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# Microwave Universal USB Power Sensors

Low Cost, Compact, and Highly Accurate Power Sensors  
for RF and Microwave Applications

**MA24208A**

True-RMS, 10 MHz to 8 GHz

**MA24218A**

True-RMS, 10 MHz to 18 GHz



## Introduction

The MA24208A and MA24218A Universal USB Power sensors are designed to provide accurate average power measurements from 10 MHz to 8 GHz and 18 GHz, respectively, over 80 dB of dynamic range. The sensors employ a patented “triple path” architecture that provides True-RMS measurements over the entire frequency and dynamic range (similar to thermal sensors), enabling users to make highly accurate average power measurements for CW, multi-tone, and digitally modulated signals up to 18 GHz.

## Features and Benefits

- Broad Frequency Range (10 MHz to 18 GHz): Ideal for general purpose, aerospace and defense, satellite and wireless communications applications
- True RMS Measurements over 80 dB Dynamic Range: Enables average power measurement on CW, multi-tone, and digitally modulated signals - independent of modulation bandwidth
- Best-in-Class Damage Protection (+30 dBm CW, +34 dBm peak < 10  $\mu$ s): Protects instrumentation investment
- No Zeroing Required (for signals > -45 dBm) and Elimination of 1 mW Reference Calibration: Reduces test time and handling in production while maintaining absolute accuracy
- Advanced Trigger Capabilities: Facilitates time dependent power measurements (for example, GSM, WiMAX, TD-SCDMA, and LTE)
- NIST Traceable Calibration: Provides high-accuracy measurements
- Easy to Use with PC or Select Anritsu Handheld Instruments: No benchtop power meter unit needed
- Silicone Protective Covering (removable): Provides additional field durability
- External Trigger Latching: For pulses as narrow as 20 ns



MA24208A and MA24218A Universal USB Power Sensors

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**Definitions**

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	60 minutes
Operating Temperature Range	0 °C to 50 °C
Characteristic Performance	Characteristic specifications are not tested and are not warranted.
ISO GUM Measurement Uncertainty	Zero and Noise uncertainty expressed with three sigma confidence level. Average and Relative Power uncertainty expressed with two sigma confidence level.
Calibration Cycle	Anritsu recommended calibration interval is 12 months. All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: <a href="http://www.anritsu.com">www.anritsu.com</a>
Notes	MA24208A and MA24218A sensors may have degraded performance when dropped without the removable protective covering. This cover is required for warranted operation.

**Sensor Specifications**

<b>Frequency</b>		MA24208A	10 MHz to 8 GHz		
		MA24218A	10 MHz to 18 GHz		
<b>Power Measurement</b>					
	Dynamic Range	-60 dBm to +20 dBm			
		≤150 MHz	>150 MHz to 2 GHz	>2 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
	VSWR, max	1.17:1	1.12:1	1.22:1	1.25:1
	Measurement Range 1	+20 dBm to +4 dBm approximate			
	Measurement Range 2	<+4 dBm to -16 dBm approximate			
	Measurement Range 3	<-16 dBm to -60 dBm approximate			
		Auto and fixed ranging available			
	Damage Levels at RF Port	+30 dBm, ±20 V DC (+34 dBm peak < 10 μs pulse and 10 % duty cycle), minimum			
<b>Response</b>					
	Signal Channel Rise Time	8 μs characteristic			
	Sampling Rate	140 kS/s			
<b>Trigger</b>					
	Source <sup>1</sup>	Bus, Continuous, Internal, External			
	Arm Type (for Internal/External)	Auto, Single, Multiple, Standby			
<b>Internal Trigger</b>					
	Dynamic Range	-35 dBm to +20 dBm			
	Level Accuracy	±0.5 dB characteristic			
	Slope	Positive or Negative			
	Delay Range	-5 ms to +10 s			
	Delay Resolution	10 μs			
	Hysteresis	0 to 10 dB, with 0.1 dB resolution			
	Trigger Hold Off	0 to 10 sec, with 0.01 ms resolution			
<b>External Trigger</b>					
	External Trigger Input	MCX (female), 5.5 V maximum			
	Impedance	4 kΩ nominal			
	Type	TTL/CMOS			
	Slope	Positive or Negative			
	Delay Range	-5 ms to +10 s			
	Delay Resolution	10 μs			
	High Level Input Voltage	2.3 V min, 3.0 V max			
	Low Level Input Voltage	1.3 V min, 1.6 V max			
	Latency <sup>2</sup>	7.1 μs max			
	Trigger Pulse Width	20 ns min			
	Trigger Repetition Period	7.1 μs min			
	Trigger Hold Off	0 s to 10 s with 0.01 ms resolution			

1. Bus trigger is not available in PowerXpert application.

2. Latency is defined as the time delay between the defined edge of the applied trigger and the sensor switching into the triggered state.

