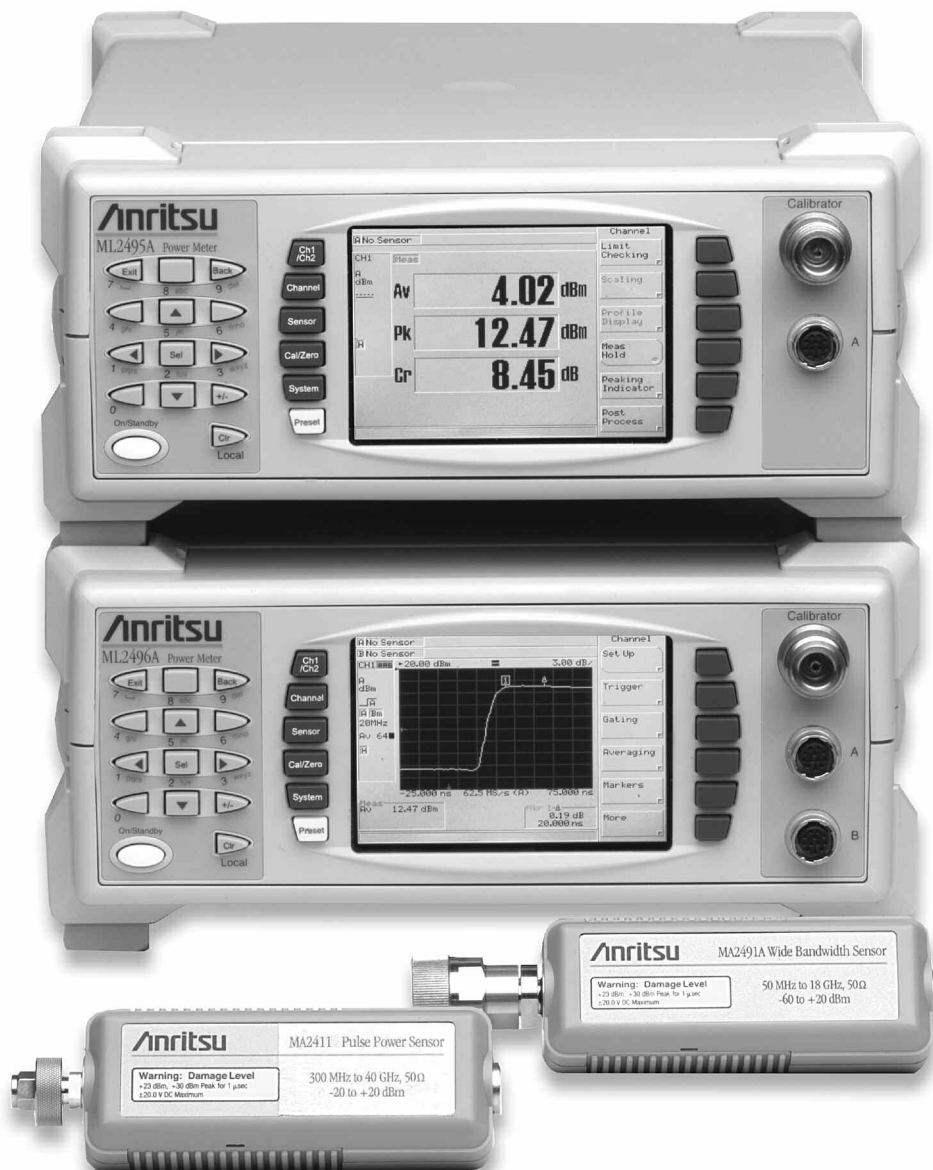


The Anritsu Family of Pulse, Wideband and CW Power Meters, and Power Sensors

ML2400A Power Meters and MA2400A/D Power Sensors
Ideal solutions for Average, Peak, and Crest Power measurements



Anritsu Power Meters and Power Sensors: Accurate, Fast, and Affordable.

Introduction

Anritsu offers the world's most comprehensive range of power meters. The ML2490A series has the performance required for narrow fast rising-edge pulse power measurements (e.g., radar), while the ML2480A series is suited for Wideband power measurements on signals such as W-CDMA, WLAN, and WiMAX. The ML2430A series of power meters are designed for CW applications, offering a combination of accuracy, speed and flexibility in a low cost package.

