

**Anritsu** Advancing beyond

# Inline Peak Power Sensor

**MA24103A**

True-RMS, 25 MHz to 1 GHz

**MA24105A**

True-RMS, 350 MHz to 4 GHz



## Introduction

The Inline Peak Power Sensors provide a forward direction path, 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 distribution function (CCDF), and burst average power. The reverse direction reverse power measurement capabilities including reverse power, reflection coefficient, return-loss, and SWR. A “dual path” architecture enables true-RMS measurements over the entire frequency and dynamic range. The presence of a micro-controller along with signal conditioning circuitry, ADC, and power supply in the Inline Peak Power Sensors make a complete miniature power meter.

The Anritsu MA24103A Inline Peak Power Sensor is designed to take accurate average power measurements over 2 mW to 150 W from 25 MHz to 1 GHz. The MA24103A measures CW and multi-tone signals.

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 MA24105A measures CW, multi-tone, and digitally modulated signals such as GSM/EDGE, CDMA/EV-DO, W-CDMA/HSPA+, WiMAX, and TD-SCDMA.

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## Features

- Used with a personal computer via USB running Microsoft® Windows and complimentary Anritsu PowerXpert™ software v3.49 or later
- Forward and reverse measurements of both transmitted power and reflections from antenna or other system components using the single inline sensor
- The MA24105A true-RMS measurements to 150 W enables accurate average power measurements of modulated signals such as WLL, GSM/EDGE, CDMA/EV-DO, W-CDMA/HSPA+, WiMAX, and TD-SCDMA
- High crest factor signal and base station transmitter output power measurements
- Compatible with most Anritsu RF and microwave handheld instruments with high accuracy power meter software Option 19. Refer to your instrument technical data sheet or contact your sales representative to ensure compatibility.

**Table of Contents**

Definitions..... 3

Sensor Specifications ..... 4

    Base Average Power Measurement ..... 4

    Maximum Power ..... 4

    Forward Peak Power Measurement ..... 5

    Reverse Power Measurement ..... 5

    Complementary Cumulative Distribution Function (CCDF)..... 5

    Burst Average Power ..... 5

    Combination Measurements ..... 5

System ..... 5

    General ..... 6

    Environmental ..... 6

    Regulatory Compliance..... 6

Ordering Information ..... 7

Included Accessories..... 7

Available Options..... 7

Optional Accessories..... 7

    Precision Coaxial Adapters..... 7

    Attenuators, N Type ..... 8

    Accessories ..... 8

    Precision Terminations (Used with appropriate Power Attenuators) ..... 8

**Definitions**

	All specifications and characteristics apply under the following conditions, unless otherwise stated:
Warm-Up Time	After 20 minutes of warm-up time, where the sensor is left in the on state.
Typical Performance	Typical specifications in parenthesis () describe performance that will be met by a minimum of 80% of all products. They do not include guard bands and are not warranted.
Calibration Cycle	Recommended calibration cycle is 2 years.
	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> .

Sensor Specifications

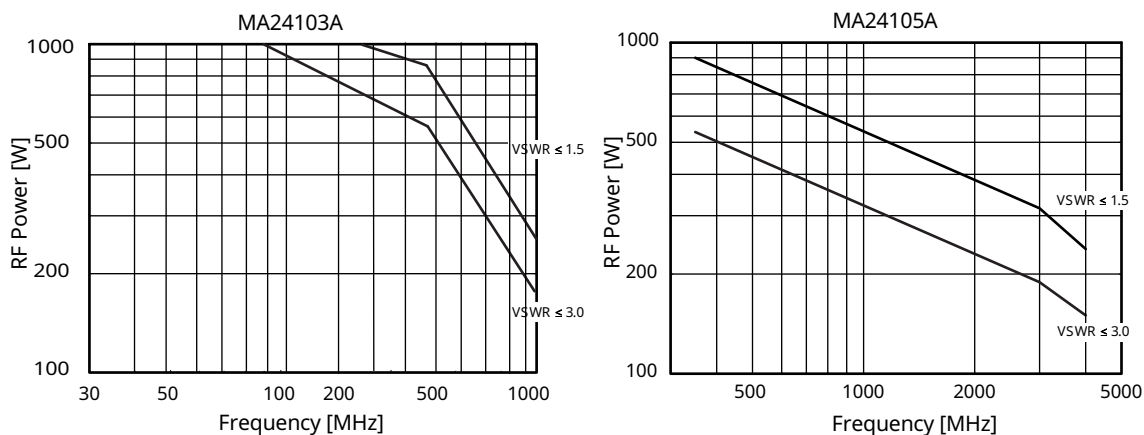
	MA24103A	MA24105A
Frequency Range	25 MHz to 1 GHz	350 MHz to 4 GHz
Measurement Range	2 mW to 150 W (+3 dBm to +51.76 dBm)	
Input Return Loss	≥ 29.5 dB from 25 MHz to 1 GHz	≥ 29.5 dB from 350 MHz to 3 GHz ≥ 26.5 dB from > 3 GHz to 4 GHz
Insertion Loss (typical)	≤ 0.15 dB from 25 MHz to 1 GHz	≤ 0.15 dB from 350 MHz to 1.25 GHz ≤ 0.20 dB from > 1.25 GHz to 4 GHz
Directivity (typical)	≥ 28 dB from 25 MHz to 1 GHz	≥ 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	(Forward and Reverse)	
Signal Channel Bandwidth	Average 100 Hz Peak (Selectable) 4 MHz (Full), 200 kHz, 4 kHz	

