Boonton

Data Sheet

RTP5000 Series

Real-Time Peak Power Sensors

Taking performance to a new peak

RTP5000 Series

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The Boonton RTP5000 series Real-Time Peak Power Sensors are the performance leaders in RF and microwave peak power measurement. They offer industry-leading performance with the widest video bandwidth, fastest rise times, finest time resolution, narrowest minimum pulse widths, highest pulse repetition rates, and superior measurement reading rates. In addition, the RTP5000 series sensors incorporate Boonton's unique Real-Time Power Processing™ technology.

Key Features

- Real-Time Power Processing™
- 16 automated pulse measurements
- Crest Factor and statistical measurements (e.g., CCDF)
- Synchronized multi-channel measurements (up to 8 channels with GUI, >8 with remote control)
- Power Analyzer: advanced measurement and analysis software

With superior performance and a small form factor, the Boonton RTP5000 series is ideal for many purposes ranging from design and verification, through manufacturing, to field installation and maintenance. The sensors are trusted by engineers and technicians at industry-leadering companies to measure pulsed, bursted, and/or modulated signals used in commercial and military radar, electronic warfare (EW), wireless communications (e.g., LTE, LTE-A, and 5G), and consumer electronics (WLAN), as well as education and research applications.

Key Specifications

Frequency range	50 MHz to 40 GHz
Measurement range	-60 dBm to +20 dBm
Video bandwidth	195 MHz
Rise-time	< 3 ns
Time Resolution/Trigger Jitter	100 ps
Min Pulse Width / Max PRF	10 ns / 50 MHz
Measurement Speed	100,000 per second.

Real-Time Power Processing™

Boonton Real-Time Power Processing™ dramatically reduces the total cycle time for acquiring and processing power measurement samples. By combining a dedicated acquisition engine, hardware trigger, integrated sample buffer, and a real-time optimized parallel processing architecture, Real-Time Power Processing™ performs most of the sweep processing steps simultaneously, beginning immediately after the trigger instead of waiting for the end of the acquisition cycle.

The advantages of the Real-Time Power Processing™ technique are shown in Figure 1a. Key processing steps take place in parallel and keep pace with the signal acquisition. With no added computational overhead to prolong the sweep cycle, the sample buffer cannot overflow. As a result, there is no need to halt acquisition for trace processing. This means gap-free signal acquisition virtually guarantees that intermittent signal phenomena such as transients, dropouts, or interference will be reliably captured and analyzed, shown in Figure 1b. These sorts of events are most often missed by conventional power meters due to the acquisition gaps while processing takes place.

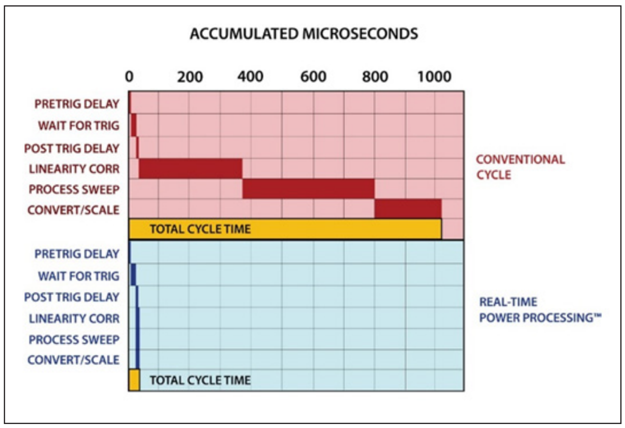

Figure 1a. Comparison between conventional power measurement sample processing and Real-Time Power Processing™.

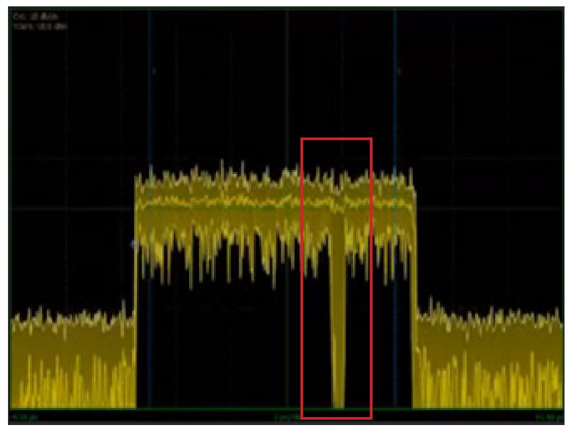

Figure 1b. Identification of a signal dropout with Real-Time Power Processing™.