Also available are five different families of power sensors with frequency coverage to 50 GHz and dynamic range up to 90 dB. Most of the power sensors can work in either pulsed/modulated or CW mode (the ML2480/90A series meters offer both modes). In choosing a power sensor, several factors must be considered, including: frequency range, dynamic range and the modulation. The rise time of the sensor should also be chosen to match the rise time of the modulation.

Power Meter Specifications

	ML2430A Series		ML2480A Series		ML2490A Series		Comments																																																				
	ML2437A	ML2438A	ML2487A	ML2488A	ML2495A	ML2496A																																																					
Signal Inputs	1	2	1	2	1	2																																																					
Frequency range	100 kHz to 65 GHz (sensor dependent)																																																										
Dynamic range	-70 to +20 dBm (dependent on sensor, external coupler or attenuator)						Continuous or Peak																																																				
Performance	100 kHz (Profile mode)		Pulse/Modulated mode 20 MHz with MA2491A sensor CW mode 17 kHz ranges 1-4 35 Hz range 5		Pulse/Modulated mode >65 MHz range 7 >38 MHz range 8 >16 MHz range 9 (Repetitive Sampling) 20 MHz (One shot) Combined B/W (with MA2411B sensor) >39 MHz range 7 >29 MHz range 8 >12 MHz range 9 MA2411B nominal Bandwidth = 50 MHz CW mode 17 kHz range 1,2,3,4 36 Hz range 5		Nominal Video BW																																																				
	31.25 kS/s		Auto/Manual CW Mode 75 kS/s Pulse/Modulated Mode 31.25 kS/s to 64 MS/s (dependent on trigger capture time)		Auto/Manual CW Mode 75 kS/s Pulse/Modulated Mode 31.25 kS/s to 62.5 MS/s Continuous Sampling (Trigger capture time 3.2 μ s to 7s, 200 data points) 1 GS/s Random Repetitive Sampling (Trigger capture time 50 ns - 3.2 ns, 200 data points) Conflicts between selected settings and other instrument settings are indicated through user warnings (displayed and GPIB)		Sampling rate																																																				
	N/A		<18 ns (with MA2411B sensor)		Typical 8 ns, Maximum 12 ns (with MA2411B sensor) Fall-time typically 11 ns		System rise-time (10% to 90% at +10 dBm)																																																				
	N/A		10% to 90% Rise-time measurement of -20 dBm to +20 dBm Peak power (with MA2491A)				Rise-time measurement dynamic range																																																				
	N/A		\leq 3% in linear power at +10 dBm				Overshoot (Pulse/Modulated mode)																																																				
	N/A		\pm 100 ppm (1 GHz clock for RRRS mode)				Sampling Rate Clock Accuracy																																																				
Accuracy (Defined by uncertainty calculations with relevant sensor and source match conditions)	<0.5%		CW Mode <0.5% (\pm 0.02 dB absolute Accuracy, \pm 0.04 dB relative Accuracy) Pulse/Modulated Mode <0.8% Nominal range 7, 8			Instrumentation Accuracy																																																					
	<0.5% of full scale in most sensitive range, measured over one hour with maximum averaging after one hour warm up at constant temperature		Equivalent Noise Power (256 Moving Average) <table border="1"> <thead> <tr> <th></th> <th>MA2472D</th> <th>MA2491A</th> </tr> </thead> <tbody> <tr> <td>Range 1</td> <td>0.5 μW</td> <td>2 μW</td> </tr> <tr> <td>Range 2</td> <td>50 nW</td> <td>100 nW</td> </tr> <tr> <td>Range 3</td> <td>0.5 nW</td> <td>2 nW</td> </tr> <tr> <td>Range 4</td> <td>0.2 nW</td> <td>1 nW</td> </tr> <tr> <td>Range 5 (CW mode)</td> <td>50 pW</td> <td>0.5 nW</td> </tr> <tr> <td>Range 7</td> <td>20 μW</td> <td>68 μW</td> </tr> <tr> <td>Range 8</td> <td>3 μW</td> <td>10 μW</td> </tr> <tr> <td>Range 9 (Pulse/Modulated mode)</td> <td>2 μW</td> <td>8 μW</td> </tr> </tbody> </table>			MA2472D	MA2491A	Range 1	0.5 μ W	2 μ W	Range 2	50 nW	100 nW	Range 3	0.5 nW	2 nW	Range 4	0.2 nW	1 nW	Range 5 (CW mode)	50 pW	0.5 nW	Range 7	20 μ W	68 μ W	Range 8	3 μ W	10 μ W	Range 9 (Pulse/Modulated mode)	2 μ W	8 μ W	Equivalent Noise Power (256 Moving Average) <table border="1"> <thead> <tr> <th></th> <th>MA2472D</th> <th>MA2491A</th> </tr> </thead> <tbody> <tr> <td>Range 1</td> <td>0.5 μW</td> <td>2 μW</td> </tr> <tr> <td>Range 2</td> <td>50 nW</td> <td>100 nW</td> </tr> <tr> <td>Range 3</td> <td>0.5 nW</td> <td>2 nW</td> </tr> <tr> <td>Range 4</td> <td>0.2 nW</td> <td>1 nW</td> </tr> <tr> <td>Range 5 (CW mode)</td> <td>50 pW</td> <td>0.5 nW</td> </tr> <tr> <td>Range 7</td> <td>5 μW</td> <td>15 μW</td> </tr> <tr> <td>Range 8</td> <td>1 μW</td> <td>5 μW</td> </tr> <tr> <td>Range 9 (Pulse/Modulated mode)</td> <td>0.5 μW</td> <td>2 μW</td> </tr> </tbody> </table>		MA2472D	MA2491A	Range 1	0.5 μ W	2 μ W	Range 2	50 nW	100 nW	Range 3	0.5 nW	2 nW	Range 4	0.2 nW	1 nW	Range 5 (CW mode)	50 pW	0.5 nW	Range 7	5 μ W	15 μ W	Range 8	1 μ W	5 μ W	Range 9 (Pulse/Modulated mode)	0.5 μ W	2 μ W
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Power Meter Specifications continued