Base Average Power Measurement

	MA24103A	MA24105A
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 <sup>a</sup>	150 W average	
Measurement Uncertainty <sup>b</sup>	±3.8% (Range 1 and Range 2)	
Effect of Noise <sup>c</sup>	±510 μW (Range 1 ≥ 100 MHz), 1.2 mW (Range 1, < 100 MHz) ±6.1 mW (Range 2 ≥ 100 MHz), 17.7 mW (Range 2, < 100 MHz) ±400 μW (Reverse ≥ 100 MHz), 930 μW (Reverse, < 100 MHz)	±170 μW (Range 1) ±1.9 mW (Range 2)
Effect of Zero Set <sup>d</sup>	±380 μW (Range 1 ≥ 100 MHz), 810 μW (Range 1, < 100 MHz) ±4.1 mW (Range 2 ≥ 100 MHz), 11.5 mW (Range 2, < 100 MHz) ±240 μW (Reverse ≥ 100 MHz), 820 μW (Reverse, < 100 MHz)	±250 μW (Range 1) ±3.0 mW (Range 2)
Effect of Zero Drift <sup>d</sup>	±120 μW (Range 1 ≥ 100 MHz), 170 μW (Range 1, < 100 MHz) ±760 μW (Range 2 ≥ 100 MHz), 1.8 mW (Range 2, < 100 MHz) ±51 μW (Reverse ≥ 100 MHz), 320 μW (Reverse, < 100 MHz)	±230 μW (Range 1) ±2.7 mW (Range 2)
Effect of Temperature (0 °C to 50 °C)	±0.06 dB	
Effect of Digital Modulation	±0.02 dB	

- a. Maximum power depends upon the system SWR and frequency of operation.
- b. 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.
- c. 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.
- d. One-hour warm up with no operation when measured with 128 averages for one hour keeping temperature within ±1 °C.

Maximum Power



**Forward Peak Power Measurement** (All measurement errors "Effects" should be RSSed before directly added to "Base" error for overall measurement uncertainty)

	MA24103A	MA24105A
Measurement Range, Burst Signal Measurement Base Uncertainty <sup>a,b</sup>	2 W to 300 W (+33 dBm to +54.77 dBm)	
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% +400 mW)	≥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	±1.6% ±150 mW (≤ 10/s)	
Effect of Low Duty Cycle	±100 mW (0.1% to 10%)	
Effect of Short Burst Width	±5% (500 ns to 1 μs) ±10% (200 ns to < 500 ns)	
Effect of Temperature on Peak Circuit	±6% (0 °C to 50 °C)	

- a. MA24103A: ≥ 100 MHz: Pulse Power > +34 dBm, < 100 MHz: Pulse Power > +37 dBm, Pulse Width > 1 μs (Full BW), Pulse Width > 5μs (200 kHz BW), Pulse Width > 200 μs (4 kHz BW)
- b. MA24105A: Pulse Power > +34 dBm, Pulse Width > 1μs (Full BW), Pulse Width > 5μs (200 kHz BW), Pulse Width > 200 μs (4 kHz BW)

**Reverse Power Measurement**

	MA24103A	MA24105A
Measurement Range	2 mW to 150 W (+3 dBm to +51.76 dBm)	
Maximum Power <sup>a</sup>	150 W average	
Measurement Uncertainty <sup>b</sup>	±(Base Average Power Uncertainty)	
Spread-spectrum Measurement Uncertainty	N/A	±(Base Average Power Uncertainty +15% +400 mW)

- a. Maximum power depends upon the system SWR and frequency of operation.
- b. 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.

**Complementary Cumulative Distribution Function (CCDF)**

	MA24103A	MA24105A
Measurement Uncertainty <sup>a,b</sup>	±0.2%	
Threshold Range	2 mW to 300 mW (+3 dBm to +54.77 dBm)	
Accuracy of Threshold	≥ 100 MHz ±(Base Average Power Uncertainty +5% +1 W), < 100 MHz ±(Base Average Power Uncertainty at +5% +2W)	±(Base Average Power Uncertainty at +5% +500 mW)

- a. MA24103A: ≥ 100 MHz: Pulse Power > +38 dBm, < 100 MHz: Pulse Power > +41 dBm, T > 50 μs (Full BW), T > 400 μs (200 kHz BW), T > 20 ms (4 kHz BW)
- b. MA24105A: Pulse Power > +37 dBm, T > 50 μs (Full BW), T > 400 μs (200 kHz BW), T > 20 ms (4 kHz BW)

**Burst Average Power MA24103A, MA24105A**

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) <sup>a,b</sup>	±(Base Average Power Uncertainty except Zero Set, Zero Drift and Noise are divided by duty cycle (t/T) ±2%)

- a. MA24103A: ≥ 100 MHz: Average Power > +33 dBm, < 100 MHz: Average Power > +36 dBm, Pulse width > 10 μs (Full BW), Pulse Width > 40 μs (200 kHz BW), Pulse Width > 3 ms (4 kHz BW)
- b. MA24105A: Average Power > +33 dBm, Pulse width > 5 μs (Full BW), Pulse Width > 40 μs (200 kHz BW), Pulse Width > 2 ms (4 kHz BW)

**Combination Measurements MA24103A, MA24105A**

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

**System MA24103A, MA24105A**

	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) <sup>a</sup>	1.7 /s	2.5 /s	1.4 /s	0.7 /s	1.6 /s

- a. Measurement speed is the rate at which the measurement or calculation is updated in a data log.

