

Model 12000 Series | RF Power Meters  
4 kHz to 40 GHz



Datasheet

**12000 Series**  
**RF Power Meter**



## 12000 Series Power Meter



The 12000 series provides design engineers and technicians the utility of traditional benchtop instrument, the flexibility and performance of modern USB RF power sensors, and the simplicity of a multi-touch display built with Berkeley Nucleonics award-winning technology.

As a benchtop meter, the 12000 series provides a standalone solution for capturing, displaying, and analyzing peak and average RF power in both the time and statistical domains through an intuitive, multi-touch touchscreen display.

The 12000 series Power Meter utilizes up to four USB RF power sensors with industry-leading performance and capabilities either independently or for synchronized multi-channel measurements of CW, modulated, and pulsed signals.

Providing the ultimate flexibility, the 12000 series sensors can be disconnected and independently used as standalone instruments.

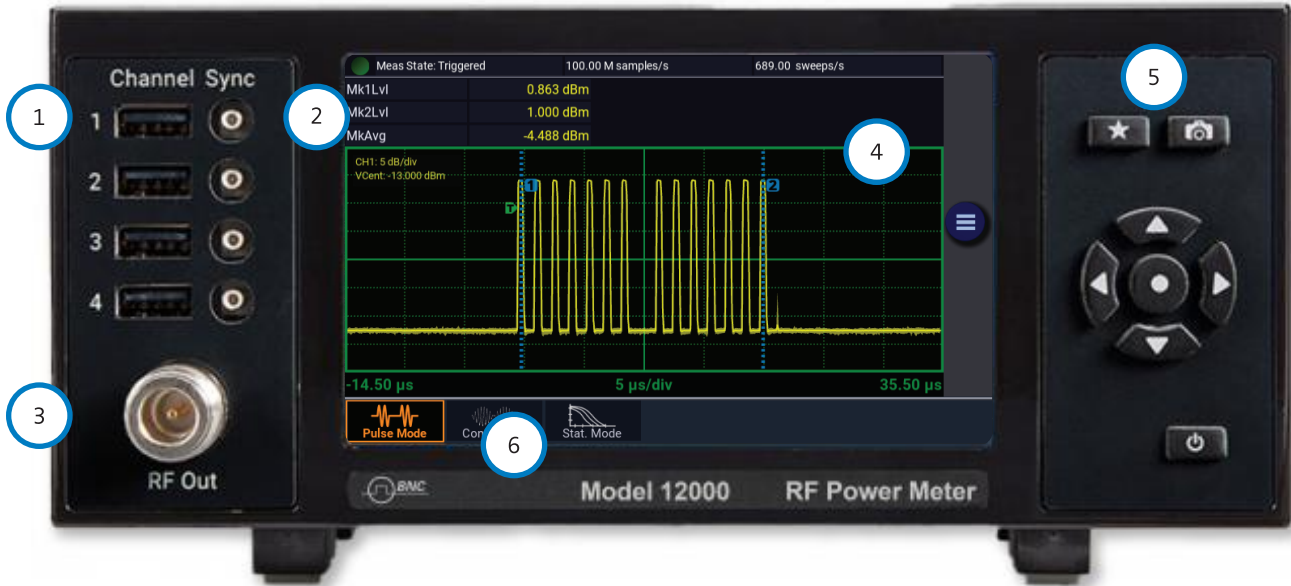
### Key Features

- Capture/display/analyze peak and average power
- Frequency range from 4 kHz to 40 GHz
- **Industry-leading** video bandwidth (195 MHz) and rise time (3 ns)
- **Industry-leading** 100,000 measurements per second
- **Industry-leading** 100 ps time resolution
- Synchronous multi-channel measurements (up to 4 channels)
- Sensors can be used as standalone instruments



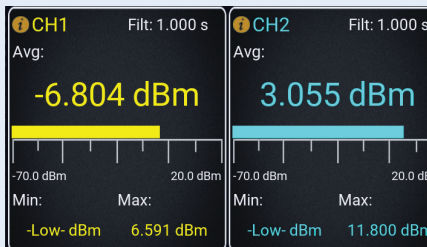
## 12000 Series RF Power Meter – Front Panel

The 12000 series' intuitive, multi-touch display enables fast configuration of up to four sensors as well as easy access to measurement and analysis tools, providing a standalone solution for capturing, displaying, and analyzing peak and average RF power in both the time and statistical domains. The meter also incorporates a test source to verify sensor operation.



