



Mini-Circuits

USB / ETHERNET

Smart Power Sensor

PWR-40PW-RC

50Ω 0.5 to 40 GHz -20 to +20 dBm Peak & Average 2.92 mm Male

THE BIG DEAL

- Peak, average, crest factor & duty cycle measurements
- Modulated, pulsed & CW signal types
- 30 MHz video bandwidth
- 20 million samples / sec
- USB and Ethernet control

APPLICATIONS

- 5G NR device testing
- ASK, FSK, OFDM, QAM, LTE modulations
- K / Ka band radar
- Signal level calibration
- Remote power monitoring



Generic photo used for illustration purposes only.

PRODUCT OVERVIEW

Mini-Circuits' PWR-40PW-RC is a high performance sensor for any power measurement application from 0.5 to 40 GHz. The 10 MHz internal modulation bandwidth, coupled with a data processing rate of 20 million samples-per-second, enables measurement of a wide range of analog & digital modulation types. The video output port additionally provides 30 MHz video bandwidth for additional analysis or automatic level control circuits.

The power meter has USB and Ethernet interfaces, allowing control directly from a PC, or remote power measurement over a network. The software provides peak & average power measurements, statistical analysis (crest factor, duty cycle, rise / fall time) and time domain plots for any signal type, including pulsed waveforms down to 100 ns pulse width and 0.1% duty cycle.

Full software support is provided, including our user-friendly GUI application for Windows and a full API with programming instructions for Windows and Linux environments (both 32-bit and 64-bit systems).

KEY FEATURES

Feature	Advantages
Peak, average and pulse profiling	Measure peak & average power of CW and modulated signals. Analyze and graphically plot the peak & average power, duty cycle, pulse width, crest factor, rise & fall times of pulsed signals.
External trigger controls	Trigger in and out ports support precise synchronization with external test equipment, allowing capture of irregular signal patterns & pulses.
Selectable video BW	Switch between CW, 1.5 MHz, 5 MHz & 10 MHz video bandwidths on demand to minimize measurement noise.
Video output port	Use in ALC (automatic level control) loops or observe the modulated signal directly on an oscilloscope for highest bandwidth.
Full software support	User friendly Windows GUI (graphical user interface) allows manual control straight out of the box, while the comprehensive API (application programming interface) with examples and instructions allows easy automation in most programming environments.

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www.minicircuits.com P.O. Box 350166, Brooklyn, NY 11235-0003 (718) 934-4500 sales@minicircuits.com

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ELECTRICAL SPECIFICATIONS^{1, 2}

Parameter	Conditions	Frequency (GHz)	Min.	Typ.	Max.	Unit
Frequency range	-	-	0.5	-	40	GHz
Input power range	-	0.5 - 40	-20	-	+20	dBm
Uncertainty of power measurement @ 25°C ^{3, 4}	-20 to -18 dBm	0.5 - 15	-	±0.10	±0.60	dB
		15 - 32	-	±0.25	±0.60	
		32 - 40	-	±0.30	±0.60	
	-18 to 0 dBm	0.5 - 15	-	±0.10	±0.40	dB
		15 - 32	-	±0.20	±0.40	
		32 - 40	-	±0.30	±0.40	
	0 to +20 dBm	0.5 - 15	-	±0.10	±0.40	dB
		15 - 32	-	±0.20	±0.40	
		32 - 40	-	±0.30	±0.40	
Uncertainty of power measurement @ 0°C to 50°C ^{3, 4}	-20 to -18 dBm ⁵	0.5 - 40	-	±0.50	-	dB
	-18 to 0 dBm ⁵	0.5 - 40	-	±0.50	-	dB
	0 to +20 dBm	0.5 - 40	-	±0.50	-	dB
Return Loss	-	0.5 - 15	-	21	18	dB
		15 - 40	-	18	15.5	
Linearity @ 25°C	-	0.5 - 40	-	2	-	%
Measurement resolution	-	0.5 - 40	0.01	-	-	dB
Averaging range	-	0.5 - 40	1	-	999	-
Sample period	Full sampling rate	0.5 - 40	4	-	80	μs
	Reduced sampling rate ⁶	0.5 - 40	-	-	1,000,000	
Measurement rate ⁷ (including typical USB delays)	Sample period = 4 μs	0.5 - 40	-	500	-	per sec
Sample rate ⁸	Sample period ≤ 80 μs	0.5 - 40	-	20	-	MSPS
	Sample period > 80 μs		-	1800 / (sample period in μsec)	-	
Time base accuracy	-	-	-	-	50	ppm
Video bandwidth	Internal pulse profiling ⁹	0.5 - 40	-	-	10	MHz
	Video out port	0.5 - 40	-	-	30	
Minimum pulse width	-	0.5 - 40	-	-	0.1	μs
Rise/Fall time ¹⁰	-	0.5 - 40	-	50	-	ns
Pulse duty cycle for pulse profiling	-	0.5 - 40	0.1	-	99.9	%
DC current (I _{cc})	Ethernet disabled	0.5 - 40	-	450	500	mA
	Ethernet enabled ¹¹		-	540	700	

1. After 15 minute warm up. For signals below -15 dBm it is recommended to perform zeroing before testing.

2. Maximum continuous safe operational power limit: +23 dBm.

3. Tested with CW signal

4. Power uncertainty is specified for default sample period of 80 μs.

5. At temperatures below 15°C, over frequency 20-40GHz, accuracy degrades when power is less than -15dBm.

6. As sample period increases above 80 μs resolution will decrease. To get high resolution of the pulse while maintaining large sample period use the "zoom on pulse" function in pulse profiling (see [related page](#) for details).