## General

USB	180 mA typical at 5 V
Size (H x W x D)	108 mm x 97 mm x 36 mm (excluding N Connectors)
Weight	535 g (1.18 lb)

## Environmental

	Tests were performed per MIL-PRF-28800F (Class 2)
Operating Temperature	0 °C to 50 °C
Storage Temperature	-51 °C to 71 °C
Maximum Relative 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)
Mechanical Shock	30 g <sub>n</sub> half-sine, 11 ms duration
Vibration	Sinusoidal: 5 to 55 Hz, 3 g max
	Random: 10 Hz to 500 Hz, power spectral density Power Spectral Density: 0.03 g <sup>2</sup> /Hz

## Regulatory Compliance

European Union	EMC 2014/30/EU, EN 61326-1:2013
	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 & 2015/863
United Kingdom	EMC SI 2016/1091; BS EN 55011 & BS 61000-4-2/3/4/5/6/8/11
	Consumer Protection (Safety) SI 2016/1101; BS EN 61010-1:2010
	Environmental Protection SI 2012/3032;2011/65/EU & 2015/863
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	R-R-A2J-1014
Canada	ICES-1(A)/NMB-1(A)

Ordering Information

Part Number	Description
MA24103A	25 MHz to 1 GHz Inline Peak Power Sensor
MA24105A	300 MHz to 4 GHz Inline Peak Power Sensor

Included Accessories

Part Number	Description
2000-1606-R	1.8 m USB 2.0 A to Micro-B cable

Available Options

Part Number	Description
MA24103A-0098	Option 98, Standard calibration to ISO17025 and ANSI/NCSL Z540.
MA24103A-0099	Option 99, Premium calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included.
MA24105A-0098	Option 98, Standard calibration to ISO17025 and ANSI/NCSL Z540.
MA24105A-0099	Option 99, Premium calibration to ISO17025 and ANSI/NCSL Z540. Test report and uncertainty data included.

Optional Accessories


Precision Coaxial Adapters		Accessory	Description
Accessory	Description		
	510-90 N(m) to 7/16 DIN(f), DC to 3.3 GHz		34ANF50 GPC-7 to N(f), DC to 18 GHz
	510-91 N(f) to 7/16 DIN(f), DC to 3.3 GHz		34NFK50 N(f) to K(m), DC to 18 GHz
	510-92 N(m) to 7/16 DIN(m), DC to 3.3 GHz		34NKF50 N(f) to K(f), DC to 18 GHz
	510-93 N(f) to 7/16 DIN(m), DC to 3.3 GHz		34NK50 N(m) to K(m), DC to 18 GHz
	34NFN50 N(m) to N(m), DC to 18 GHz		34NKF50 N(m) to K(f), DC to 18 GHz
	34AN50 GPC-7 to N(m), DC to 18 GHz		34NN50A DC to 18 GHz, 50 Ω, N(m)-N(m)

### Attenuators, N Type (up to 18 GHz)

Accessory	Description
	1010-121-R 40 dB, 100 W, DC to 18 GHz, N(f) to N(m), Uni-directional
	3-1010-122 20 dB, 5 W, DC to 12.4 GHz, N(m) to N(f)
	3-1010-123 30 dB, 50 W, DC to 8.5 GHz, N(m) to N(f)
	3-1010-124 40 dB, 100 W, DC to 8.5 GHz, N(f) to N(m), Uni-directional


Accessory	Description
	42N50-20 20 dB, 5 W, DC to 18 GHz, N(m) to N(f)
	42N50A-30 30 dB, 50 W, DC to 18 GHz, N(m) to N(f)
	1010-127-R 30 dB, 150 W, DC to 3 GHz, N(m) to N(f)
	1010-128-R 40 dB, 150 W, DC to 3 GHz, N(m) to N(f)


### Accessories

Accessory	Description
	01-200 Calibrated Torque End Wrench, GPC-7 and Type N
	2000-1593-R 3 meters USB A to Mini-B cable

Accessory	Description
	2000-1594-R 5 meters USB A to Mini-B cable

### Precision Terminations (Used with appropriate Power Attenuators)

Accessory	Description
	28N50-3 DC to 8.6 GHz, 50 Ω, N male
	28N50-2 DC to 18 GHz, 40 dB, 50 Ω, N male

Accessory	Description
	28NF50-2 DC to 18 GHz, 40 dB, 50 Ω, N female



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