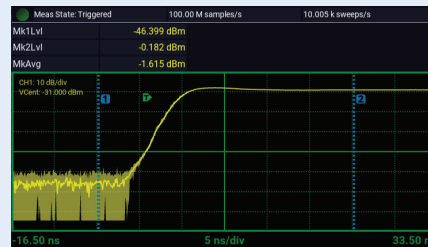
- 1 Connect up to 4 USB sensors for multi-channel measurements.
- 2 Sync ports to source or receive triggers for timing and synchronization.
- 3 Test source to verify sensor operation.
- 4 Multi-touch display with intuitive user interface.
- 5 One touch to quickly access presets and favorite functions.

### 6 12000 Series Measurement Modes



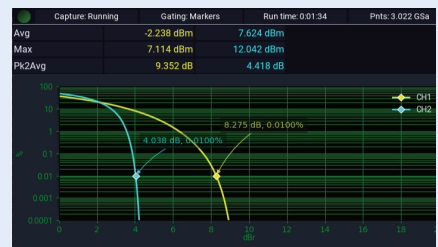
#### Continuous Mode

For simple, intuitive measurements of repetitive waveforms, the 12000 series Continuous Mode of operation provides a numeric display of average, maximum and minimum signal powers.



#### Pulsed Mode

Analysis of fast-rising single pulses or pulses with short pulse repetition intervals (PRIs) requires an instrument with sophisticated trigger and data acquisition capability. Within Pulsed Mode, more than 16 pulse parameters can be measured.



#### Statistical Mode

In Statistical Mode, the 12000 series plots the Complementary Cumulative Distribution Function (CCDF). The CCDF plot shows the rate of occurrence of a specific crest factor for signals, such as those used in 5G, 4G/LTE, and Wi-Fi applications.

## High-Performance and Versatile USB Power Sensors

The Berkeley Nucleonics 12000 Series Power Meter utilizes the USB RF power sensors with industry leading performance and capabilities. All RTP sensors incorporate the unique Berkeley Nucleonics Real-Time Power Processing technology, which virtually eliminates gaps in measurement suffered by other power sensors and enables industry best measurement speeds. In terms of RF performance, the 12200 series Real-Time Peak Power Sensors are the fastest responding sensors with 3 ns rise times and 195 MHz of video bandwidth.

### 12200 Series Real-Time Peak Power Sensors

- 50 MHz to 6 GHz, 18 GHz and 40 GHz peak RF power sensors
- Up to 195 MHz video bandwidth with 3 ns rise time
- Crest factor and statistical measurements (e.g., CCDF)
- 10 GS/s effective sample rate



### All RTP Real-Time Power Sensors

- Real-Time Power Processing™ technology with virtually zero measurement latency
- 100,000 measurements per second
- 80 dB dynamic range
- Synchronized multi-channel measurements

# Software Features

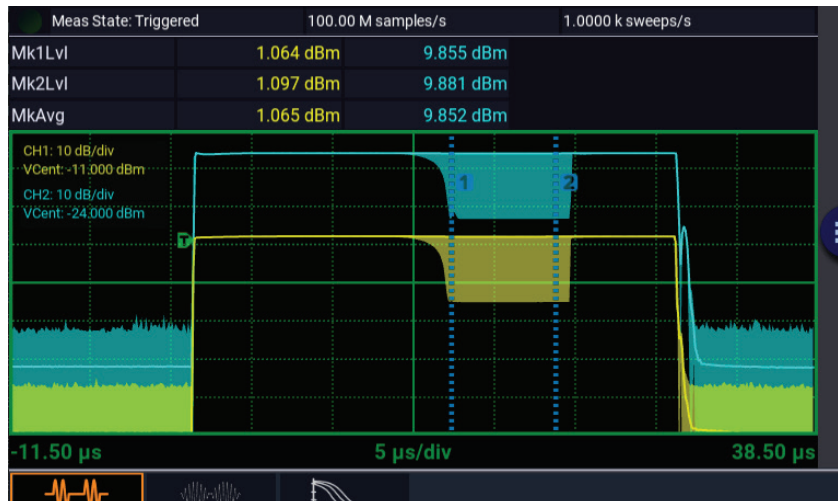
## Real-Time Power Processing

Berkeley Nucleonics' 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 that 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 or dropouts will be reliably captured and analyzed.