Superior Time Resolution

The RTP5000 series features 100 ps time base resolution and with an acquisition rate up to 100 MSPS, can provide 50 points per division with a time base range as low as 5 ns / division. This enables users to see meaningful waveform information (Figure 2a) missed by alternative power analyzers (Figure 2b). In addition, Boonton's superior time management enables several other advantages. Pulse widths as narrow as 10 ns can be captured and characterized with outstanding trigger stability (< 100 ps jitter, rms).

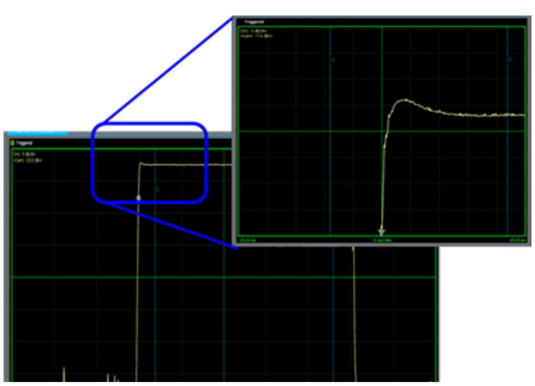

Figure 2a. RTP5000 series waveform analysis with 10 ns/div time base and 50 samples per division.

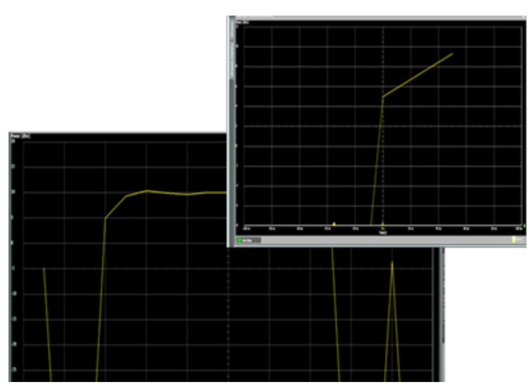

Figure 2b. "Conventional" power meter waveform analysis with 10 ns/div time base and 1 sample per division.

Simplified Test with Automated Measurements

To simplify test, the RTP5000 series can measure and calculate 16 common power and timing parameters and display the parameters of interest(Figure 3). Other parameters include: rise time, fall time, pulse average, overshoot, and droop.

Use markers to define a portion of the waveform on which to make measurements. "Between Marker" measurements are ideal for monitoring parameters such as pulse power or crest factor over long intervals.

Pulse Measurements

Parameter	CH1
Width	20.000 µs
Period	1.0000 ms
PRF	1.0000 kHz
Duty	2.000 %
Offtime	980.00 µs
WavAv	-4.897 dBm
PulsPk	15.351 dBm
Top	12.071 dBm
Bottom	-30.093 dBm
EdgDly	355.01 µs
Skew	0.00 ns
✳Click here to add a new row	

Figure 3. Automatic Pulse Measurements

Powerful Statistical Analysis

Crest factor, or peak-to-average power ratio, is an important measurement for characterizing device-under-test (DUT) performance, such as amplifier linearity. With the Boonton Power Analyzer software package, users can utilize the complementary cumulative distribution function (CCDF) to assess the probability of various crest factor values to gain further insight into DUT performance. The CCDF and other statistical values are determined from a very large population of power samples captured at a 100 MSPS acquisition rate on all channels simultaneously.

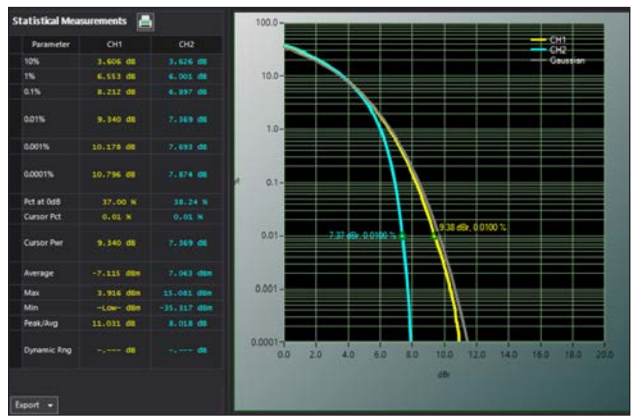

Figure 4. Comparing CCDF plots of a signal at an amplifier input (yellow) and output (blue).