7. The number of complete measurements taken per second (including typical USB communication time) with the specified sample period.

8. The rate at which the sensor captures discrete samples over the specified sample period. With sample periods greater than 80 μs the sample rate will be reduced to allow covering the full sample period.

9. Video bandwidth can be set to 1.5 MHz, 5 MHz or OFF (~10 MHz) for Peak mode, or switched to Average (CW) mode.

10. The minimum rise/fall time (measured at 10% to 90% i.e. 0.5 to 10 dBc) or resolution that can be observed in a pulsed and modulated signal. While the sensor's internal rise time is 50 ns, this does not mean a signal with a rise time of 50 ns can be accurately measured. See page 5 for details.

11. When Ethernet control is enabled, it is recommended to use an external power supply (USB-AC/DC-5+ or equivalent), a powered hub, or USB 3.0/3.1 port, as USB 2.0 ports are specified to supply 500 mA load and thus may not be able to supply the required current.





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TRIGGER PARAMETERS, 25°C ^{1, 2}

Parameter		Conditions	Min.	Typ.	Max.	Unit
Trigger Input Options ¹²		Internal (on rise), external (on rise or fall), free running				
Trigger Timeout ¹³		Internal & External Triggers	1	-	5000	ms
Internal Trigger	Threshold (level)	Internal Trigger (on rise)	-15	-	+15	dBm
	Resolution		-	1	-	dB
	Accuracy		-	1	-	dB
Trigger In Delay (set by user)		Trigger to Start of Sample Period	0	-	10	ms
Trigger Out Delay (from RF)		In Internal Trigger modes	-	250	-	ns
Trigger In	Logic Low		0	-	0.6	V
	Logic High		2.7	-	5.0	
Trigger Out ¹⁴ (into high impedance load)	Logic Low (Inactive)		0	-	0.3	
	Logic High (Active)		3	-	5.2	
Video Out @ 50 Ω load		Output Voltage	0.05	-	0.7	

12. Internal trigger only available in peak mode, in response to pulse signals. Free running or external triggers should be used for average mode.

13. Trigger Timeout is set by default to 500 ms, but can be changed using SCPI commands. Please refer to programming guide for details.

14. Trigger out follows the RF input; active (high) on rising edges and inactive (low) on falling edges.

ABSOLUTE MAXIMUM RATINGS

Parameter	Ratings
Operating Temperature	0°C to 50°C
Storage Temperature	-30°C to 70°C
DC voltage at RF Ports	5 V
Trigger In	-0.3 to 5.5 V
CW Power	+27 dBm

Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.





