Data Sheet

RF Peak Power Sensors
Real-Time with USB
RFP3000 Series

USB

Features and benefits

- Real-Time Power Processing
- Powered by host USB connection, no need for external power supply
- SeaLATCH brand USB cable provides a reliable connection
- Superior 100 ps time base resolution
- Acquisition rate up to 100 MSPS supporting 50 points per division
- Synchronized multi-channel measurements (up to 8 channels with Power Analyzer software, >8 with remote control)
- Outstanding hardware trigger control with low jitter < 100 ps jitter, rms
- Trigger hold off for bursted waveforms such as TDMA or GSM
- Two adjustable markers with automatic measurement
- 16 automated pulse measurements
- Crest Factor and statistical measurements (e.g., CCDF)
- Includes B&K Precision's Power Analyzer software for advanced measurement and analysis
- Optional stand-alone benchtop power meter RFM3000

The RFP3000 Series RF Peak Power Sensors are the performance leaders in the peak power measurement segment. Each sensor utilizes real-time processing and enhanced hardware triggering to capture even the most elusive signals. The RFP3000 Series specifications are impressive, offering best in class video bandwidth, rise times and time resolution.

The sensors, in combination with the included Power Analyzer software measure pulsed, bursted, and modulated signals used in commercial and military radar, electronic warfare (EW), wireless communications (e.g., LTE, LTE-A, and 5G), consumer electronics (WLAN and WiFi 6), as well as education and research applications.

The RFP3000 Series is powered by the host computer's USB port. The Power Analyzer software takes full advantage of the sensor's capabilities to perform peak power measurements in real-time and can be installed on additional workstations as needed.

Sensor	RFP3006	RFP3008	RFP3018	RFP3118	RFP3040	RFP3140
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
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
Dynamic Range						
Average	-60 to +20 dBm	-60 to +20 dBm[1] -53 to +20 dBm[2]	-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[1] -43 to +20 dBm[2]	-24 to +20 dBm	-40 to +20 dBm	-24 to +20 dBm	-40 to +20 dBm

[1] From 50 MHz to 6 GHz, [2] From >6 GHz to 8 GHz

Technical data subject to change

Advanced measurement and analysis software

B&K Precision's Power Analyzer software supports sensor configuration, signal capturing and analysis. Install Power Analyzer on as many workstations as you need at no cost.

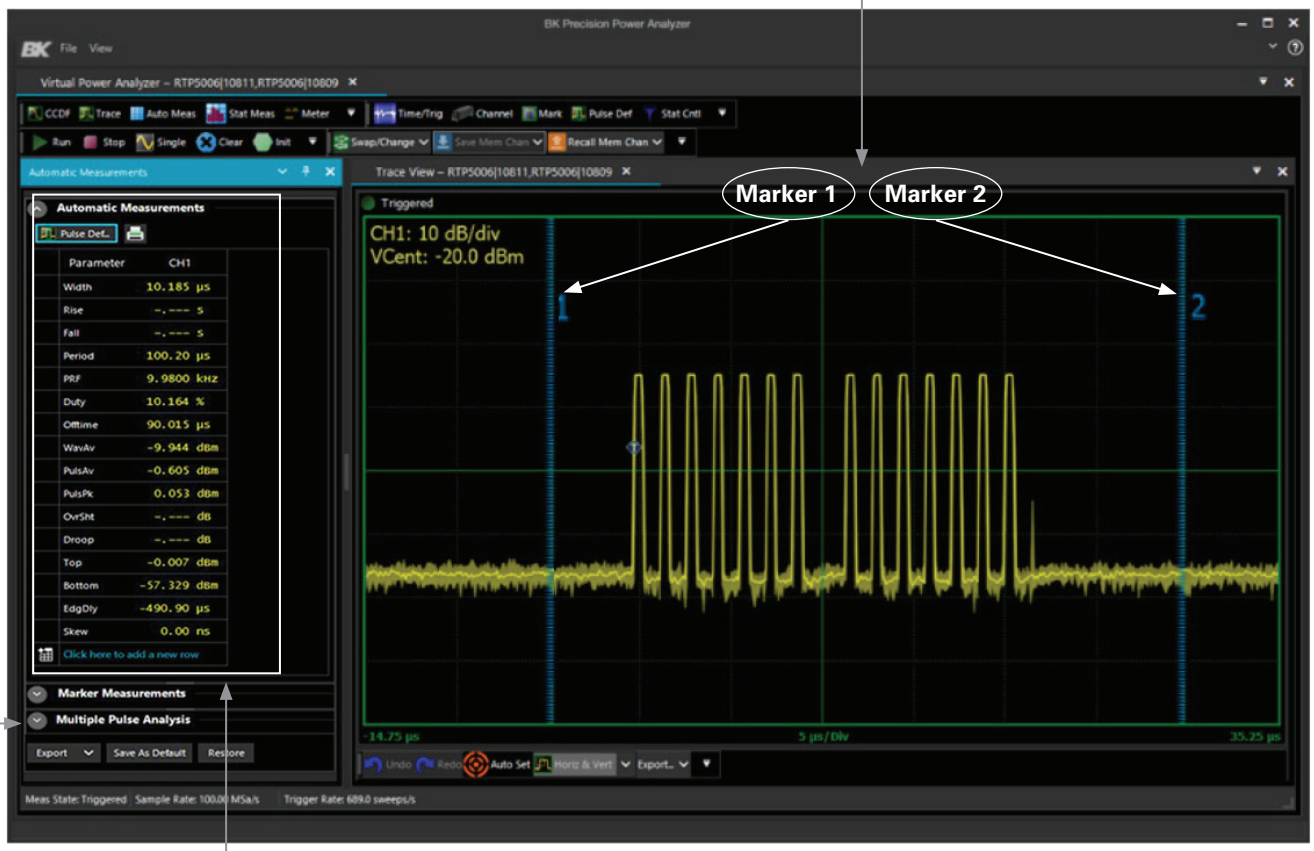
Features include:

- Trace and meter display types
- Statistical measurement mode, including CCDF
- Markers and automatic measurements
- Multi-pulse analysis
- Supports up to 8 simultaneous power measurement channels
- Skew adjustment between channels
- Save and recall measurement settings
- Screen capture and flexible data export in csv and pdf format
- USB driver, remote control API, firmware updater, virtual panel

Auto Marker Measurements

View up to 16 unique Automatic Marker Measurements on-screen.

"Between Marker" measurements are ideal for monitoring parameters such as pulse power or crest factor over long intervals.



Advanced Multi-channel Pulse Analysis

Power Analyzer software

To simplify testing, the RFP3000 Series can automatically measure and calculate 16 common power and timing parameters and display the parameters of interest. Other parameters include: rise time, fall time, pulse average, overshoot, and droop.

Operation highlights

Real-Time Power Processing

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 Ia. 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 Ib. These sorts of events are most often missed by conventional power meters due to the acquisition gaps while processing takes place.

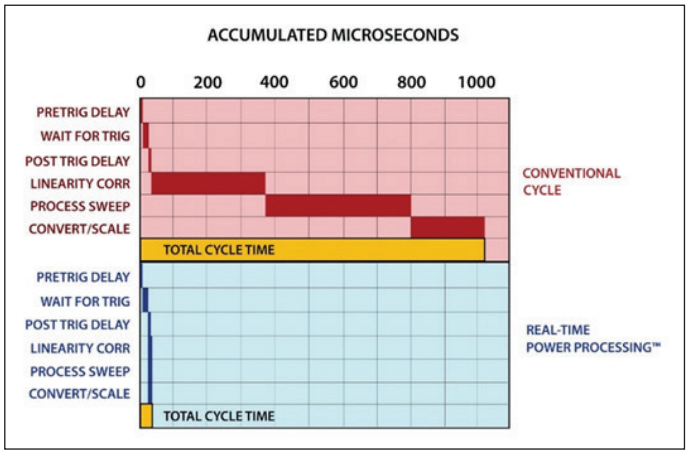


Figure Ia. Comparison between conventional power measurement sample processing and Real-Time Power Processing.

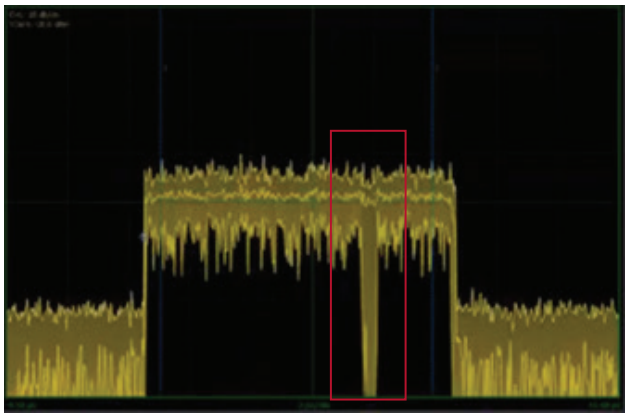


Figure Ib. Identification of a signal dropout with Real-Time Power Processing.

