Brochure / Technical Data Sheet

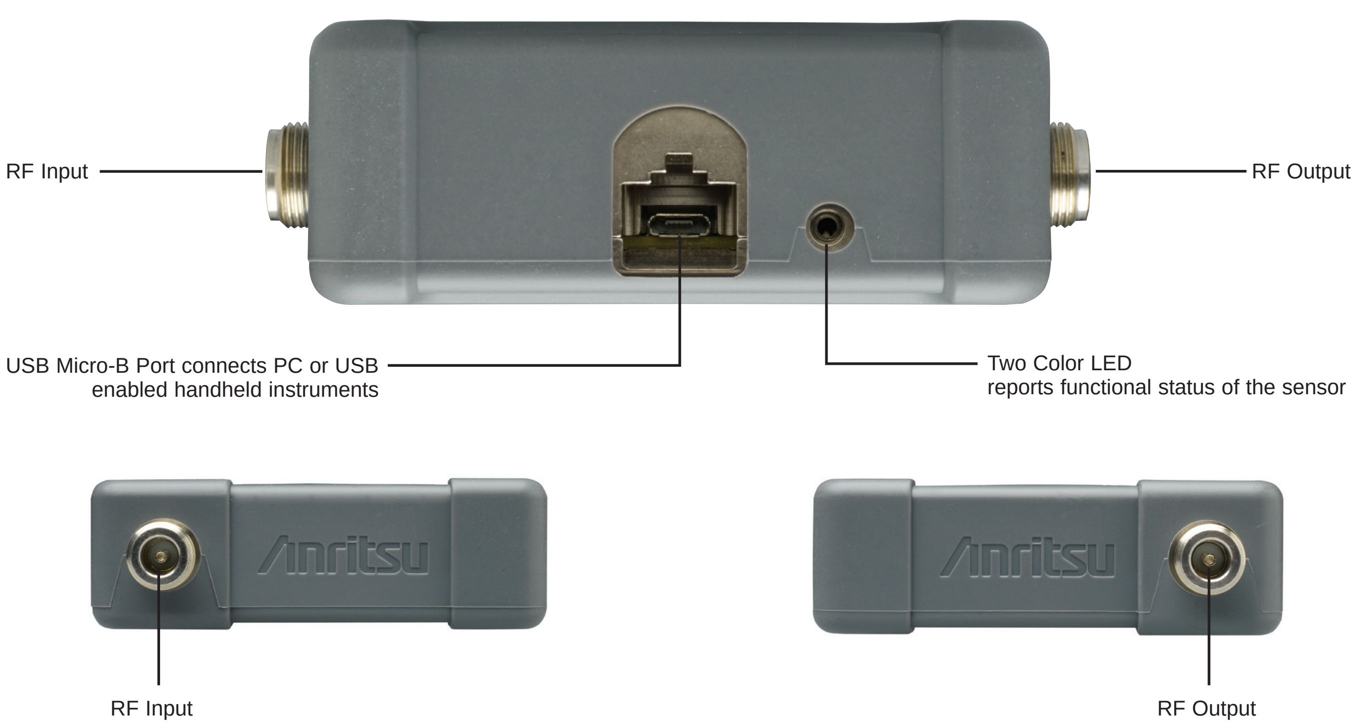
MA24105A
Inline Peak Power Sensor

True-RMS, 350 MHz to 4 GHz

A Standalone, Compact, and Highly Accurate Bi-Directional
Inline Peak Power Sensor for your RF Power Measurement Needs

MA24105A at a Glance

Feature	Benefit
Broad Frequency Range (350 MHz to 4 GHz)	Covers all major cellular and communication bands, such as WLL, GSM/EDGE, CDMA/EV-DO, W-CDMA/HSPA+, WiMAX, and TD-SCDMA
Widest Measurement Range Inline Power Sensor in its Class	Eliminates need for additional low level power sensors
Forward and Reverse Measurements	Measures both transmitted power and reflections from antenna or other system components using the single inline tool
True-RMS Measurements to 150 W	Enables accurate average power measurements of modulated signals Excellent tool for **LTE** average power measurements Ideal for high crest factor signal and base station transmitter output power measurements
Standalone, Low Cost, Plug and Play Device	Eliminates the need for 1 mW user calibration Compatible with Anritsu handheld instruments No base unit needed No extra elements or element holder required

