, sum (power sensors) or difference (voltage sensors) between channels or between a channel and a reference measurement

Statistical Mode Operation

Acquisition Mode
- Continuous sample acquisition

Sampling Rate
- Configuration dependent

Number of Histogram Bins
- 16384

Bin Power Resolution
- <0.02 dB (statistical measurements)

Limit Count
- Adjustable, 2 – 4096 MSamples

Terminal Action
- Stop, flush and or decimate

Graph Presentation
- Normalized CCDF trace (relative to maximum power)

Horizontal Scale
- 0.1 to 5 dB/div

Horizontal Offset
- ±50.00 dB

Vertical Axis
- 0.0001 to 100% (Log, 6 decades)

Text Measurements
- Average, Peak and Minimum absolute power, Peak-to-Average and Dynamic Range ratios
- CCDF table (Peak/Average ratios at decade-spaced % CCDF intervals)

Cursor Measurements
- Peak-to-Average ratio at specified % CCDF
- % CCDF at specified Peak-to-Average ratio

Status Display
- Total acquisition time (MM:SS)
- Total acquired Samples

Field Parameter

Measurements, settings, parameters & channel math that can be displayed (User selectable)

Calibration Source

Internal Calibrator

Operating Modes
- Off, On CW

Frequency
- 50.025 MHz ± 0.1%

Level Range
- -60 to +20 dBm

Resolution
- 0.1 dB

RF Connector
- Type N

Source VSWR
- 1.05 (reflection coefficient = 0.024)

Accuracy, OC to 20C, NIST traceable
- ±0.055 dB (1.27%)
- ±0.075 dB (1.74%)
- ±0.105 dB (2.45%)

Auto-calibration
- Automatically generated linearity calibration data for peak power sensors

Measurement Setup / Storage

25 complete user defined settings (save & recall)

Presets
- Default
- Bluetooth
- IDEN
- 802.11b/g
- DVB
- EDGE
- W-CDMA
- MCPA
- 1xEV-DO
- 1xEV-DV
- TD-SCDMA
- Reference 1
- Reference 2
- 802.11a
- 1xEV-DO
- 1xEV-DV
- TD-SCDMA

External Interfaces

Remote Control
- GPIB
- Complies with IEEE-488.1 and SCPI version 1993. Implements AH1, SH1, T6, LEO, SR1, RL1, PPO, DC1, DT1, C0, and E1.

LAN
- TCP/IP Ethernet Programmable interfaces

USB
- “USB Device”, Type-B connector

Multi I/O BNC connector
- User selectable

User selectable
- Status, trigger, alarm or voltage output

Range
- 0 to 10 V (Analog unipolar)
- -10 V to +10 V (Analog bipolar)
- 0 or 5 V (Logic)

Accuracy
- ±200 mV (±100 mV typical)

Linearity
- 0.1% typical

VGA Out / Ext Cal
- HDB-15 connector, video output (320x240) for VGA compatible analog RGB video monitor or external calibrator control interface for Model 2530 calibrator
Physical And Environmental Characteristics

Case Dimensions  8.4 W x 3.5 H x 13.5 D inches  
(21.3 x 8.9 x 34.3 cm), Half-rack width, 2U height

Weight  7.7 lbs (3.5 kg)

Power Requirements
- 90 to 260 VAC, 47 to 60 Hz
- 90 to 135 VAC, 47 to 400 Hz
- 50 W (70 VA)

Operating Temperature  0 to 50 deg C (32 F to 122 F)

Storage Temperature  -40 to +75 deg C (-40 F to 167 F)

Ventilation  Thermostatically controlled fan

Humidity  95% maximum, non-condensing

Altitude  Operation up to 15,000 feet (4575 m)

Shock  Withstands ±5 G, 11 ms impulse in X, Y, and Z axes, as per EN 60068-2-27

Vibration  Withstands 2 G sine, 1.25 G random, as per EN 60068-2-6 and EN 60068-2-64

Other Characteristics

Display  4.0” Diagonal TFT color LCD, 320 x 240 pixels, CCFL backlight

Keyboard  27 Key conductive rubber

Main Computer  32-bit Floating Point embedded processor

DSP  32-bit Floating Point DSP

Battery  User-replaceable BR2325 lithium coin cell (alkaline cells optional), typical life: >10 years (lithium)