Measurement Buffer Mode

The RTP5000 series Measurement Buffer mode is a remote control function that works in conjunction with Real-Time Power Processing™ to provide only the relevant burst or pulse information, eliminating the need to download and post-process large sample buffers. As a result, users can collect and analyze measurements from a virtually unlimited number of consecutive pulses or events. A wide variety of parameters can be calculated and plotted, such as duty cycle, pulse repetition rate, pulse width variation, and pulse jitter. In addition, anomalies, such as dropouts, can be identified.

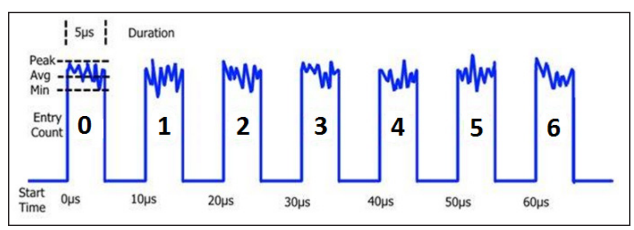

Figure 5a. Example seven pulse waveform.

Entry Count	Interval Start	Interval Duration	Interval Average	Interval Minimum	Interval Peak
0	0.00 us	5.01 us	-0.043 dBm	-39.042 dBm	8.826 dBm
1	9.99 us	5.00 us	-0.006 dBm	-38.431 dBm	8.827 dBm
2	19.99 us	5.01 us	0.039 dBm	-41.549 dBm	9.742 dBm
3	30.00 us	5.00 us	0.017 dBm	-38.551 dBm	9.802 dBm
4	40.01 us	5.00 us	0.022 dBm	-40.699 dBm	9.477 dBm
5	49.99 us	5.00 us	-0.020 dBm	-39.706 dBm	8.102 dBm
6	60.00 us	5.00 us	0.036 dBm	-37.803 dBm	9.750 dBm

Figure 5b. Measurement buffer data returned for waveform in Figure 5a.

Specifications	RTP5006	RTP5008	RTP5318	RTP5518	RTP5340	RTP5540
RF Frequency Range	50 MHz to 6 GHz	50 MHz to 8 GHz	50 MHz to 18 GHz	50 MHz to 18 GHz	50 MHz to 40 GHz	50 MHz to 40 GHz
Dynamic Range						
Average	-60 to +20 dBm	-60 to +20 dBm* -53 to +20 dBm†	-34 to +20 dBm	-50 to +20 dBm	-34 to +20 dBm	-50 to +20 dBm
Pulse	-50 to +20 dBm	-50 to +20 dBm* -43 to +20 dBm†	-24 to +20 dBm	-40 to +20 dBm	-24 to +20 dBm	-40 to +20 dBm
Internal Trigger Range						
Range	-38 to +20 dBm	-38 to +20 dBm	-10 to +20 dBm	-27 to +20 dBm	-10 to +20 dBm	-27 to +20 dBm
Min Pulse Width (fast/std)	10 ns / 3 µs	10 ns / 3 µs	10 ns / 3 µs	200 ns / 3 µs	10 ns / 3 µs	200 ns / 3 µs
Max Repetition Rate	50 MHz	50 MHz	50 MHz	5 MHz	50 MHz	5 MHz
Rise time (fast/std)	3 ns / < 10 µs	4 ns / < 10 µs	5 ns / < 10 µs	< 100 ns / < 10 µs	5 ns / < 10 µs	< 100 ns / < 10 µs
Video Bandwidth (high/std)	195 MHz / 350 kHz	165 MHz / 350 kHz	70 MHz / 350 kHz	6 MHz / 350 kHz	70 MHz / 350 kHz	6 MHz / 350 kHz
Single-shot Bandwidth	35 MHz	35 MHz	35 MHz	6 MHz	35 MHz	6 MHz
RF Input	Type N, 50 Ω	Type N, 50 Ω	Type N, 50 Ω	Type N, 50 Ω	2.92 mm, 50 Ω	2.92 mm, 50 Ω
VSWR	1.25 (0.05 to 6 GHz)	1.20 (0.05 to 6 GHz) 1.25 (6 GHz to 8 GHz)	1.15 (0.05 to 2.0 GHz) 1.28 (2.0 to 16 GHz) 1.34 (16 to 18 GHz)	1.15 (0.5 to 2.0 GHz) 1.20 (2.0 to 6.0 GHz) 1.28 (6.0 to 16 GHz) 1.34 (16 to 18 GHz)	1.25 (0.05 to 4.0 GHz) 1.65 (4 to 38 GHz) 2.00 (38 to 40 GHz)	1.25 (0.5 to 4.0 GHz) 1.65 (4.0 to 38 GHz) 2.00 (38 to 40 GHz)