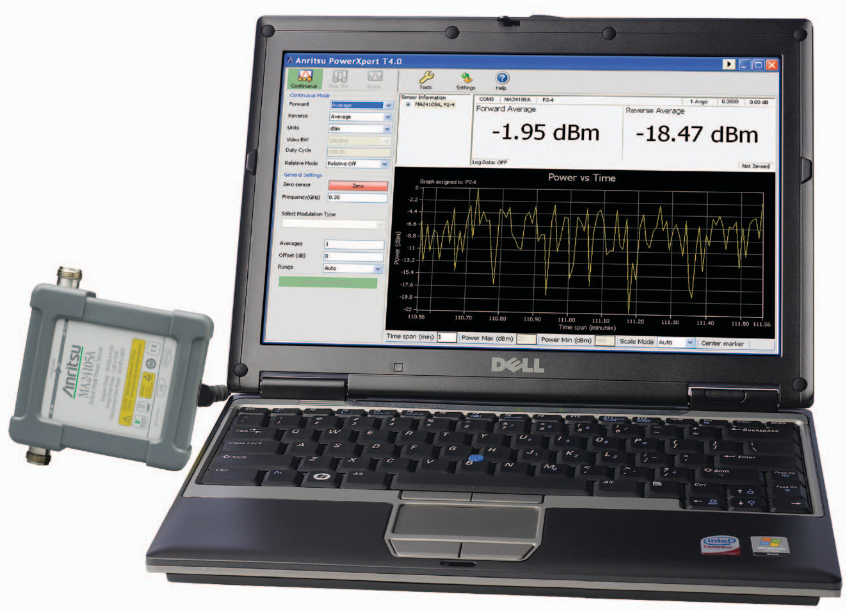


Complements Your Existing Instrument

The Anritsu MA24105A Inline Peak Power Sensor is designed to take accurate average power measurements over 2 mW to 150 W, from 350 MHz to 4 GHz. The sensor employs a “dual path” architecture that enables True-RMS measurements over the entire frequency and dynamic range allowing users to measure CW, multi-tone and digitally modulated signals such as GSM/EDGE, CDMA/EV-DO,W-CDMA/HSPA+, WiMAX, and TD-SCDMA. The forward direction path also include a 4 MHz bandwidth channel that has peak and comparator/integrator circuits that add measurement functions such as peak envelope power (PEP), crest factor, complimentary cumulative distribultion function (CCDF), and burst average power. Another detection circuit on the reverse direction adds reverse power measurement capabilities including reverse power, reflection coefficient, return-loss, and SWR. The presence of a micro-controller along with signal conditioning circuitry, ADC, and power supply in the sensor makes it a complete miniature power meter.

Operation with Personal Computer (PC)

The power sensor can be used with a personal computer running Microsoft® Windows via USB. It comes with a complimentary copy of the PowerXpert™ application (version 2.11 or greater) for data display, analysis, and sensor control. The software provides a front panel display making the personal computer appear like a traditional power meter. The application has abundant features like data logging, power versus time graph, and offset table that enable quick and accurate measurements.



Operation with Anritsu Handheld Instruments

Handheld instruments having the high accuracy power meter software Option 19 can operate the MA24105A Inline Peak Power Sensor. The MA24105A is currently compatible with Site Master™ (S3xxE), Spectrum Master™ (MS271xE and MS272xB), Cell Master™ (MT8212E), BTS Master™ (MT822xB), VNA Master™ (MS202xA/B and MS203xA) and Economy Benchtop Spectrum Analyzers (MS271xB). The power sensor easily connects to these instruments via a USB A/Micro-B cable.

MA24105A Applications

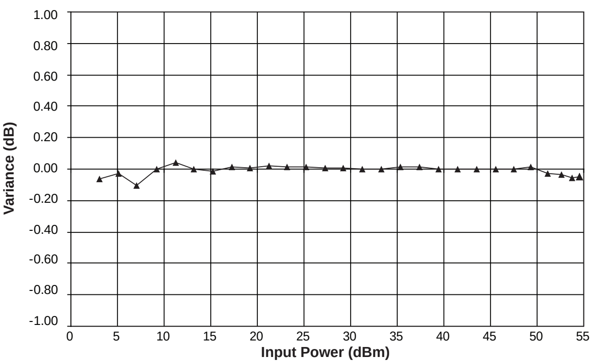


Figure 1. *Measurement linearity error referenced to an ideal thermal power sensor measurement of a 900 MHz CW signal in the forward direction.*