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50Ω

0.5 to 40 GHz

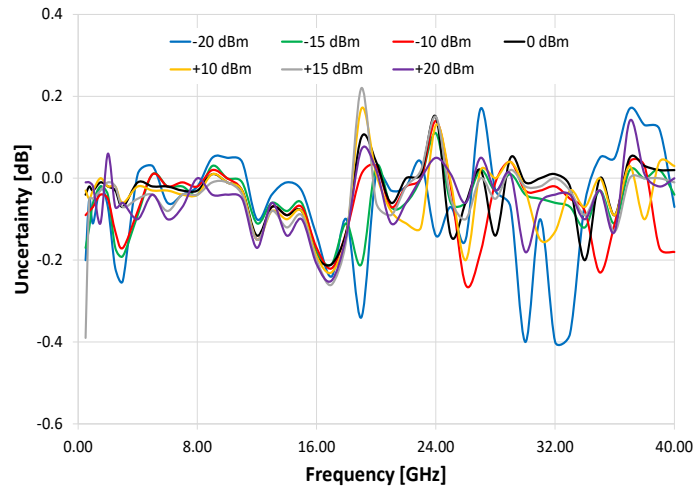
-20 to +20 dBm

Peak & Average

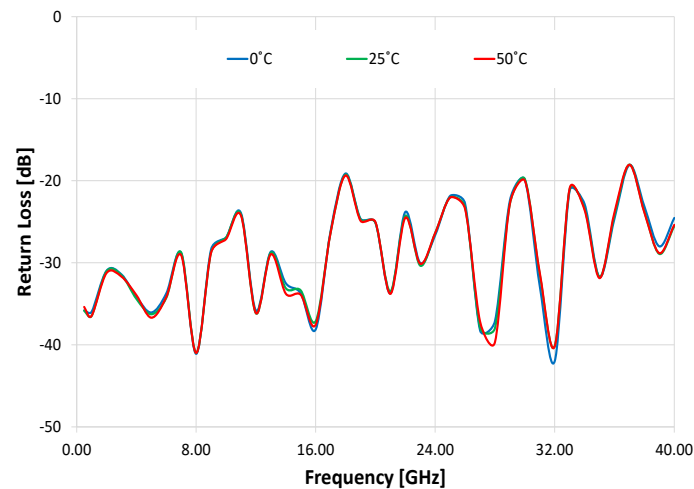
2.92 mm Male

TYPICAL PERFORMANCE GRAPHS

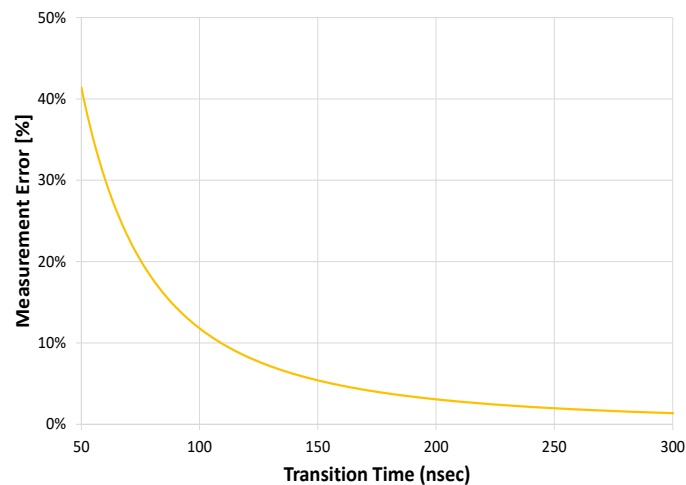
Uncertainty in Power Measurement @ 25°C



Return Loss vs. Frequency



Rise/Fall Time Measurement Error



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**SOFTWARE SPECIFICATIONS****SOFTWARE & DOCUMENTATION DOWNLOAD**

- Mini-Circuits' full software and support package including user guide, Windows GUI, DLL files, programming manual and examples can be downloaded free of charge from: <https://www.minicircuits.com/softwaredownload/pm.html>
- Please contact testsolutions@minicircuits.com for support

MINIMUM SYSTEM REQUIREMENTS

Parameter	Requirements	
Interface	USB HID or Ethernet (HTTP & Telnet)	
System Requirements	GUI	Windows 7 or later
	USB API DLL	Windows 7 or later and programming environment with ActiveX or .NET support
	USB Direct Programming	Linux, Windows 7 or later
	Ethernet	Windows, Linux or Mac computer with a network port and Ethernet TCP/IP support
Hardware	Intel i3 (or equivalent) or later	
Control cable	Power sensor to be used with the supplied USB cable only	

APPLICATION PROGRAMMING INTERFACE (API)**ETHERNET SUPPORT:**

- Simple ASCII / SCPI command set for attenuator control
- Communication via HTTP or Telnet
- Supported by most common programming environments

USB SUPPORT (WINDOWS):

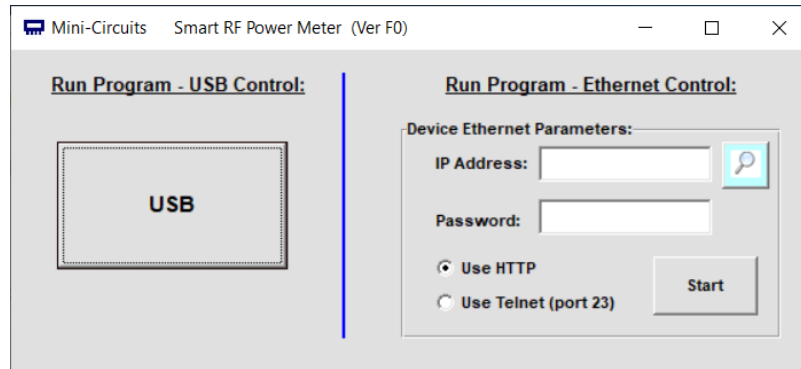
- ActiveX COM DLL file for creation of 32-bit programs
- .NET library DLL file for creation of 32 / 64-bit programs
- Supported by most common programming environments

USB SUPPORT (LINUX):

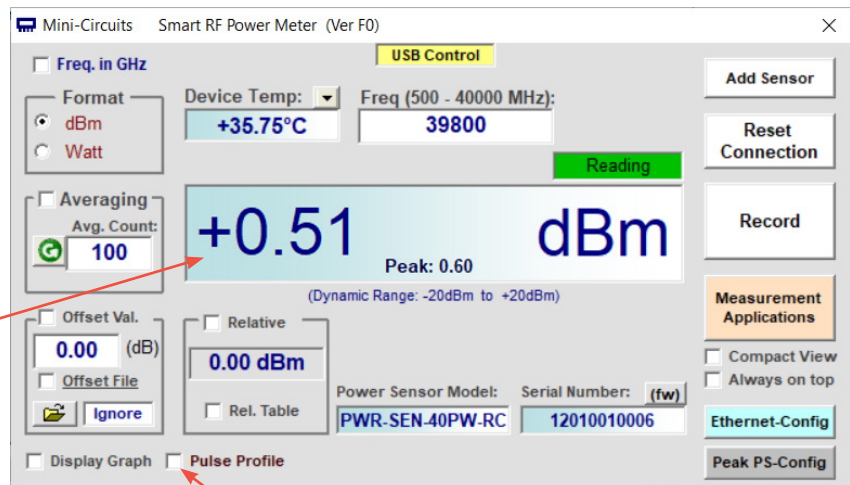
- Direct USB programming using a series of USB interrupt codes
- Full programming instructions and examples available for a wide range of programming environments / languages.