Measurement Uncertainty

Average Power (dB) <sup>3</sup>	Over 0 °C to 50 °C ambient temperature range:								
	Range (dBm)	≤0.05 GHz		>0.05 to 2 GHz		>2 to 12.4 GHz		>12.4 to 18 GHz	
	-60 to <-16	0.14		0.14		0.14		0.17	
	-16 to <+4	0.14		0.14		0.13		0.13	
	+4 to +20	0.14		0.15		0.15		0.14	
	Over 20 °C to 30 °C ambient temperature range:								
	Range (dBm)	≤0.05 GHz		>0.05 to 2 GHz		>2 to 12.4 GHz		>12.4 to 18 GHz	
	-60 to <-16	0.13		0.12		0.14		0.14	
	-16 to <+4	0.11		0.10		0.13		0.11	
	+4 to +20	0.11		0.10		0.10		0.11	
Relative Power (dB) <sup>3</sup>	≤0.05 GHz:								
		Over 0 °C to 50 °C			Over 20 °C to 30 °C				
	Range (dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16		
	-60 to <-16	0.14	0.13	0.03	0.08	0.09	0.03		
	-16 to <+4	0.14	0.04	0.13	0.06	0.03	0.09		
	+4 to +20	0.05	0.14	0.14	0.05	0.06	0.08		
	>0.05 GHz to 2 GHz:								
		Over 0 °C to 50 °C			Over 20 °C to 30 °C				
	Range (dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16		
	-60 to <-16	0.16	0.16	0.03	0.11	0.12	0.03		
	-16 to <+4	0.17	0.05	0.16	0.09	0.04	0.12		
	+4 to +20	0.06	0.17	0.16	0.06	0.09	0.11		
	>2 GHz to 12.4 GHz:								
		Over 0 °C to 50 °C			Over 20 °C to 30 °C				
	Range (dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16		
	-60 to <-16	0.16	0.16	0.04	0.12	0.14	0.04		
	-16 to <+4	0.17	0.05	0.16	0.10	0.04	0.14		
	+4 to +20	0.06	0.17	0.16	0.07	0.10	0.12		
	>12.4 GHz to 18 GHz:								
		Over 0 °C to 50 °C			Over 20 °C to 30 °C				
Range (dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16			
-60 to <-16	0.14	0.15	0.04	0.12	0.14	0.04			
-16 to <+4	0.11	0.06	0.15	0.10	0.05	0.14			
+4 to +20	0.06	0.11	0.14	0.06	0.10	0.12			
Zero <sup>4</sup>		Set		Drift					
	Range (dBm)	Watts	dBm	Watts	dBm				
	-60 to <-16	3.32E-10	-64.78	3.44E-10	-64.64				
	-16 to <+4	3.87E-08	-44.12	4.29E-08	-43.67				
	+4 to +20	1.07E-06	-29.70	9.96E-07	-30.02				
Noise <sup>5</sup>	Range (dBm)	Watts							
	-60 to <-16	1.23E-10							
	-16 to <+4	1.01E-08							
	+4 to +20	8.56E-07							
Effect of Digital Modulation <sup>6</sup>	Range (dBm)	dB							
	-60 to <-16	-0.048 to 0.080							
	-16 to <+4	-0.038 to 0.088							
	+4 to +20	-0.055 to 0.067							

- Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.
- Zero uncertainty expressed with three sigma confidence level. One hour warm-up followed by a Zero operation. Measured with 256 averages and 40 ms aperture and with the temperature kept within ±1 °C.  
Zero Set: Average of the reported power over one hour.  
Zero Drift: Two sigma value of the reported power over one hour.
- Two sigma noise at 10.2 seconds of integration time (integration time = aperture time x averaging number). Effect of noise can be reduced by increasing the number of averages and/or increasing the aperture time. Noise is inversely proportional to the square root of number of ADC samples used per measurement; the number of ADC samples per measurement is the product of the sample rate, aperture time, and number of averages used. Noise uncertainty is expressed with three sigma confidence level.
- Measurement error with reference to a CW signal of equal power and frequency between 20 °C to 30 °C in Normal mode and average power ≤+20 dBm. In general, the error caused by modulation depends on the peak to average power ratio and RF bandwidth of the signal.