* From 50 MHz to 6 GHz

† From >6 GHz to 8 GHz

For sensor uncertainties, utilize the Boonton RTP5000 Series uncertainty calculator at **www.boonton.com**.

Series Specifications	
Sampling Techniques	Real-time / Equivalent Time / Statistical Sampling
Continuous Sample Rate	100 MHz
Effective Sample Rate	10 GHz

Time Base	
Time Base Range	5 ns / div to 50 ms / div (pulse mode)
Time Base Accuracy	+/- 25 ppm
Time Base Resolution	100 ps (RIS mode) 10 ns (Single-sweep)

Trigger	
Trigger Sources	Internal (applied RF), External TTL, Crossover (from another sensor)
Trigger Modes	Single, Normal, AutoTrig, AutoLevel, Free Run
Trigger Slope	Positive or negative
Trigger Delay	
Range	+/- 1.0 s (timebase dependent)
Resolution	0.02 divisions
Trigger Holdoff (arming control)	
Modes	Off, Holdoff, Gap (frame) arming
Range	10 ns to 1000 ms
Resolution	10 ns
Trigger Jitter	≤ 0.1 ns rms
Trigger Latency	< 10 ns
External Trigger	
Logic Thresholds	High: > 2.4 V, Low: < 0.7 V
Maximum Input Range	-0.1 V to 5.1 V
Input Impedance	10 kOhms
Minimum Pulse Width	10 ns
Maximum Repetition Rate	50 MHz

Speed

Trace Acquisition Speed	> 100,000 triggered sweeps / s
Measurement Speed over USB	
Triggered or Free-run	100,000 readings / s (buffered mode)
Continuous Query/Response	1000 measurements / s

Interface

Connectivity	
Data Interface	USB 2.0 Hi-Speed
Device Type	USB High-Power device, bus powered
Current draw	500 mA max (480 mA typical)
Connector	Type B, locking
Multi-I/O	
Connector type	SMB female
Input Modes	Ext Trig, Crossover Slave, Analog
Output Modes	Timebase ref, Sweep, Trig Threshold, Crossover Master, Status
Software Interface	
Application Programming Interface	Windows DLL
Graphical User Interface	Boonton Power Analyzer™ software
Supported Operating Systems	Windows 7 (32-bit and 64-bit) Windows 8 (32-bit and 64-bit) Windows 10
System Hardware Requirements	
Processor	1.3 GHz or higher recommended
RAM	512 MB (1 GB or more recommended)
Hard Disk Space	Min 1.0 GB free space to install or run
Display Resolution	800 x 600 (1280 x 1024 or higher recommended)

Power Analyzer™ Software

Display Types	
Trace (power vs time)	Meter (numeric display)
CCDF	Statistical measurements
Automatic measurements (pulse / multiple pulse analysis, marker measurements)	
Marker Measurements (in Trace View)	
Markers (vertical cursors)	Settable in time relative to the trigger position
Marker Independently	Power at specified time
Pair of Markers:	
Min and max power between markers and ratio or average power between them.	
Ref Lines (horizontal cursors)	Settable in power
Automatic Tracking -	
Intersection of either marker and the waveform. Either marker and pulse distal, mesial or proximal levels.	
Pulse Mode – Automatic Measurements	
Pulse width	Pulse period
Pulse rise-time	Pulse fall-time
Pulse repetition frequency	Pulse duty cycle
Pulse off-time	Waveform average
Pulse average	Pulse peak
Pulse overshoot	Pulse droop
Top level power	Bottom level power
Edge delay	Pulse edge skew between channels