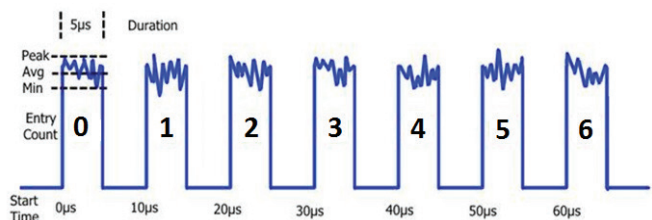
RTPP is available within the 12200 series sensors.

Dropouts, such as those shown left, are the sorts of events often missed by conventional power meters due to the acquisition gaps while processing takes place.



## Measurement Buffer Mode

The Model 12000 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 without gaps. 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.



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

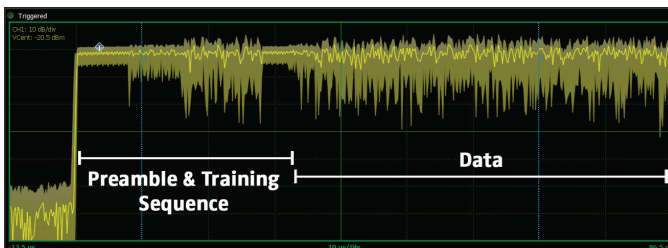
Measurement buffer data returned for waveform in above.

# 12000 Series RF Power Meter

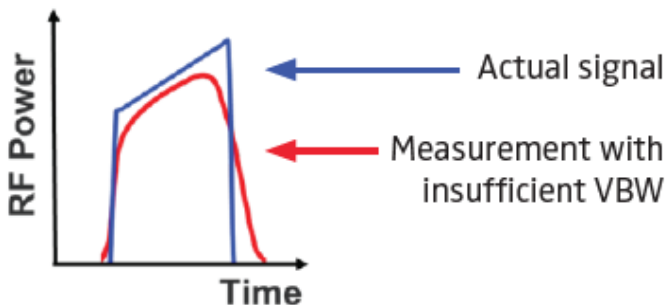
## Addressing RF Communications and Radar Measurement Challenges

### Wi-Fi and Wireless Communication Signal Analysis

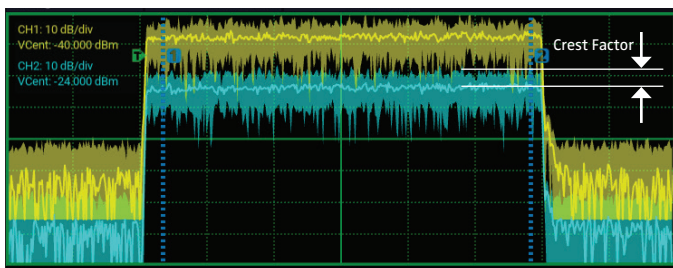
Characterization and compliance testing of Wi-Fi and LTE chipsets and devices involves significant challenges for design and test engineers. With multiple-input, multiple-output (MIMO) architectures and channel bandwidths up to 160 MHz, testing is complex, especially when measuring RF power per channel and time alignment between channels. The 12000 series enables packet power measurements to be performed independently on multiple synchronous or asynchronous transmit chains with a common timebase shared among sensors.



Use markers to define a portion of the waveform on which to make measurements. **“Between Marker” measurements** are ideal for monitoring specific portions of a packet over long intervals.



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 12000 series offers the **widest video bandwidth (195 MHz)** making it ideal for measuring 80 MHz, 100 MHz, and 160 MHz channels.