	ML2430A Series		ML2480A Series		ML2490A Series		Comments
	ML2437A	ML2438A	ML2487A	ML2488A	ML2495A	ML2496A	
Operation	2		2 (CW or Pulse/Modulated measurement modes)				Measurement Display-Readout (Numerical)
	Power vs. Time graphic of readout data or Profile of Peak power for analysis of repetitive pulse or transient waveforms		2 (Pulse/Modulated measurement mode)				Measurement Display-Profile (Graph)
	Single channel power sweep or frequency sweep						Source sweep
	±5 dB range CW (Readout mode) only						Peaking meter
	Dynamic range covered by five overlapping amplifier ranges, R1, R2, R3, R4 and R5 Universal Sensor MA2481/82D ranges 1 to 6		Pulse modulated mode: Dynamic range covered by three overlapping amplifier ranges, R7, R8 and R9 CW mode: Dynamic range covered by five overlapping amplifier ranges, R1, R2, R3, R4 and R5 Universal Sensor MA2481/82D ranges 1 to 6				Amplifier Range
	Auto or Manual (current range or selectable 1 through 5)		Automatic or manual. When in manual clear indication given to user (display and GPIB) of fault conditions (under or over-range)				Range Hold
Features (summary)	0.1 to 0.001 dB Linear power units, 3 to 6 digit, 1 to 3 digits selectable to right of decimal nW to W; Voltage, 1 to 2 digits selectable to right of decimal		0.1 to 0.001 dB				Display resolution in Readout mode
	0.01 dB						Display resolution in Profile mode
	Profile and P vs. T modes: 200 pixels display resolution For a 1 ms Profile window, cursor resolution on the display is 5 μs		16 ns Pulse/Modulated mode 15 μs CW Mode		1 ns (RSS mode) 16 ns (non RSS mode) Pulse/Modulated mode 15 μs CW Mode		Time measurement resolution
	Hold, Max, Min						Measurement hold
	Average, Min, Max		Average, Min, Max, Peak, Crest, PAE (Power Added Efficiency)				Measurements
	—		PDF, CDF, CCDF				Power statistics
	0.00 to 20.00V nominal						Voltage measurement range
	Watt, %, Volts						Display units (Lin) Display units (Log)
	dBm, dB, dBμV, dBmV, dBr		dBm, dBW, dB, dBμV, dBmV				
	-199.99 to +199.99 dB						Display range
	1		Four Independently set Gates or eight repeated Gates One Fence per Measurement gate Gate measurement supports Average, Peak, Crest, Max and Min				Measurement Gates
	2		Four Markers and One Delta Marker, Marker to Max/Min, Pulse Rise/Fall-time, Pulse Width, Off Period, Pulse Repetition Interval Rise Fall/Search Parameter Variable % Reference: Max Marker or Gate Power Level				Markers
	Fixed value high and low limits with audible, rear panel TTL output, and/or visible Pass/Fail alarm indication Failure indication can latch for transient failure detection		Simple pass/fail for CW Complex limits for pulsed and TDMA systems 30 Limits Stores available on the instrument				Limit lines
-199.99 to +199.99 dB (Fixed value or frequency dependent table)						Offset range	