**GRAPHICAL USER INTERFACE (GUI) FOR WINDOWS - KEY FEATURES**

- Connect via USB or Ethernet (HTTP, Telnet) to control the module.
- Control multiple power sensors at once.



- Set compensation frequency and monitor power measurement.
- Configure measurement (offsets, relative power readings, averaging, set video BW, etc.).
- Peak and average power measurement.
- Pulse profiling (see [user-guide](#) and page 8 for details).
- Internal & external triggers and video outputs.
- Graphical pulse display with "zoom on pulse" feature (see [user-guide](#) and page 8 for details).
- Schedule data recording.

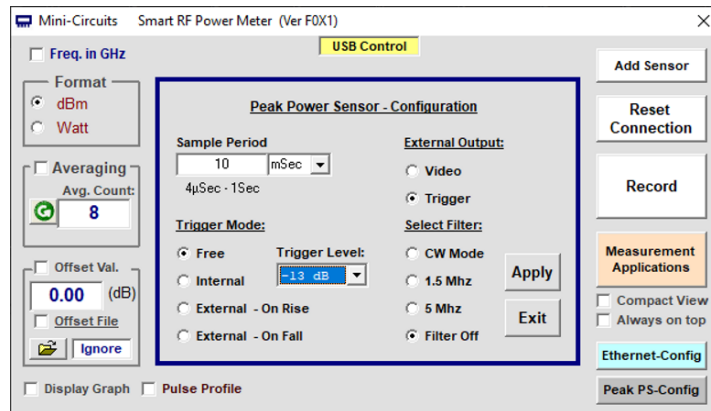


Note: Main screen power measurement will be accurate only for duty cycle 99.9% to 0.1%. For duty cycles outside this range use the "zoom on pulse" function, see page 9 for details.

Enable pulse profiling and graphical pulse display, see page 8 for details.

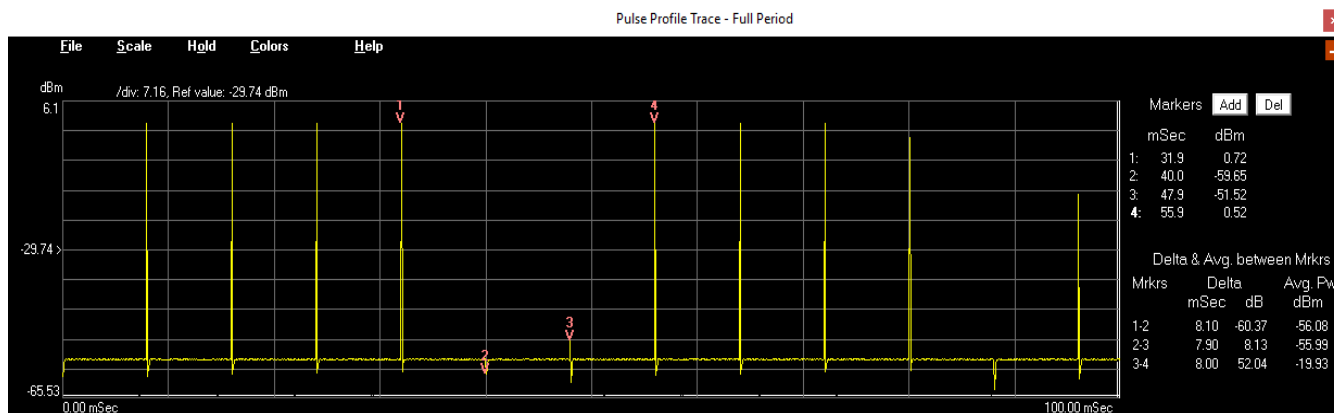


PULSE PROFILING FEATURES CONFIGURATION SCREEN



- Set the sample period between 1 μ s and 1s to capture the pulse profile.
- Select from 4 trigger options:
 1. Free – No trigger / free running measurements.
 2. Internal – Detect and stabilize the measurements on the rising edge of the RF signal (at the level specified).
 3. External On Rise – Measurements are triggered on the rising edge of an external trigger signal.
 4. External On Fall – Measurements are triggered on the falling edge of an external trigger signal.
- Select an external output type:
 1. Video – Output allows wider bandwidth pulses to be recorded by external measurement equipment.
 2. Trigger – Provides a TTL output on the rising edge of a pulse for synchronization with external measurement equipment.