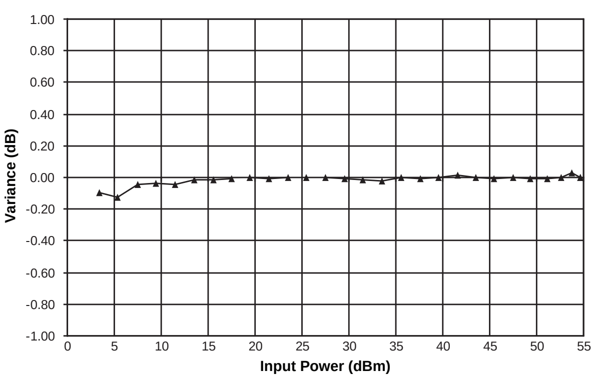


Figure 2. *Measurement linearity error referenced to an ideal thermal power sensor measurement of a 900 MHz CW signal in the reverse direction.*

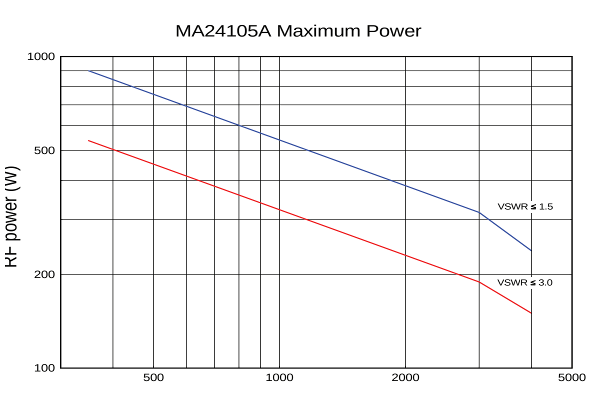


Figure 3. *Maximum power handling capacity of the sensor terminated with a load having VSWR of 1.5 and 3.0.*

High Accuracy Measurements

Accurate power measurements in the field are important for verifying that transmitter outputs are operating at specified levels. For example, service technicians need to verify base station output power because lower output power can quickly translate into large coverage differences. Highly accurate average power measurements to 150 W are assured as the calibration data is stored directly in the sensor and all necessary corrections (frequency and temperature) are done inside the microprocessor of the sensor. Also, the return loss and directivity of the instrument are optimized to maintain high accuracy. The standards used to calibrate this sensor are directly traceable to NIST.

Continuous Monitoring of Radio Systems

This sensor is designed to have good match and low insertion loss making it ideal for continuous monitoring of transmitter power and antenna reflections. The data logging function in the PowerXpert software application for PC equips the user the ability to record measured power over time to a hard disc or other storage media. This is useful for long term drift measurements, environmental testing, and trend analysis. A user settable data logging interval allows a frequency of measurement adjustment to match the user test application requirements. Data are stored as comma-separated values (.csv) that can be directly opened in Microsoft® Excel allowing powerful custom analysis of measured data.

Ideal for Field

The MA24105A power sensor provides lab performance accuracy in a rugged and portable field solution. The sensor is accurate over a wide temperature range (0 ºC to 55 ºC), making it perfect for cellular base station installation and maintenance applications. Field and service technicians will appreciate the small size and versatility of this stand-alone unit as they will not have to carry extra elements, heavy high power attentuators, or power meters. A very easy to use PC application with a large display makes the job even easier for technicians who need accurate measurement results quickly.

Average Measurements of CW, Pulsed, or Modulated Signals

The MA24105A is rated to meet all specifications up to an average input power level of 150 W, depending on load match (see figure 3). Time varying and bursted signals can have a peak power up to 300 W. To ensure accurate readings, the peak to average ratio (crest factor) of signals must be less than 12 dB.

Peak Power, Crest Factor, Burst Average and Complementary Cumulative Distribution Function (CCDF)

The MA24105A and associated PowerXpert™ application provide information critical to development, manufacturing and operation of modern communications systems. The Peak Power function enables the user to determine the maximum power of the modulated signal envelope for signals with a modulation bandwidth of < 4 MHz. The ratio between the Peak Power and Average Power result provides the Crest Factor. Of particular use in TDMA systems, the Burst Average Function uses duty cycle information obtained either automatically or as user-entry to calculate the average power during a burst based on the measurement of Average Power. Critical to those working with spread spectrum systems, which exhibit a non-deterministic envelope, the CCDF feature shows the percentage of the time that the peak power exceeds a user-set threshold.