**PowerXpert™****PC Requirements** (version 3.0 or greater)

Processor and RAM	Minimum: Equivalent to Intel® Pentium® III with 1 GB RAM or Intel® Pentium® IV with 512 MB RAM Recommended: Equivalent to Intel® Pentium® IV with 1 GB RAM
Operating System	Microsoft® Windows® 8, Windows® 7, and Windows® XP
Hard-Disk Free Space	100 MB minimum
Display Resolution	1024 × 768 minimum
Interface	USB 2.0 high speed

**System**

Measurand	Average power
Measurement Resolution	0.01 dB max via PowerXpert™, 0.001 dB max via remote command
Offset Correction <sup>7</sup>	-100 dB to +150 dB
Averaging Type	Auto, Manual Moving, Repeat
Number of Averages (Manual) <sup>8</sup>	1 to 65,536
Auto Average Resolution <sup>9</sup>	1 dB, 0.1 dB, 0.01 dB
Auto Average Source	Timeslot Number: 1 to 128 Scope Data Point Number: 1 to 16,384

**Continuous Average Mode**

Duty Cycle Correction	0.01 % to 100 %
Aperture Time	0.01 ms to 1 s
Measurement Time <sup>10</sup>	$N \times (\text{aperture time} \times C_t) + 0.375 \text{ ms} + T_{\text{com}}$ Continuous: >1,600 readings/s (minimum aperture, one average) Buffered: >11,000 readings/s (minimum aperture, one average)
Buffer Size	8192

**Scope Mode**

Capture Time	0.01 ms to 1 s
Data Points	1 to 16,384
Resolution	0.01 ms max
Measurement Time <sup>11</sup>	$N \times (\text{capture time} \times C_t) + (P_n \times 0.042 \text{ ms}) + T_{\text{com}}$

**Timeslot Mode**

Maximum Number of Slots	128
Slot Width	0.01 ms to 100 ms
Maximum Capture Time	1000 ms (slot width × number of slots)
Resolution	0.01 ms max via remote command 0.01 ms max via PowerXpert™
Exclusion Periods	Start Exclusion: 0 ms to 10 ms End Exclusion: 0 ms to 10 ms
Measurement Time <sup>12</sup>	$N \times (\text{slot width} \times \text{number of slots} \times C_t) + (P_n \times 0.064 \text{ ms}) + T_{\text{com}}$

**List Mode**

Number of Measurements	1 to 1000
Input Parameters	Frequency (GHz), aperture time (ms), averages

- Offset correction feature is available only through the PowerXpert application. There is no remote command for it in the sensor firmware.
- Maximum number of averages allowed in Continuous Average mode and Timeslot mode is 65,536. In Scope mode, the maximum number of averages is equal to 16,777,216 divided by the number of data points.
- Averaging resolution of 0.001 dB is not available with the PowerXpert application. It is defined as the place after the decimal to which the reading becomes stable. For example, if 0.01 is selected, then the reading will typically be stable within ±0.01 dB. Please refer to the remote operation chapter in the user guide for information regarding access to this feature.
- Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-2010-R), where:  
Number of Repeat Averages = N (N = 1 for moving average mode)  
Capture Time Coefficient =  $C_t = 1.62$   
Command Processing Time =  $T_{\text{com}} = 0.2 \text{ ms}$   
Speed may vary depending on the speed of and load on the CPU controlling the sensor. Specified results obtained with Intel® Core™ i5-3550 CPU running at 3.30 GHz
- Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-2010-R), where:  
Number of Repeat Averages = N (N = 1 for moving average mode)  
Capture Time Coefficient =  $C_t = 1.645$   
Number of Points =  $P_n$   
Command Processing Time =  $T_{\text{com}} = 0.24 \text{ ms}$
- Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-2010-R), where:  
Number of Repeat Averages = N (N = 1 for moving average mode)  
Capture Time Coefficient =  $C_t = 1.625$   
Number of Points =  $P_n$   
Command Processing Time =  $T_{\text{com}} = 0.29 \text{ ms}$

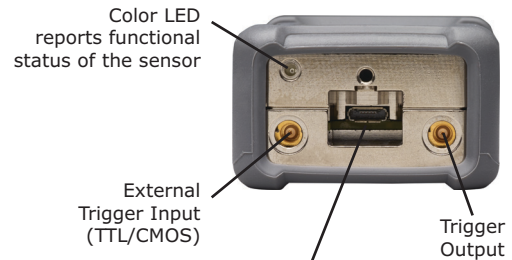


General

RF Connector	N male
Interface to Host	USB 2.0 high speed
Current Consumption	410 mA to 450 mA characteristic (20 °C to 30 °C)
Size	110 mm x 46 mm x 25.6 mm, excluding N connector and silicone protective covering
Weight	397 g (0.88 lb)
Warranty	1 year



N Type connector designed for use with a torque wrench ensuring repeatable connections



USB Micro-B port for connectivity to host (PC or Anritsu handheld instrument)

Operational Requirements

Tests were performed per MIL-PRF-28800F (Class 3).