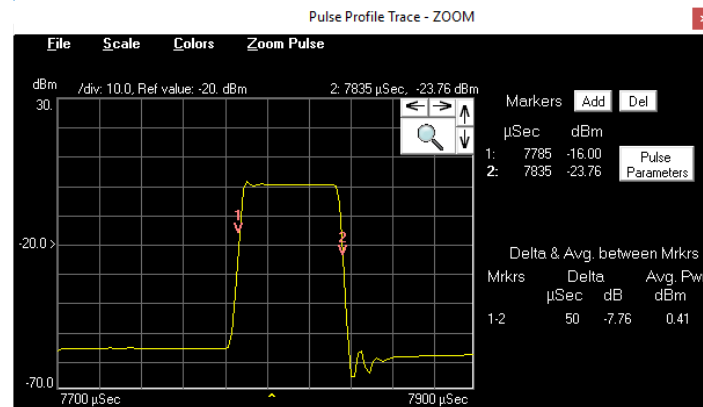
FULL SAMPLE PERIOD



The main pulse profile display shows the full sample period of the sensor in the time domain. Up to four markers can be set as required to measure power levels and calculate time / power deltas.



ZOOM ON PULSE



"Zoom on pulse" feature will automatically zoom on the first identified pulse and allows any portion of the pulse profile to be focused on / expanded in a second graphical display. Simply 'right-click' and drag the mouse cursor over relevant section of the profile.

For signals with duty cycle greater than 99.9% or under 0.1% the automatic "zoom on pulse" may not work. In such cases, you can adjust the zoom window by clicking on the arrow icons to increment/decrement the trigger delay and span, or the magnifying glass to type in precise values.

CALCULATED PULSE PARAMETERS

Calculated Parameters	
Parameter	Value
Pulse Width (mSec)	0.044
Pulse Period (mSec)	8.020
Duty Cycle (%)	0.55
Rise Time (μ s)	3.54
Fall Time (μ s)	3.54
Pulse Pwr (dBm)	0.75
Cycle Avg. (dBm)	-19.70
Crest Factor (dB)	20.45
Over Shoot (dB)	0.98

Full pulse parameters are calculated and displayed in tabular form, including peak / average power, pulse width / period, duty cycle, rise / fall time, crest factor and overshoot.

Note: If "zoom on pulse" window is not showing, the pulse signal calculated parameter may not be correct.