More Applications

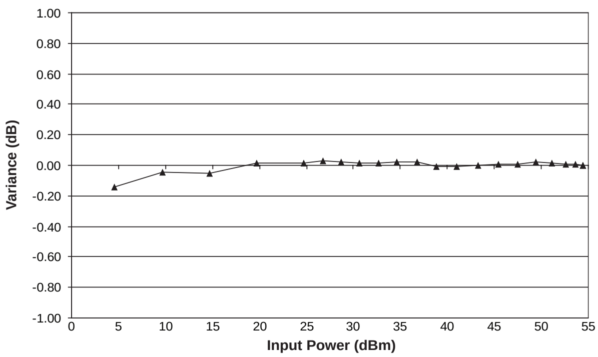


***Figure 4**. Forward average power linearity error referenced to an ideal thermal power sensor measurement of a W-CDMA signal at 2 GHz.*

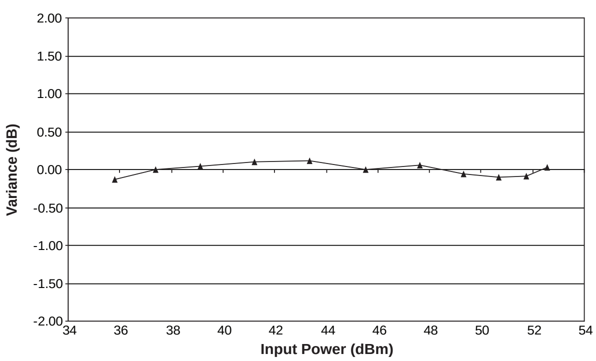


***Figure 5**. Forward Peak power linearity error referenced to Anritsu MA2491A peak power sensor measurement of a W-CDMA signal.*

Reverse Power, Reflection Coefficient (magnitude), Return Loss and Standing Wave Ratio (SWR)

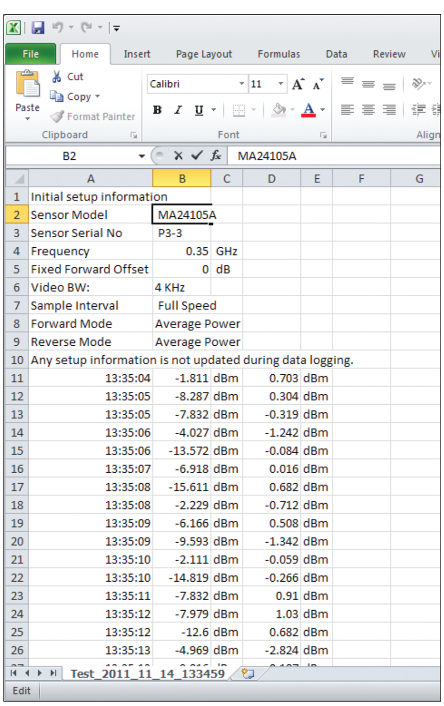
The MA24105A sensor's capability to measure both forward and reverse average power also permits the user to gain information about the load mismatch. This result is conveniently available in Reflection Coefficient (magnitude), Return Loss and SWR forms.

Optimized for Production

The MA24105A facilitates lab quality measurements on the production floor for a fraction of cost of existing solutions. Since the sensor is connected directly to the PC, there is no need for a base unit saving valuable rack space. The Inline Sensor can measure signals with levels as low as 2 mW, thus eliminating the need of terminated power sensors in the production line resulting in reduced capital expenditure and set up costs. The sensor's speed is optimized for best accuracy and noise performance thus making it suitable for wide variety of ATE applications. Multiple sensors can be connected and remote controlled via a single PC allowing flexibility to match specific measurement needs. A software toolkit is supplied with every sensor containing a sample program with source code for controlling the sensor.
The 1 mW reference calibrator typically needed by power meters has also been eliminated as the connecting USB cable only transfers digital data (corrected power), minimizing test station complexity, sensor handling and test times.

Remote Monitoring via LAN or Data-Logging

Since the USB cable connected to the sensor only transfers corrected power back to the host, a 1 mW reference calibrator is not required. USB data transfer capabilities limit the cable length to 5 meters prohibiting remote monitoring. However, this limitation can be overcome by installing a low cost USB-to-LAN hub converter (e.g. BELKIN® F5L009) at the measurement site along with the MA24105A. In this way, power monitoring can be performed across continents if desired. Or, data can be logged in a .csv file for offline analysis (see figure 6).