By comparing the peak-to-average power ratio, or crest factor (CF), of input and output signals of an RF transmission chain, engineers can assess circuit linearity. Additional insight can be provided with the 12000 series statistical mode Complementary Cumulative Distribution Function (CCDF) plot displaying the rate of occurrence of a specific CF. As an amplifier output compresses, the CF will reduce and the CCDF plot will move left.

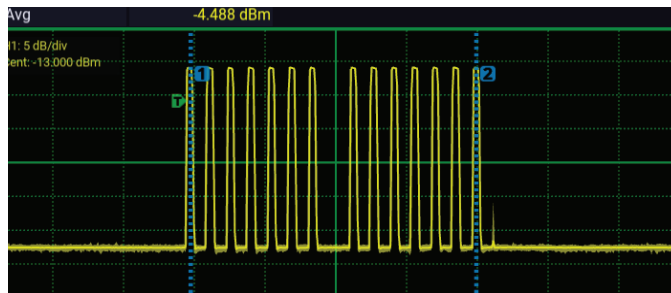


# 12000 series RF Power Meter

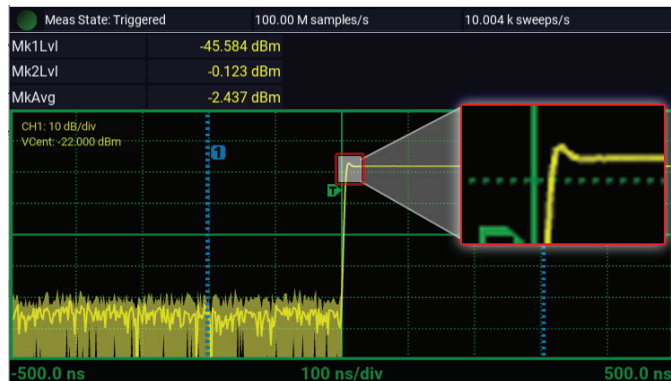
## Addressing RF Communications and Radar Measurement Challenges

### Secondary Surveillance Radar (SSR)

Design, verification, troubleshooting and maintenance of secondary surveillance radar (e.g. IFF-based radar) has never been more demanding.



Proper design and operation of SSR systems is critical to the the safety and security of aviation. The 12000 series can be used to easily and accurately capture SSR waveforms. Markers enable measurements on specific portions of the waveform.



**Industry-leading** rise time (<3 ns) enables characterization of the most demanding radar signals.

Utilize the superior 100 ps time resolution to zoom and uncover signal characteristics that might otherwise be missed.

Param	CH1	CH2
Width	30.080 μs	30.012 μs
Rise	21.061 μs	21.132 μs
Fall	22.395 μs	23.404 μs
Period	999.77 μs	999.89 μs
PRF	1.0002 kHz	1.0001 kHz
Duty	3.01%	3.00%
Offtime	969.69 μs	969.88 μs
WavAv	-14.158 dBm	-5.348 dBm
PulsAv	0.484 dBm	9.445 dBm
PulsPk	1.327 dBm	10.098 dBm
OvrSht	0.290 dB	0.110 dB

Users can take advantage of the 12000 series automated pulse measurement feature to measure and calculate 16 common power and timing parameters and display the parameters of interest: rise-time, fall time, pulse width, off-time, period, pulse repetition frequency, duty cycle, pulse peak, pulse overshoot, pulse average, waveform average, top level power, droop, bottom level power, edge delay, and pulse edge skew between channels.