Operating Temperature Range	0 °C to 50 °C
Storage Temperature Range	-40 °C to +71 °C
Relative Humidity (non-condensing)	45 % at 50 °C 75 % at 40 °C 95 % at 30 °C
Altitude	4600 m operational 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 <sup>2</sup> /Hz

Regulatory Compliance

European Union	EMC 2014/30/EU, EN 61326:2013, CISPR 11/EN 55011, IEC/EN 61000-4-2/3/4/5/6/8/11 Low Voltage Directive 2014/35/EU Safety EN 61010-1:2010 RoHS Directive 2011/65/EU
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

## Ordering Information

### Available Models

MA24208A	8 GHz USB Universal Power Sensor
MA24218A	18 GHz USB Universal Power Sensor

### Included Accessories

10585-00021	Quick Start Guide
2000-1605-R	1.5 m BNC(m) to MCX(m) cable
2000-2010-R	1.83 m USB A to Micro-B cable

### Available Options

MA24208A-097	Option 97: ISO/IEC 17025 and ANSI/NCSL Z540-1 or ANSI/NCSLI Z540.3 (includes test report, uncertainty data, and accreditation symbol)
MA24208A-098	Option 98: Standard calibration ISO/IEC 17025 and ANSI/NCSL Z540-1
MA24208A-099	Option 99: Premium calibration ISO/IEC 17025 and ANSI/NCSL Z540-1 (includes test report and uncertainty data)
MA24218A-097	Option 97: ISO/IEC 17025 and ANSI/NCSL Z540-1 or ANSI/NCSLI Z540.3 (includes test report, uncertainty data, and accreditation symbol)
MA24218A-098	Option 98: Standard calibration ISO/IEC 17025 and ANSI/NCSL Z540-1
MA24218A-099	Option 99: Premium calibration ISO/IEC 17025 and ANSI/NCSL Z540-1 (includes test report and uncertainty data)

## Optional Accessories

### Calibrated Torque Wrenches

01-200	Calibrated torque wrench for N connector
01-204	Calibrated torque wrench for K and V connectors

### Power Attenuators

3-1010-123	DC to 8.5 GHz, 30 dB, 50 W, 50 Ω, N(m) to N(f)
3-1010-124	DC to 8.5 GHz, 40 dB, 100 W, 50 Ω, N(m) to N(f)
3-1010-122	DC to 12.4 GHz, 20 dB, 5 W, 50 Ω, N(m) to N(f)
42N50-20	DC to 18 GHz, 20 dB, 5 W, 50 Ω, N(m) to N(f)
42N50A-30	DC to 18 GHz, 30 dB, 50 W, 50 Ω, N(m) to N(f)
41KB-3	DC to 26.5 GHz, 3 dB, 50 Ω, K(m) to K(f)
41KB-6	DC to 26.5 GHz, 6 dB, 50 Ω, K(m) to K(f)
41KB-10	DC to 26.5 GHz, 10 dB, 50 Ω, K(m) to K(f)
41KB-20	DC to 26.5 GHz, 20 dB, 50 Ω, K(m) to K(f)
43KB-3	DC to 26.5 GHz, 3 dB, 50 Ω, K(m) to K(f)
43KB-6	DC to 26.5 GHz, 6 dB, 50 Ω, K(m) to K(f)
43KB-10	DC to 26.5 GHz, 10 dB, 50 Ω, K(m) to K(f)
43KB-20	DC to 26.5 GHz, 20 dB, 50 Ω, K(m) to K(f)

### Precision Coaxial Adapters

510-90-R	DC to 3.3 GHz, N(m) to 7/16 DIN(f)
510-91-R	DC to 3.3 GHz, N(f) to 7/16 DIN(f)
510-92-R	DC to 3.3 GHz, N(m) to 7/16 DIN(m)
510-93-R	DC to 3.3 GHz, N(f) to 7/16 DIN(m)
33NFN50B	DC to 18 GHz, N(f) to N(f)
33NNF50B	DC to 18 GHz, N(m) to N(f)
33NN50B	DC to 18 GHz, N(m) to N(m)
34AN50	DC to 18 GHz, GPC-7 to N(m)
34ANF50	DC to 18 GHz, GPC-7 to N(f)
34NFK50	DC to 18 GHz, N(f) to K(m)
34NFKF50	DC to 18 GHz, N(m) to K(f)
34NK50	DC to 18 GHz, N(m) to K(m)
34NKF50	DC to 18 GHz, N(m) to K(f)
1091-26-R	DC to 18 GHz, N(m) to SMA(m)
1091-27-R	DC to 18 GHz, N(m) to SMA(f)
1091-80-R	DC to 18 GHz, N(f) to SMA(m)
1091-81-R	DC to 18 GHz, N(f) to SMA(f)



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