	A	B	C	D	E
1	Initial setup information				
2	Sensor Model	MA24105A			
3	Sensor Serial No	P3-3			
4	Frequency	0.35	GHz		
5	Fixed Forward Offset	0	dB		
6	Video BW:	4 KHz			
7	Sample Interval	Full Speed			
8	Forward Mode	Average Power			
9	Reverse Mode	Average Power			
10	Any setup information is not updated during data logging.				
11	13:35:04	-1.811	dBm	0.703	dBm
12	13:35:05	-8.287	dBm	0.304	dBm
13	13:35:05	-7.832	dBm	-0.319	dBm
14	13:35:06	-4.027	dBm	-1.242	dBm
15	13:35:06	-13.572	dBm	-0.084	dBm
16	13:35:07	-6.918	dBm	0.016	dBm
17	13:35:08	-15.611	dBm	0.682	dBm
18	13:35:08	-2.229	dBm	-0.712	dBm
19	13:35:09	-6.166	dBm	0.508	dBm
20	13:35:09	-9.593	dBm	-1.342	dBm
21	13:35:10	-2.111	dBm	-0.059	dBm
22	13:35:10	-14.819	dBm	-0.266	dBm
23	13:35:11	-7.832	dBm	0.91	dBm
24	13:35:12	-7.979	dBm	1.03	dBm
25	13:35:12	-12.6	dBm	0.682	dBm
26	13:35:13	-4.969	dBm	-2.824	dBm

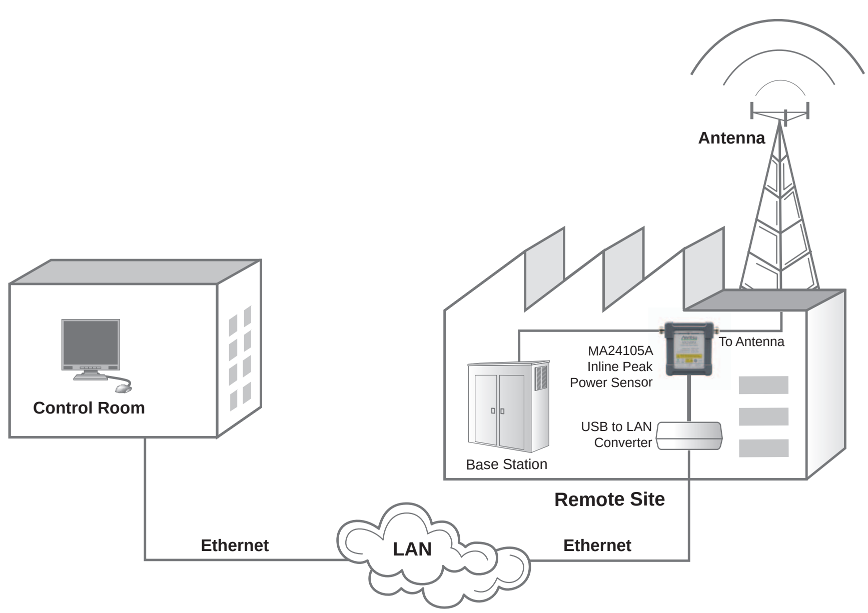


***Figure 6**. Remote monitoring via LAN or data-logging*

Specifications

Sensor

Frequency Range	350 MHz to 4 GHz
Measurement Range	2 mW to 150 W (+3 dBm to +51.76 dBm)
Input Return Loss	≥ 29.5 dB from 350 MHz to 3 GHz ≥ 26.5 dB from > 3 GHz to 4 GHz
Insertion Loss (typical)	≤ 0.15 dB from 350 MHz to 1.25 GHz ≤ 0.20 dB from > 1.25 GHz to 4 GHz
Directivity	≥ 28 dB from 350 MHz to < 1 GHz ≥ 30 dB from ≥ 1 GHz to ≤ 3 GHz ≥ 28 dB from > 3 GHz to 4 GHz
Measurement Channel	2 (Forward and Reverse)
Signal Channel Bandwidth	Average: 100 Hz Peak (Selectable): 4 MHz (full) 200 kHz 4 kHz

