Microwave Universal USB Power Sensors

MA24208A, True-RMS, 10 MHz to 8 GHz
MA24218A, True-RMS, 10 MHz to 18 GHz

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

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.

USB Power Sensor Feature Highlights

Feature	Benefit
• 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 µs)	• 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

MA24218A Universal USB Power Sensor with PowerXpert™

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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: www.anritsu.com
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

Frequency

MA24208A	10 MHz to 8 GHz
MA24218A	10 MHz to 18 GHz

Power Measurement

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			

Response

Signal Channel Rise Time	8 µs characteristic
Sampling Rate	140 kS/s

Internal Trigger

Source[1]	Bus or Continuous (Auto, Single, or Multiple)
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

External Trigger

External Trigger Input	MCX (female), 5.5 V maximum
Impedance	4 kΩ nominal
Type	TTL/CMOS
Slope	Positive
Delay Range	–5 ms to +10 s
Delay Resolution	10 µs
Positive Threshold Voltage	2.3 V characteristic
Negative Threshold Voltage	2.1 V characteristic
Hysteresis	0.2 V characteristic
Latency[2]	10.6 µs max
Trigger Pulse Width	7.1 µs min
Trigger Repetition Period	14.2 µs min

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)[3]

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)[3]

≤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[4]

	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[5]

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[6]

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

3. 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.
4. 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.
5. 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.
6. 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[7]	–100 dB to +150 dB
Averaging	Auto, Manual
Type	Moving, Repeat
Number of Averages (Manual)[8]	1 to 65,536
Auto Average Resolution[9]	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	0.001 % to 100 %
Aperture Time	0.01 ms to 1 s
Measurement Time[10]	N x (aperture time x C_t) + 0.27 ms + T_{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[11]	N x (capture time x C_t) + (P_n x 0.045 ms) + T_{com}

Timeslot Mode

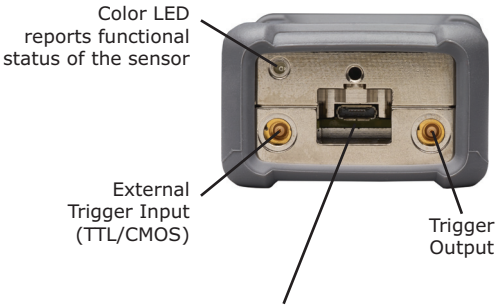
Maximum Number of Slots	128
Slot Width	0.01 ms to 100 ms
Maximum Capture Time	1000 ms (slot width x number of slots)
Resolution	0.01 ms max via remote command 0.01 ms max via PowerXpert™
Exclusion Periods	Start Exclusion: 0 ms to 10 ms End Exclusion: 0 ms to 10 ms
Measurement Time[11]	N x (slot width x number of slots x C_t) + (P_n x 0.056 ms) + T_{com}

7. Offset correction feature is available only through the PowerXpert application. There is no remote command for it in the sensor firmware.
8. 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.
9. 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.
10. Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1816-R), where:
    Number of Repeat Averages = N (N = 1 for moving average mode)
    Capture Time Coefficient = C_t = 1.645
    Command Processing Time = T_{com} = 0.2 ms
    Speed may vary depending on the speed of the CPU controlling the sensor. Specified results obtained with Intel® Core™ i5-3550 CPU @ 3.30 GHz
11. Speed is defined as the data throughput at the "A" end of the USB A to Micro-B Cable (p/n 2000-1816-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_{com} = 0.2 ms

General

RF Connector	N male
Interface to Host	USB 2.0 high speed
Current Consumption	410 mA to 450 mA characteristic (20 ºC to 30 ºC)
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 ºC to 50 ºC
Storage Temperature Range	–40 ºC to +71 ºC
Humidity	45 % relative humidity at 50 ºC (non-condensing) 75 % relative humidity at 40 ºC (non-condensing) 95 % relative humidity at 30 ºC (non-condensing)
Altitude	4600 m operational max
Shock	30 g_n half-sine, 11 ms duration
Vibration	Sinusoidal: 5 Hz to 55 Hz, 3 g max Random: 10 Hz to 500 Hz Power Spectral Density: 0.03 g^2 / Hz
EMC	EN 61326-1:2013 (Class A)
Safety	EN 61010-1

Ordering Information

Available Models

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

Included Accessories

2300-283	Product Disc – Anritsu PowerXpert Software and USB Power Sensor Documentation
10585-00021	Quick Start Guide
2000-1605-R	1.5 m BNC(m) to MCX(m) cable
2000-1816-R	1.8 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)
33NFNF50B	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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MA24208A/MA24218A USB Power Sensor TDS

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