Regulatory Categories

Full CE compliance with the following European Union directives and standards

Low Voltage Directive 2006/95/EC EN 60950-1:2002 for safety

Electromagnetic Compatibility Directive (EMC) 2004/108/EC

RoHS Directive 2002/95/EC for material safety

Manufactured to the intent of MIL-T28800E, Type III, Class 5, Style E

Sensors / Voltage Probes

Peak Power

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Dynamic Range</th>
<th>Rise Time (Bandwidth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>57006</td>
<td>0.05 to 6.0 GHz</td>
<td>-50 to +20 dBm</td>
<td>&lt;7 ns (70 MHz)</td>
</tr>
<tr>
<td>59318</td>
<td>0.05 to 18.0 GHz</td>
<td>-24 to +20 dBm</td>
<td>&lt;10 ns (50 MHz)</td>
</tr>
<tr>
<td>57518</td>
<td>0.05 to 18.0 GHz</td>
<td>-40 to +20 dBm</td>
<td>&lt;100 ns (6 MHz)</td>
</tr>
<tr>
<td>59340</td>
<td>0.05 to 40.0 GHz</td>
<td>-24 to +20 dBm</td>
<td>&lt;10 ns (50 MHz)</td>
</tr>
<tr>
<td>57540</td>
<td>0.05 to 40.0 GHz</td>
<td>-40 to +20 dBm</td>
<td>&lt;100 ns (6 MHz)</td>
</tr>
</tbody>
</table>

CW Power

Wide Dynamic Range

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Dynamic Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>51071A</td>
<td>10 MHz to 26.5 GHz</td>
<td>-70 to +20 dBm</td>
</tr>
<tr>
<td>51072A</td>
<td>30 MHz to 40 GHz</td>
<td>-70 to +20 dBm</td>
</tr>
<tr>
<td>51075A</td>
<td>500 kHz to 18 GHz</td>
<td>-70 to +20 dBm</td>
</tr>
<tr>
<td>51077A</td>
<td>500 kHz to 18 GHz</td>
<td>-60 to +30 dBm</td>
</tr>
<tr>
<td>51079A</td>
<td>500 kHz to 18 GHz</td>
<td>-50 to +40 dBm</td>
</tr>
</tbody>
</table>

Thermocouple

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Dynamic Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>51100  (9E)</td>
<td>10 MHz to 18 GHz</td>
<td>-20 to +20 dBm</td>
</tr>
<tr>
<td>51200</td>
<td>10 MHz to 18 GHz</td>
<td>0 to +37 dBm</td>
</tr>
</tbody>
</table>

Special Purpose

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Dynamic Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>51011 (EMC)</td>
<td>10 kHz to 8GHz</td>
<td>-60 to +20 dBm (DC coupled)</td>
</tr>
<tr>
<td>51011 (4B)</td>
<td>100 kHz to 12.4 GHz</td>
<td>-60 to +20 dBm</td>
</tr>
<tr>
<td>51013 (4E)</td>
<td>100 kHz to 18 GHz</td>
<td>-60 to +20 dBm</td>
</tr>
<tr>
<td>51015 (5E)</td>
<td>100 kHz to 18 GHz</td>
<td>-50 to +30 dBm</td>
</tr>
<tr>
<td>51033 (6E)</td>
<td>100 kHz to 18 GHz</td>
<td>-40 to +33 dBm</td>
</tr>
<tr>
<td>51078</td>
<td>100 kHz to 18 GHz</td>
<td>-20 to +37 dBm</td>
</tr>
</tbody>
</table>

Diode Average

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Dynamic Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>51085</td>
<td>500 kHz to 18GHz</td>
<td>-30 to +20 dBm</td>
</tr>
</tbody>
</table>

For 51085 Peak Power - 1kW peak, 5μs pulse width, 0.25% duty cycle
For 51085 CW Power - 5W (+37dBm) average to 25°C ambient temperature, derated linearly to 2W (+33dBm) at 85°C

Voltage Probes

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>95206302A</td>
<td>RF-Voltage Probe Kit</td>
</tr>
<tr>
<td></td>
<td>10 kHz -1.2 GHz</td>
</tr>
<tr>
<td>95206402A</td>
<td>Low Frequency Voltage Probe Kit</td>
</tr>
<tr>
<td></td>
<td>10 Hz - 100 MHz</td>
</tr>
</tbody>
</table>
Ordering Information

4541 RF Power Meter, single channel, front panel input
4542 RF Power Meter, dual channel, front panel inputs
-02 Rear sensor inputs
-03 Calibrator, rear panel output
-30 Warranty extended to 3 years

Accessories

95403001A 19" Rack Mount Kit
95006201A Transit case, holds the 4540 Series and up to 4 sensors