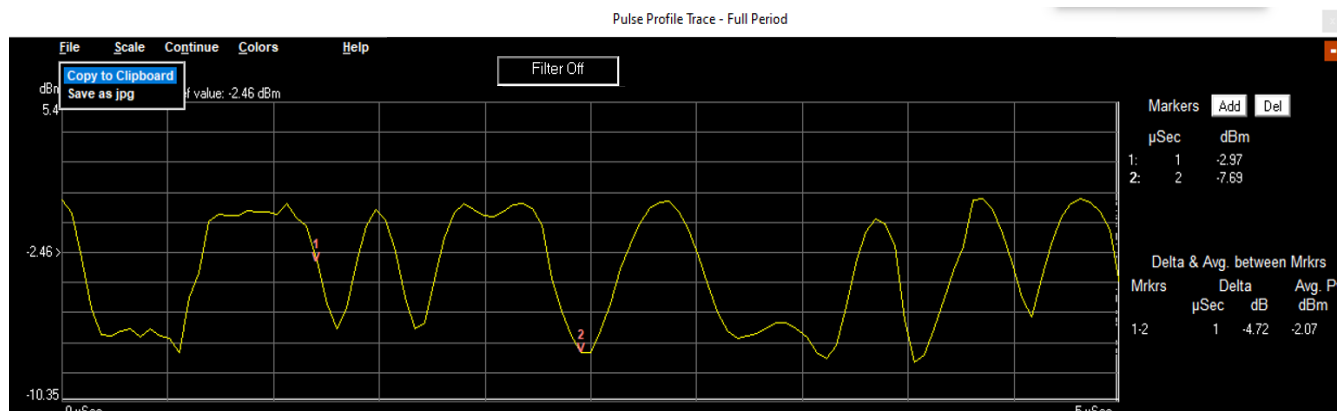
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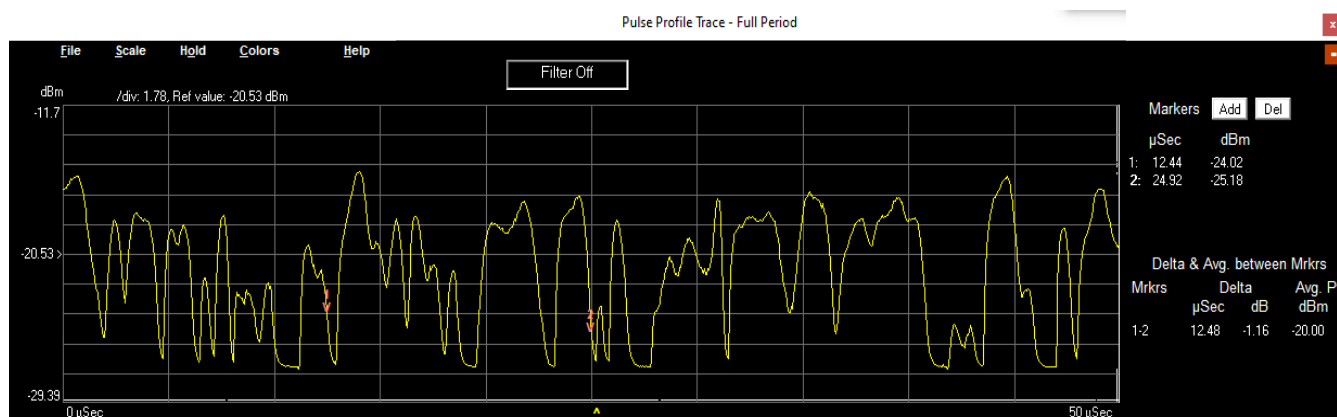
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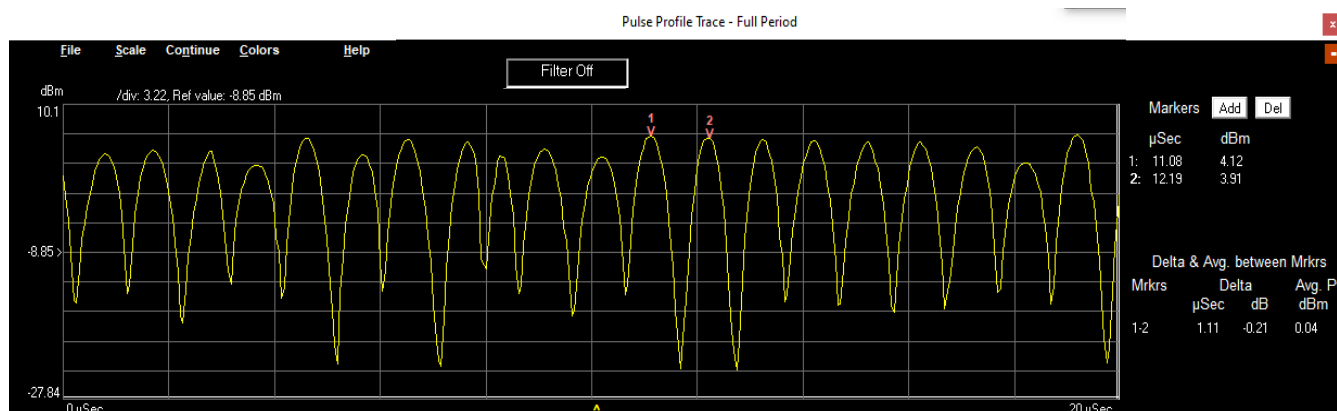
PULSE PROFILING EXAMPLES FOR STANDARD MODULATION TYPES



ASK @ 5 Msps



QAM256 in DECT setup, Gaussian filter @ 1.152 Msps



QPSK, QAM16 & QAM64 in LTE uplink setup (1.4 MHz channels, 3.7 MHz offsets) 8 MHz clock