Superior time resolution

The RFP3000 Series features I00 ps time base resolution and with an acquisition rate up to I00 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, the instrument's superior time management enables several other advantages. Pulse widths as narrow as I0 ns can be captured and characterized with outstanding trigger stability (< I00 ps jitter, rms).

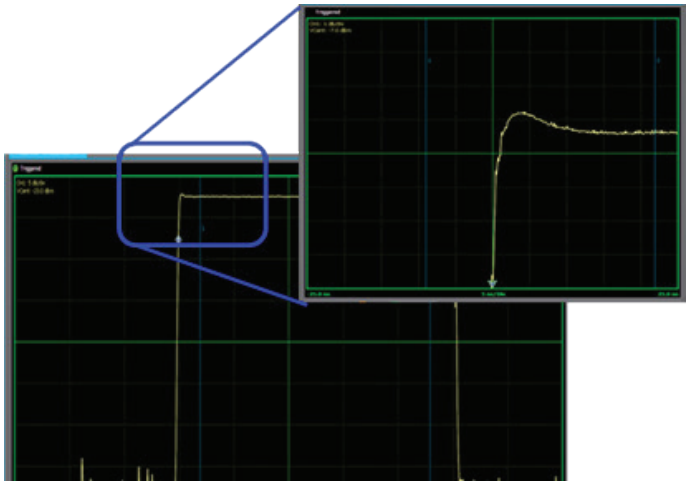


Figure 2a. RFP3000 Series waveform analysis with I0 ns/div time base and 50 samples per division.

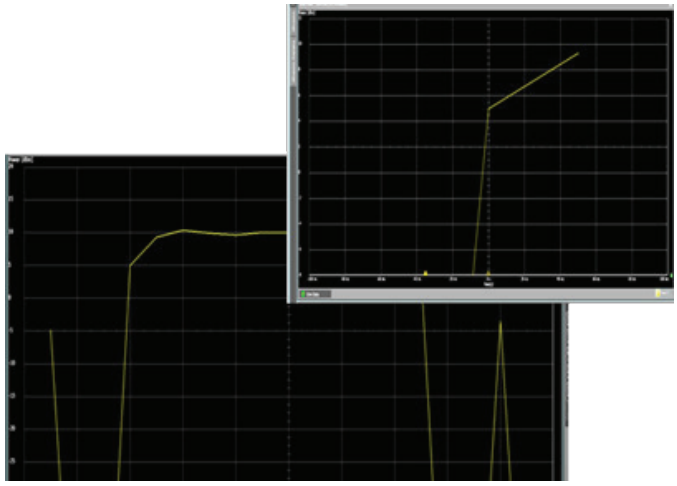
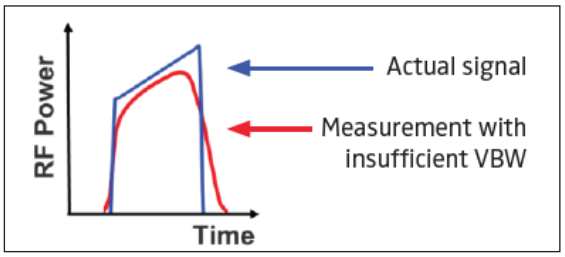


Figure 2b. "Conventional" power meter waveform analysis with I0 ns/div time base and I sample per division.

Operation highlights

Video bandwidth

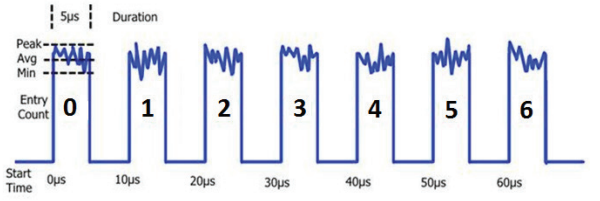
Video bandwidth (VBW) describes the ability of a power sensor to track peak (envelope) power. Insufficient VBW will result in errant envelope and average power measurements. The RFM3000 Series offers the widest video bandwidth (195 MHz) making it ideal for measuring 80 MHz, 100 MHz, and 160 MHz channels.



Measurement buffer mode

The RFP3000 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 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.