Statistical Mode – Automatic Measurements

Peak power	Average power
Minimum power	Peak to average ratio
Dynamic range	Percent at reference line
Crest factor at markers	Crest factor at various probabilities

Operational Requirements	Tests performed per MIL-28800F (Class3)
Operating Temperature	0 C to 55 C
Storage Temperature	-40 C to +70 C
Relative Humidity (non-condensing)	< 45 % at 50 C < 75 % at 40 C < 95 % at 30 C
Altitude	3048 m max
Shock	30 g half-sine, 11 ms duration
Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g max Random: 10 Hz to 500 Hz, 2.34 g rms Power Spectral Density: 0.01 g^2 / Hz

Regulatory Compliance	Class A Equipment
European Union	EMC Directive 2014/30/EU, EN 61326:2013, EN 55011:2019 Low Voltage Directive 2014/35/EU, EN 61010-1:2001 RoHS Directive 2015/863/EU
Australia and New Zealand	RCM AS/NZS 4417:2012

General Characteristics	
Power Consumption	2.5W max (USB High-Power device)
Dimensions (HxWxD)	1.7" x 1.7" x 5.7" (4.3 cm x 4.3 cm x 14.5 cm)
Weight	0.8 lbs (0.36 kg)
Warranty	3 years

Figure 6a. Top and bottom views of the RTP5000 series sensors. The information labels on the RTP series sensors contain information on the maximum power levels the device can handle and the meaning of the various status LED flash patterns.

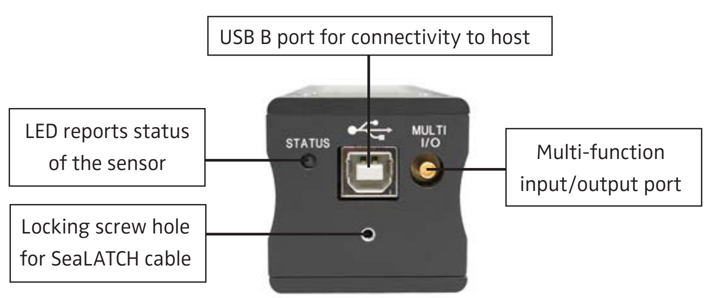

Figure 6b. End view of the RTP5000 series sensors.

Ordering Information

RTP5006	Real-Time Peak Power Sensor 50 MHz to 6 GHz
RTP5008	Real-Time Peak Power Sensor 50 MHz to 8 GHz
RTP5318	Real-Time Peak Power Sensor 50 MHz to 18 GHz
RTP5518	Real-Time Peak Power Sensor 50 MHz to 18 GHz
RTP5340	Real-Time Peak Power Sensor 50 MHz to 40 GHz
RTP5540	Real-Time Peak Power Sensor 50 MHz to 40 GHz

Included Accessories	
84620400A	Information Card
57500800A	0.9 m BNC (m) to SMB (m) cable
57500900A	0.9 m SMB (m) to SMB (m) cable
57401000A	1.8 m USB A (m) to USB B (m) locking SeaLATCH cable

Options	
RTP5006-ACAL0	17025 Accredited Calibration for RTP5006
RTP5008-ACAL0	17025 Accredited Calibration for RTP5008
RTP5318-ACAL0	17025 Accredited Calibration for RTP5318
RTP5518-ACAL0	17025 Accredited Calibration for RTP5518
RTP5xxx-CAL1	Prepaid Z540 Calibration for RTP5xxx
RTP5006-ACAL1	Prepaid 17025 Accredited Calibration for RTP5006
RTP5008-ACAL1	Prepaid 17025 Accredited Calibration for RTP5008
RTP5318-ACAL1	Prepaid 17025 Accredited Calibration for RTP5318
RTP5318-ACAL1	Prepaid 17025 Accredited Calibration for RTP5318
RTP5xxx-CARE1	Prepaid Z540 Calibration and Repair for RTP5xxx
xxx = 006, 008, 318, 518, 340, or 540	

Compatable with **PMX40 RF Power Meter** for benchtop operation.