Base Average Power Measurement

Measurement Range	Range 1: 2 mW to 6.31 W (+3 dBm to +38 dBm) Range 2: 6.31 W to 150 W (+38 dBm to +51.76 dBm)
Maximum Power(7)	150 W average, 300 W pulse
Measurement Uncertainty(1)	± 3.8% (Range 1 and Range 2)
Effect of Noise(2)	± 170 µW (Range 1) ± 1.9 mW (Range 2)
Effect of Zero Set(3)	± 250 µW (Range 1) ± 3.0 mW (Range 2)
Effect of Zero Drift(3)	± 230 µW (Range 1) ± 2.7 mW (Range 2)
Effect of Temperature (0 ºC to 50 ºC)	± 0.06 dB
Effect of Digital Modulation(4)	± 0.02 dB

Forward Average Power Measurement (Forward Average Power Uncertainty is same as Base Average Power Uncertainty)

Forward Peak Power Measurement(5)

Measurement Range	2 W to 300 W (+ 33 dBm to + 54.77 dBm)	
Burst Signal Measurement Base Uncertainty	Repetition Rate: ≥ 10/s Duty Cycle: ≥ 10%:	Full Bandwidth: ± (Base Average Power Uncertainty +7% + 400 mW) 4 kHz and 200 kHz Bandwidth: ± (Base Average Power Uncertainty +3% + 200 mW)
Effect of Low Repetition Rate (≤ 10/s)	± 1.6% ± 150 mW	
Effect of Low Duty Cycle (0.1% to 10%)	± 100 mW	
Effect of Short Burst Width (500 ps to 1 µs) (200 ps to < 500 ps)	± 5% ± 10%	
Effect of Temperature on Peak Circuit (0 ºC to 50 ºC)	± 6%	
Spread-spectrum Measurement Uncertainty	± (Base Average Power Uncertainty + 15% + 400 mW)	

Reverse Power Measurement(5)

Measurements Range	2 mW to 150 W (+ 3 dBm to + 51.76 dBm)
Maximum Power(7)	150 W average
Measurement Uncertainty(1)	± (Base Average Power Uncertainty)
Spread-spectrum Measurement Uncertainty	± (Base Average Power Uncertainty + 15% + 400 mW)

Complementary Cumulative Distribution Function (CCDF)

Measurement Uncertainty(10)	± 0.2%
Threshold Range	2 mW to 300 mW (+ 3 dBm to + 54.77 dBm)
Accuracy of Threshold	± (Base Average Power Uncertainty + 5% + 500 mW)

Burst Average Power

Measurement Uncertainty (User Mode)	Same as Base Average Power Uncertainty except Zero Set, Zero Drift and Noise are divided by duty cycle ($^t/_T$)
Measurement Uncertainty (Auto Mode)(11)	± (Base Average Power Uncertainty except Zero Set, Zero Drift and Noise are divided by duty cycle ($^t/_T$) ± 2%)

Combination Measurements

Reflection Measurement Uncertainty	± (Base Average Power Uncertainty + Reverse Power Measurement Uncertainty)
Crest Factor Uncertainty	± (Base Average Power Uncertainty + Forward Peak Power Measurement Uncertainty)

System

Measurand	Forward/Reverse True-RMS/Average power	Peak Power	Crest Factor	Burst Average Power	CCDF
Measurement Resolution	0.01 dB	0.01 dB	0.01 dB	0.01 dB	0.01%
Offset Range	100 dB	100 dB	100 dB	100 dB	100%
Averaging Range	1 to 512	1 to 512	1 to 512	1 to 512	1 to 512
Measurement Speed (typical) (9)	1.7 meas. per second	2.5 meas. per second	1.4 meas. per second	0.7 meas. per second	1.6 meas. per second
Interface	USB 2.0				
Host Operating System (PowerXpert™ version 2.11 compatibility)	Microsoft® Windows® Vista, Window® 7 , Windows® XP, and Windows® 2000				

Specifications

General		
USB	Current (via host USB)(6)	180 mA typical at 5 V
Size (H x W x D)(8)	102 mm x 87 mm x 30 mm	
Weight	535 g (1.18 lb)	
Environmental Tests were performed per MIL-PRF-28800F (Class 2)		
Operating Temperature Range	0 °C to + 55 °C	
Storage Temperature Range	– 50 °C to + 80 °C	
Humidity	45% relative humidity at 55 °C (non-condensing) 75% relative humidity at 40 °C (non-condensing) 95% relative humidity at 30 °C (non-condensing)	
Shock	30 g's half-sine, 11 ms duration	
Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g's max. Random: 10 Hz to 500 Hz Power Spectral Density: 0.03 g^2 /Hz	
EMC	Meets EN 61326, EN 55011	
Safety	Meets EN 61010-1	