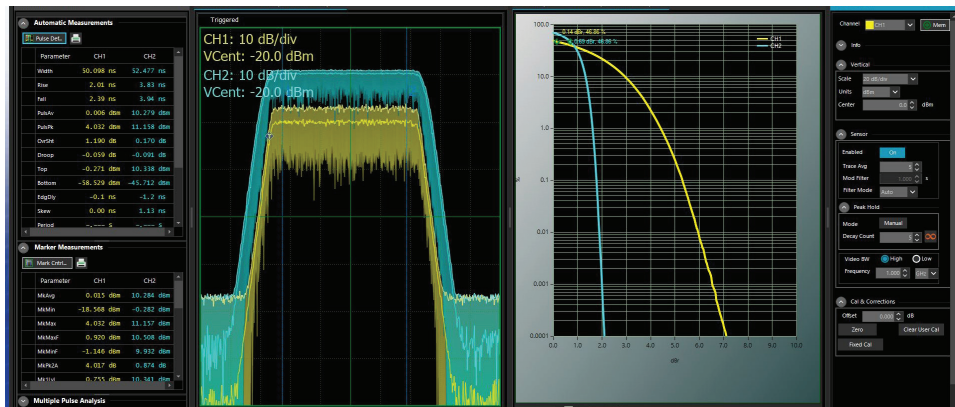
## Sensor Software

### Power Analyzer - Advanced Measurement and Analysis Software

Power Analyzer is a complimentary PC-Based software package for 12200 series sensor control, measurement configuration, and advanced analysis. It includes USB drivers, remote control API, firmware updater and virtual instrument application.

#### Key Features and Functionality

- Data displayed as numerical meter or waveform trace
- Statistical analysis with CCDF plot
- Multiple marker measurements, including between marker data and marker ratios
- Automated measurements; e.g., 16 automated pulse measurements
- Export measurement data in .csv or .pdf formats
- Up to 8 simultaneous power measurement channels
- Simulation mode available to preview functionality when a sensor is not available

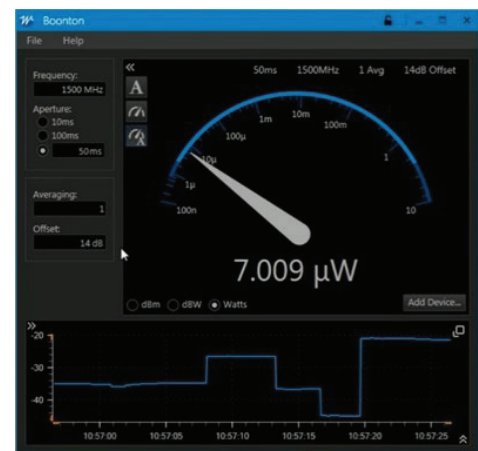


### Power Viewer – Simple and Intuitive Measurement Software

Power Viewer is a complimentary PC-based software package for CPS2008 sensor control, measurement configuration, and analysis. It includes USB drivers, remote control API, firmware updater and virtual instrument application.

#### Key Features and Functionality

- Large numeric readout and/or analog meter display
- Zoom and pan through data logging strip chart
- Quickly set frequency, aperture (averaging) and offset values all from the main screen
- Calculates ratios between sensor measurements
- Control up to 8 sensors at once
- Simulation mode available to preview functionality when a sensor is not available





## Sensor Specifications

	12206S	12218S	12218L	12240S	12240L
<b>RF Frequency Range</b>	50 MHz to 6 GHz	50 MHz to 18 GHz	50 MHz to 18 GHz	50 MHz to 40 GHz	50 MHz to 40 GHz
<b>Dynamic Range</b>					
Average	-60 to +20 dBm	-34 to +20 dBm	-50 to +20 dBm	-34 to +20 dBm	-50 to +20 dBm
Pulse	-50 to +20 dBm	-24 to +20 dBm	-40 to +20 dBm	-24 to +20 dBm	-40 to +20 dBm
<b>Internal Trigger</b>					
Range	-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 $\mu$ s	10 ns / 3 $\mu$ s	200 ns / 3 $\mu$ s	10 ns / 3 $\mu$ s	200 ns / 3 $\mu$ s
Max Repetition Rate	50 MHz	50 MHz	5 MHz	50 MHz	5 MHz
<b>Rise time (fast/std)</b>	3 ns / < 10 $\mu$ s	5 ns / < 10 $\mu$ s	< 100 ns / < 10 $\mu$ s	5 ns / < 10 $\mu$ s	< 100 ns / < 10 $\mu$ s
<b>Video Bandwidth (high/std)</b>	195 MHz / 350 kHz	70 MHz / 350 kHz	6 MHz / 350 kHz	70 MHz / 350 kHz	6 MHz / 350 kHz
<b>Single-shot Bandwidth</b>	35 MHz	35 MHz	6 MHz	35 MHz	6 MHz
<b>RF Input</b>	Type N, 50 $\Omega$	Type N, 50 $\Omega$	Type N, 50 $\Omega$	2.92 mm, 50 $\Omega$	2.92 mm, 50 $\Omega$
<b>VSWR</b>	1.25 (0.05 - 6 GHz)	1.15 (0.05 - 2.0 GHz) 1.28 (2.0 - 16 GHz) 1.34 (16 - 18 GHz)	1.15 (0.5 - 2.0 GHz) 1.20 (2.0 - 6.0 GHz) 1.28 (6.0 - 16 GHz) 1.34 (16 - 18 GHz)	1.25 (0.05 - 4.0 GHz) 1.65 (4.0 - 38 GHz) 2.00 (38 - 40 GHz)	1.25 (0.05 - 4.0 GHz) 1.65 (4.0 - 38 GHz) 2.00 (38 - 40 GHz)