Power Meter Specifications continued

	ML2430A Series		ML2480A Series		ML2490A Series		Comments
	ML2437A	ML2438A	ML2487A	ML2488A	ML2495A	ML2496A	
Averaging	Auto (Moving), Manual (Moving, Repeat)						Type
	1 to 512						Range
	Low, Medium and High settings apply post average low pass filter to improve visibility at high display resolution		N/A				Low-level Averaging
Triggering	Internal, External (TTL or RF Blanking), GPIB, Manual, Continuous		Internal, External (TTL), GPIB, Continuous, External Bus		Continuous (not in Random Repetitive Sampling mode) Internal, External TTL (Rising or falling Edge), GPIB or external Bus		Source
	Manual Single power value set to cover entire measurement dynamic range of sensor Auto Automatically sets trigger level for signal over measurement dynamic range						Trigger modes
	N/A				Variable-auto set and manual 20 MHz, 2 MHz, 200 kHz, 20 kHz		Nominal Internal Trigger Bandwidth
	Sets the trigger arming, unless the trigger source is set to EXTTTL When ARMING is set to Blanking ON, only samples taken when the rear panel Digital Input BNC is active will be averaged in the measurement		Continuous Sampling Modes: Single Automatic Frame for QAM and multi-pulse		Repetitive Sampling Modes: Automatic Frame for QAM and multi-pulse Continuous Sampling Modes: Single Automatic Frame for QAM and multi-pulse		Arming Sources
	N/A		0 to 64 x trigger capture time range or 120s whichever is the greater				Frame Arming Time range
	-15 to 20 dBm (all diode sensors, selectable to -25 dBm)		-15 to 20 dBm		-28 dBm to +10 dBm with MA2472D CW mode -18 dBm to +14 dBm with MA2491A -30 dBm to +10 dBm with MA2472D Pulse/Modulated mode		Internal Trigger dynamic range
	1 dB						Internal Trigger level Accuracy (typical)
	0.1 dB						Internal Trigger settable resolution
	N/A		± 16 ns or display resolution whichever is the larger (Trigger Capture time 3.2 μ s to 7s)		± 2 ns or display resolution, whichever is the larger (Trigger Capture time 50 ns to 3.2 μ s) ± 16 ns or display resolution whichever is the larger (Trigger Capture time 3.2 μ s to 7s)		Trigger time resolution Uncertainty
	0.0 to 999 ms		0.0 to 999 ms Dependent on trigger capture time		Pulse modulated mode Pretrigger (-ve): 95% of the Trigger Capture range Post Trigger: Set by 256K buffer and sample rate CW mode Post Trigger Only: 0-999 ms depending on Trigger Capture period setting		Trigger delay range
TTL rising or falling edge (BNC input)						External Trigger range	
N/A		90% of trigger capture range				Pre-trigger range	
0.5% of display period or 100 ns		0.5% of display period or 16 ns		200 display points 1 ns or 0.5% of trigger capture time, whichever is the larger 400 display points 1 ns or 0.25% of trigger capture time (400 points), whichever is the larger		Trigger delay settable resolution	