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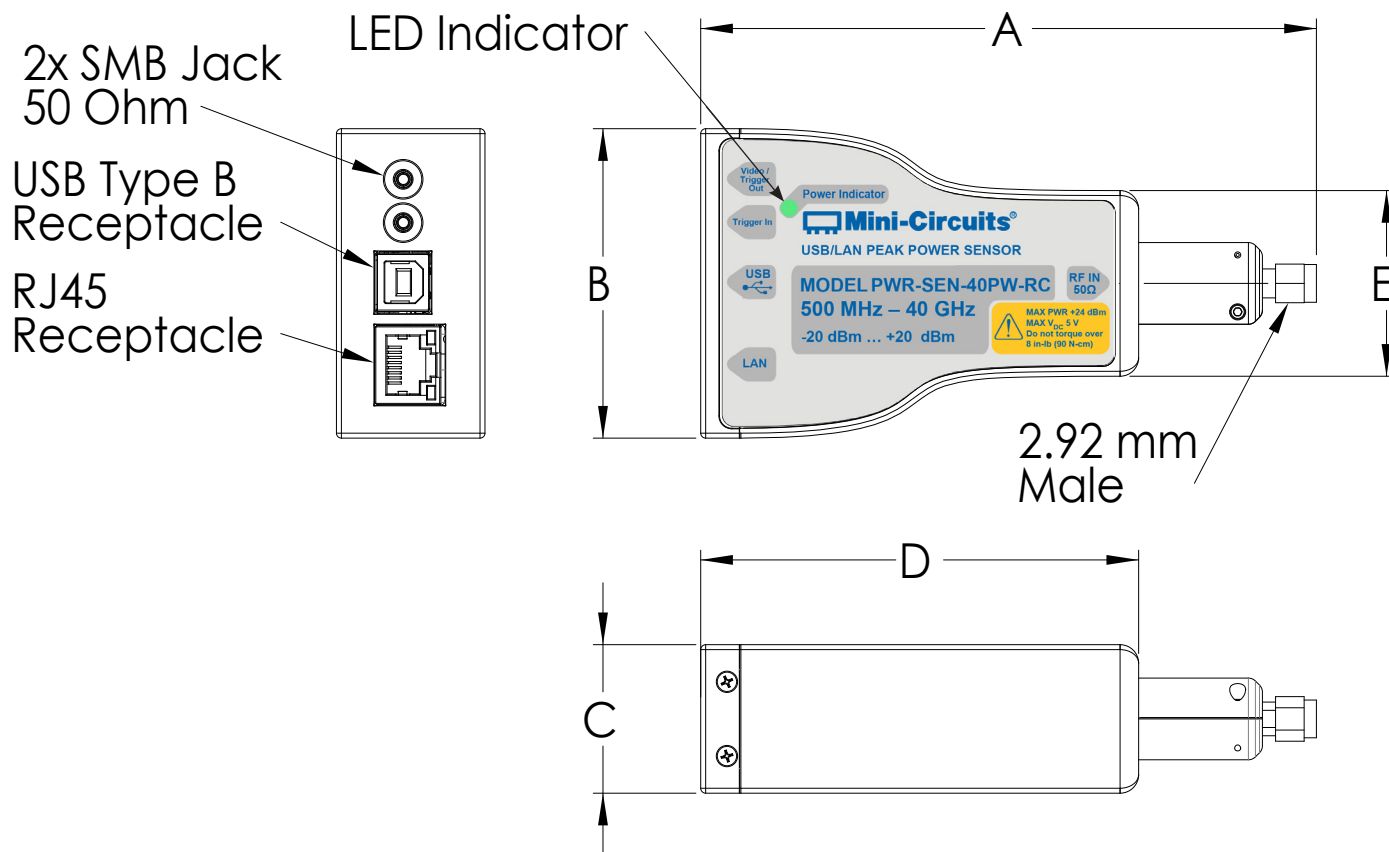
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OUTLINE DRAWING (JL3257)



OUTLINE DIMENSIONS (INCH MM)

A	B	C	D	E	weight (grams)
4.97	2.50	1.20	3.54	1.50	260
126.30	63.50	30.50	89.90	38.10	

CONNECTIONS

Port Name	Connector Type
RF Input	2.92 mm male
Trigger In	SMB male
Trigger Out	SMB male
USB	USB type-B female
Ethernet	RJ45 socket