12200 Series Real-Time Peak  
USB Power Sensors

## Specifications

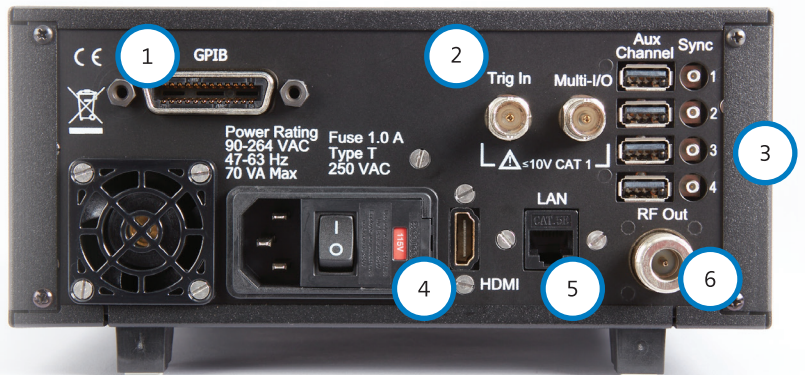
<b>Channels</b>	Up to 4	
<b>Sensors</b>	12200 Series	
<b>Display</b>	5-inch WVGA multi-touch display with intuitive graphical user interface	
Display Modes	Trace (power vs time)	Meter (numeric display)
	Statistical measurements	CCDF
	Automatic measurements (pulse, statistical, and markers measurements)	
<b>Marker Measurements</b> (in Trace View)	Markers (vertical cursors)	Settable in time relative to the trigger position
	Marker Independently	Avg, Min and Max Power at a specified time offset
	Interval Between Markers	Avg, Min and Max Power over the defined interval
	Pair of Markers	Ratio of power values at each marker
<b>Pulse Mode –</b> Automatic Measurements	Pulse rise-time	Pulse fall-time
	Pulse width	Pulse off-time
	Pulse period	Pulse repetition frequency
	Pulse duty cycle	Waveform average
	Pulse peak	Pulse average
	Pulse overshoot	Pulse droop
	Top level power	Bottom level power
	Edge delay	Pulse edge skew between channels
<b>Statistical Mode –</b> Automatic Measurements	Peak power	Average power
	Minimum power	Peak to average ratio
	Dynamic range	Percent at cursor
	Crest factor at cursor	Crest factor at various percents
<b>Trigger</b>	Synchronization*	Among RTP Series (internal trig distribution)
	Mode	Normal, Auto, Auto Pk-to-Pk, Free Run
	Source	Any connected RTP Series sensor (via SMB's) or rear panel external trigger
	Internal Level Range	-40 dBm to +20 dBm (sensor dependent)
	External Level Range	±5 volts or TTL
	Slope	+ or -
	Hold-off, Min Pulse Width, Max Trigger Rate	Sensor and timebase dependent
<b>Time Base</b>	Time Base Resolution, Range, Accuracy	Sensor dependent
	Time Base Display	Sweeping or Roll Mode
	Trigger Delay Range	Sensor dependent
	Trigger Delay Resolution	0.02 divisions