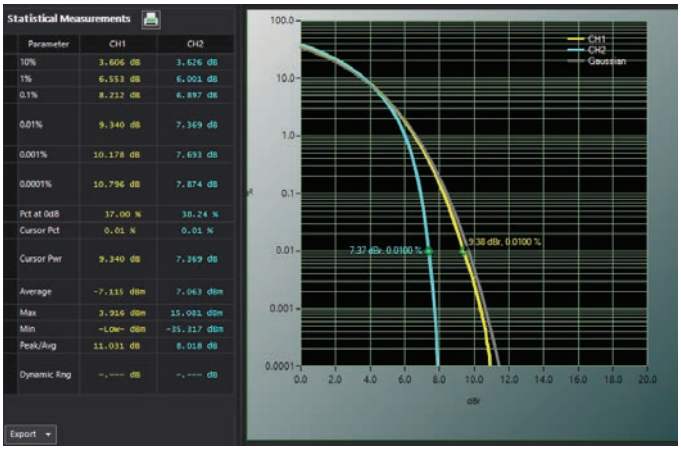


Entry Count	Interval Start	Interval Duration	Interval Average	Interval Minimum	Interval Peak
0	0.00 us	5.01 us	-0.043 dBm	-39.042 dBm	8.826 dBm
1	9.99 us	5.00 us	-0.006 dBm	-38.431 dBm	8.827 dBm
2	19.99 us	5.01 us	0.039 dBm	-41.549 dBm	9.742 dBm
3	30.00 us	5.00 us	0.017 dBm	-38.551 dBm	9.802 dBm
4	40.01 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

Example of pulses and events showing waveform and measurement buffer data.

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 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.

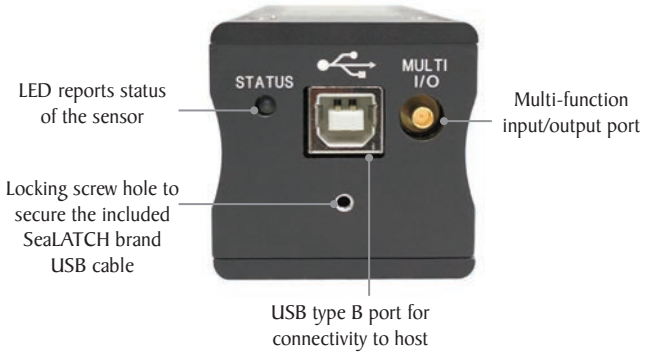


Comparing CCDF plots of a signal at an amplifier input (yellow) and output (blue).

Top view

Bottom view

Rear view



Specifications

Note: All specifications apply to the unit after a temperature stabilization time of 15 minutes over an ambient temperature range of 23 °C ± 5 °C. Specifications are valid for single unit operation only.

Sensor		RFP3006	RFP3008	RFP3018	RFP3118	RFP3040	RFP3140
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[1] -53 to +20 dBm[2]	-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[1] -43 to +20 dBm[2]	-24 to +20 dBm	-40 to +20 dBm	-24 to +20 dBm	-40 to +20 dBm
Internal Trigger	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		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 (4.0 to 38 GHz) 2.00 (38 to 40 GHz)	1.25 (0.05 to 4.0 GHz) 1.65 (4.0 to 38 GHz) 2.00 (38 to 40 GHz)

[1] From 50 MHz to 6 GHz

[2] From >6 GHz to 8 GHz

Specifications (cont.)

RFP3000 Series			
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 kΩ	
	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 T	Timebase ref, Sweep, Trig Threshold, Crossover Master, Status
Software Interface	Application Programming Interface	Windows DLL
	Graphical User Interface	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)

Operational Requirements	
Tests performed per MIL-28800F (Class 3)	
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, and RoHS Directive 2015/863/EU
Australia and New Zealand	RCM AS/NZS 4417:2012
General	
Power Consumption	2.5 W max (USB High-Power device)
Dimensions (H x W x D)	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
Standard Accessories	0.9 m BNC (m) to SMB (m) cable, 0.9 m SMB (m) to SMB (m) cable, 1.8 m USB A (m) to USB B (m) locking SeaLATCH cable, power cord, test report & certificate of calibration

Specifications (cont.)

Power Analyzer™ Software		
Display Types	Graph (power vs time) - Numeric (numeric data) Statistical Measurements - CCDF	
	Automatic measurements (pulse / multiple pulse analysis, marker measurements)	
Marker Measurements (in Graph 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 channel	
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	

Compatible with RFM3000 RF Power Meter for benchtop operation

The RFM3000 Series is suited for stand-alone operation in a familiar benchtop form factor supporting up to 4 sensors. B&K Precision's Power Analyzer software is built-in with LAN and optional GPIB connectivity.

For more information, see the RFM3000 Series data sheet

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