USB / ETHERNET

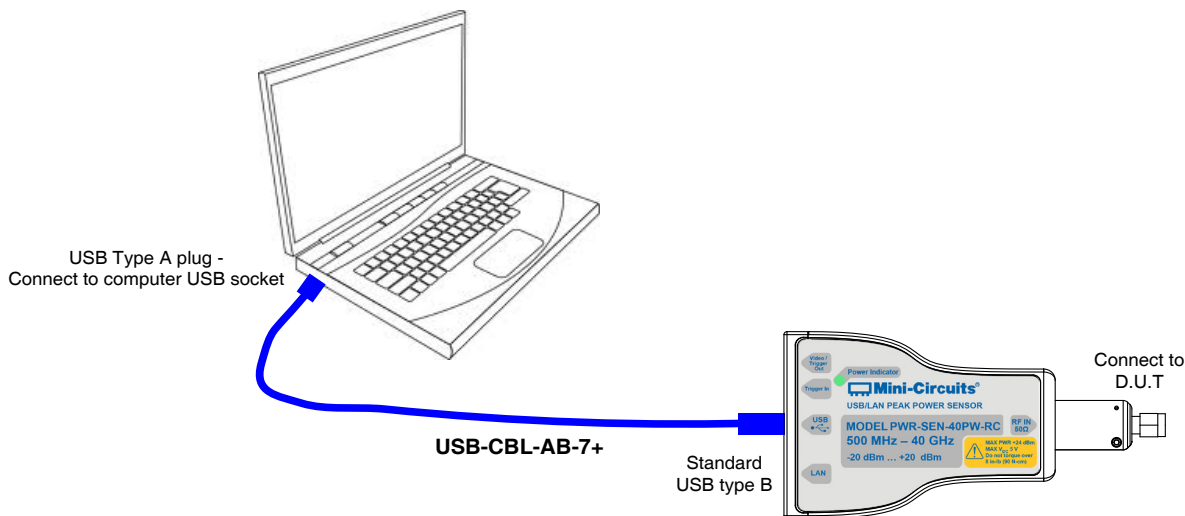
Smart Power Sensor

PWR-40PW-RC

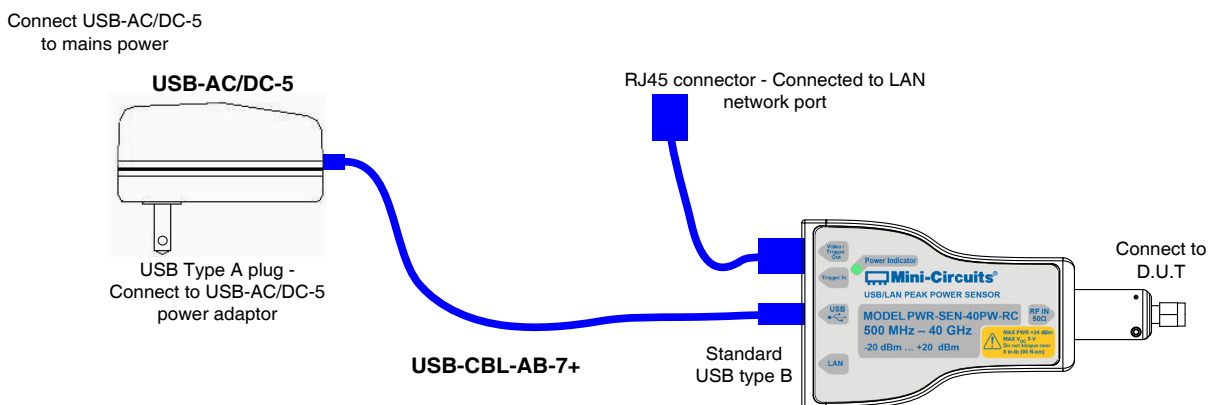
50Ω 0.5 to 40 GHz -20 to +20 dBm Peak & Average 2.92 mm Male

CONNECTION DIAGRAMS

USB CONTROL

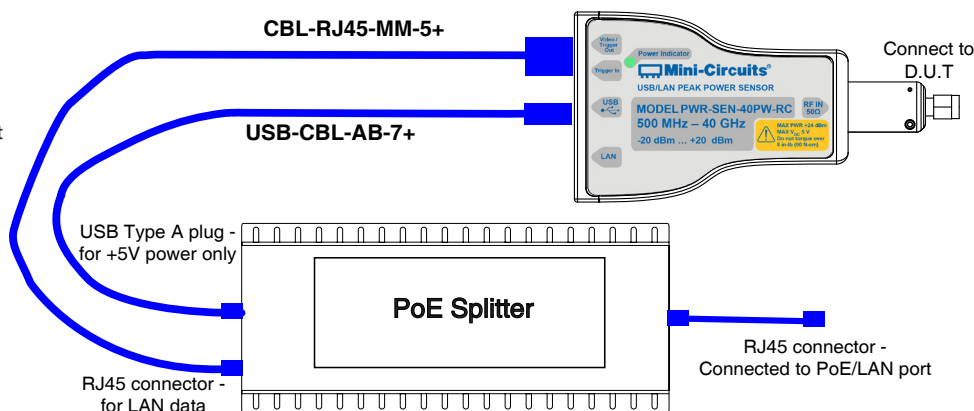


ETHERNET CONTROL (USING POWER ADAPTER)



ETHERNET CONTROL (USING POE SYSTEM)

Note:
Commercially available PoE splitter not supplied by Mini-Circuits.





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DETAILED MODEL INFORMATION IS AVAILABLE ON OUR WEBSITE

[CLICK HERE](#)

Performance Data & Graphs	Data Graphs
Case Style	JL3257
Environmental Rating	ENV50
Software, User Guide & Programming Manual	https://www.minicircuits.com/softwaredownload/pm.html
Regulatory Compliance	<p>Refer to user guide for compliance information</p> <p>CE FC UK CA</p> <p>https://www.minicircuits.com/app/AN48-003.pdf</p>
Support	testsolutions@minicircuits.com

INCLUDED ACCESSORIES ¹⁵

	Part No.	Description	Qty.
	USB-CBL-AB-7+	6.8 ft (2.1 m) USB Cable: USB type A (Male) to USB type B (Male) ¹⁶	1
	CBL-5FT-BMSMB+	5.0 ft (1.5 m) Trigger cable: BNC (Male) to SMB (Female)	1

15. Additional quantities are available for purchase as optional accessories.

16. Power sensor to be used with the supplied control cable only.

OPTIONAL ACCESSORIES

	Part No.	Description
	USB-CBL-AB-3+	2.7 ft (0.8 m) USB Cable: USB type A (Male) to USB type B (Male)
	CBL-RJ45-MM-5+	5.0 ft (1.5 m) Ethernet cable: RJ45 (Male) to RJ45 (Male) Cat 5E cable
	NF-SF50+	N-Type Female to SMA Female Adapter
	NM-SF50+	N-Type Male to SMA Female Adapter.
	185F-KF+	1.85 mm Female to 2.92 Female Adapter.
	USB-AC/DC-5+	AC/DC +5V power adaptor with USB connector ^{17, 18}

17. Includes power plugs for US, UK, EU, IL, AU & China. Plugs for other countries are also available. If you need a power cord for a country not listed please contact testsolutions@minicircuits.com

18. Power adaptor, powered hub or USB 3.0/3.1 port may be used to provide power when in Ethernet control, not needed in USB control.





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CALIBRATION

Part No.	Description
CALSEN-40PW-RC	Calibration Service for PWR-40PW-RC CLICK HERE

NOTES:

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at <https://www.minicircuits.com/terms/viewterm.html>