Notes:
All specs are applicable after twenty minutes warm-up at room temperature and after zeroing unless specified otherwise.
(1) Expanded uncertainty with K=2 for power measurements of a CW signal with a matched load. Measurement results referenced to the input side of the sensor.
(2) Expanded uncertainty with K=2 after zero operation when measured with 128 averages for 5 minutes. In high aperture time mode, noise is 50 µW and 12 mW in range 1 and range 2 respectively.
(3) After one hour warm-up and zero operation. Measured with 128 averages for one hour keeping the temperature within ± 1 ºC.
(4) Measurement uncertainty with reference to a CW signal of equal power and frequency at 25 ºC.
(5) All measurement errors "Effects" should be RSSed before directly added to "Base" error for overall measurement uncertainty.
(6) 150 mA max.
(7) Maximum power depends upon the system SWR and frequency of operation (see Figure 3)
(8) Not including N connectors.
(9) Measurement speed is the rate at which the measurement or calculation is updated in a data log.
(10) Pulse Power > + 37 dBm, T > 50 µs (Full BW), T > 400 µs (200 kHz BW), T > 20 ms (4 kHz BW)
(11) Average Power > + 33 dBm, Pulse width > 5 µs (Full BW), Pulse Width > 40 µs (200 kHz BW), Pulse Width > 2 ms (4 kHz BW)

Ordering Information

MA24105A Inline Peak Power Sensor

Available Options

Option Number	Description
MA24105A-098	Option 98, Standard calibration to Z540, ISO-17025
MA24105A-099	Option 99, Premium calibration to Z540, ISO-17025

Included Accessories

Model	Description
2000-1606-R	1.8 m USB 2.0 A to Micro-B cable
2300-526	Product CD - Anritsu PowerXpert and USB power sensors
10585-00021	Quick Start Guide

Optional Accessories

Calibrated Torque Wrenches

Model	Description
01-200	Calibrated torque wrench for N connector

Power Attenuators

Model	Frequency range	Rating	Connectors
3-1010-122	DC to 12.4 GHz	20 dB, 5 W, 50 Ω	N male to N female
3-1010-123	DC to 8.5 GHz	30 dB, 50 W, 50 Ω	N male to N female
3-1010-124	DC to 8.5 GHz	40 dB, 100 W, 50 Ω	N male to N female
42N50-20	DC to 18 GHz	20 dB, 5 W, 50 Ω	N male to N female
42N50A-30	DC to 18 GHz	30 dB, 50 W, 50 Ω	N male to N female
1010-121	DC to 18 GHz	40 dB, 100 W, 50 Ω	N male to N female
1010-127-R	DC to 3 GHz	30 dB, 150 W, 50 Ω	N male to N female
1010-128-R	DC to 3 GHz	40 dB, 150 W, 50 Ω	N male to N female

Precision Terminations
(To be used in conjunction with appropriate Power Attenuators)

Model	Frequency range	Description	Connectors
28N50-3	DC to 8.6 GHz	50 Ω	N male
28N50-2	DC to 18 GHz	40 dB, 50 Ω	N male
28NF50-2	DC to 18 GHz	40 dB, 50 Ω	N female

Precision Coaxial Adapters

Model	Frequency range	Connectors
510-90	DC to 3.3 GHz	N male to 7/16 DIN female
510-91	DC to 3.3 GHz	N female to 7/16 DIN female
510-92	DC to 3.3 GHz	N male to 7/16 DIN male
510-93	DC to 3.3 GHz	N female to 7/16 DIN male
33NFNF50B	DC to 18 GHz	N female to N female
33NNF50B	DC to 18 GHz	N male to N female
33NN50B	DC to 18 GHz	N male to N male
34AN50	DC to 18 GHz	GPC-7 to N male
34ANF50	DC to 18 GHz	GPC-7 to N female
34NFK50	DC to 18 GHz	N female to K male
34NFKF50	DC to 18 GHz	N female to K female
34NK50	DC to 18 GHz	N male to K male
34NKF50	DC to 18 GHz	N male to K female

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