## Specifications, Continued

<b>Inputs/Outputs (front panel)</b>	USB with SMB trigger port	4 ports USB2.0: Type A receptacle 4 ports SMB(f)
Test Source (optional rear panel placement)	50 MHz	1.00 mW (0 dBm) +/- 2.3% (0.1 dB) typ
<b>Inputs/Outputs (rear panel)</b>	LAN	10/100 Ethernet: RJ-45 modular socket
	USB with SMB trigger port	4 ports USB2.0: Type A receptacle 4 ports SMB(f)
Multi I/O Connector	User Selectable Range	Status, trigger, or voltage output 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	0.4% typical
<b>Remote Control</b>	Command Set	SCPI-1999.0
	LAN	Ethernet:10/100/1000 BaseT; HiSLIP
	GPIB (optional)	
<b>Regulatory Compliance</b>	CE compliance with the following European Union directives Low Voltage Directive 2014/35/EU Electromagnetic Compatibility Directive (EMC) 2014/30/EU RoHS Directive EU 2015/863, WEEE Directive 2012/19/EU	
<b>Construction</b>	Manufactured to the intent of MIL-PRF-28800F, Class	
<b>Dimensions (excluding connectors)</b>	H x W x D	3.5x8.3x11.2 (in),89x211x284 (mm)
<b>Weight</b>	4.8 lbs, 2.2 kg	
<b>AC Power</b>		
Rated Voltage	100 to 240 VAC	
Voltage Range	90 to 264 VAC	
Rated Frequency	50/60 Hz	
Frequency Range	47 to 63 Hz	
Power Consumption	60 W (70 VA) max, 30 W (35 VA) nominal with no external peripheral devices attached	
<b>Operating Temperature</b>	0 to 50 °C (32 to 122 °F)	
<b>Storage Temperature</b>	-40 to +70 °C (-40 to 158 °F)	
<b>Humidity</b>	95% maximum, non-condensing	
<b>Altitude</b>	Operation up to 15,000 feet (4,575 m)	
<b>Warranty</b>	3 years	

This instrument is designed for indoor use only

- 1 Optional GPIB connectivity
- 2 External trigger input
- 3 Auxiliary sensor and Sync inputs
- 4 HDMI output for remote front panel display
- 5 LAN connectivity
- 6 Optional Test Source rear panel output



# Ordering Information

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## 12000 Series

**RF Power Meter** (includes 2 active channels)

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### Options

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12000-4CH	Adds 2 Active Channels (for a total of 4)
12000-GPIB	GPIB Control (internally installed)
12000-RTS	Moves Test Source output to the rear panel
12000-SECURE	Removes internal microSD and enables boot from USB drive (included)
12000-2SECOP	Installation of 12000-SECURE post initial purchase (retrofit); requires return to factory

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### Included Accessories

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Information Card (provides information on where to download the latest manual, software, utilities)

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### Optional Accessories

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12000-RMK	Full-width 19" Rack Mount Kit (includes handles & hardware for mounting one or two meters)
12000-TCASE	Transit case, hold the 12000 series and up to 4 sensors
12000-RSSD	Additional external USB drive for secure operation

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## RF Power Sensors

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12206S	Real-Time Peak Power Sensor	50 MHz to 6 GHz
12218L	Real-Time Peak Power Sensor	50 MHz to 18 GHz
12218S	Real-Time Peak Power Sensor	50 MHz to 18 GHz
12240L	Real-Time Peak Power Sensor	50 MHz to 40 GHz
12240S	Real-Time Peak Power Sensor	50 MHz to 40 GHz

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### Included Accessories

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Information Card (provides information on where to download the latest manual, software, utilities)

- 0.9 m BNC (m) to SMB (m) cable (RTP sensors)
- 0.9 m SMB (m) to SMB (m) cable (RTP sensors)
- 1.8 m USB A (m) to USB B (m) locking SeaLATCH cable (RTP sensors)
- 1.6 m USB A (m) to USB B (m) cable (CPS sensors)

Specifications and performance subject to change

### Options

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Contact the factory for Calibration and Repair Services. BNC offers 17025 (NIST Traceable) and Z540 Calibration Services

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Berkeley Nucleonics Corporation - 2955 Kerner Blvd., San Rafael CA 94901 USA  
Specifications subject to change without notice.