Power Meter Specifications continued

	ML2430A Series		ML2480A Series		ML2490A Series		Comments	
	ML2437A	ML2438A	ML2487A	ML2488A	ML2495A	ML2496A		
Triggering	N/A		±2 ns for pre and post trigger (Trigger capture time of 3.2 µs or 50 ns)				Trigger delay uncertainty	
	N/A				±15 ns (20 MHz trigger BW)		Trigger latency	
	Profile mode: 10 ms to 7s P v T mode: 1m to 24 hrs		3.2 µs to 7s		50 ns to 7s		Trigger/Display capture range	
	N/A		200 display points 16 ns or 0.5% of trigger capture time, whichever is the larger 400 display Points 16 ns or 0.25% of trigger capture time, whichever is the larger		200 display points 1 ns or 0.5% of trigger capture time, whichever is the larger 400 display Points 1 ns or 0.25% of trigger capture time, whichever is the larger		Trigger capture time settable resolution	
	On-screen indicator/message		Trigger point depicted by trigger edge waveform. Edge represents trigger point of signal. Display position of trigger edge waveform adjustable				Trigger point display (on-screen)	
System Configuration	10 storage registers plus RESET default settings		20 settings stores Preset accessible on Front Panel Offset tables				Save/Recall	
	Wipes non-volatile memory on power up when active.						Secure mode	
Interfaces	Yes		No				Remote monitoring	
	Yes		No				Modem Compatibility	
	>600 readings/sec (per input channel) Emulation of Anritsu ML4803, Agilent 436, 437 and 438		>400 readings/sec in CW mode. 10 Sweeps/sec in Profile mode (200 data points/sweep, Binary float output format, 5 µs Trigger capture time) >350 readings/sec (Fast Mode, Gate output, 1 µs gate width)		>400 Readings/second CW Mode [TR3 mode] >350 Readings/second Pulse/Modulated Mode (Continuous Sampling) [1 µs pulse, readout mode, Display turned off, TR3 Mode] >10 profile transfers/sec Pulse/Modulated Mode (Profile data) [200 points per sweep, Binary Float Output, 5 µs Trigger Capture Time] >20 Readings/sec Pulse/Modulated Mode (Repetitive Sampling) [50 ns pulse, readout mode, Display turned off, TR3 Mode] Back Compatible with ML2480A with Additional functionality added			GPIB (IEEE-488.2, IEC-625)
	Supports software download, Instrument control and modem dial-out. 1200, 2400, 4800, 9600, 19200, 38400, 57600 Baud rates supported		Supports software download and Instrument control 1200, 2400, 4800, 9600, 19200, 38400, 57600 Baud rates supported				RS232	
	Operating Modes: Display voltage reading on selected channel Voltage proportional to frequency for sensor calibration factor compensation Blanking Input -TTL levels only Selectable positive or negative polarity Input Range: 0 to 20V Resolution: 0.5 mV Control: Adjustable voltage to frequency relationship		Can be configured for: Cal factor correction from synthesiser, Ext Voltage Voltmeter, Connection:- current probe for PAE applications				Cal Factor Voltage Input (BNC)	
	TTL, maximum frequency of 800 kHz		TTL, maximum frequency of 1 MHz		TTL, maximum frequency of 10 MHz		External trigger (BNC)	
	Two outputs configurable to Log or Lin Operating Modes: Selectable channel adjusted for calibration factors and other power reading correction settings Pass/Fail -Selectable TTL High or Low Channel output -Near real time analog Uncalibrated AC Modulation Output -Output 1 only Dwell Output -Output 2 only Output Range: -5.0 to 5.0V Resolution: 0.1 mV		Output 1 can be configured for: Analog Output, Pass/Fail TTL o/p Limits, Levelling: -Sensor Input A Output 2 can be configured for: Analog Output, Pass/Fail TTL o/p Limits, Levelling: -Sensor Input B, Trigger Output				Analogue Output (BNC)	

Power Meter Specifications continued

	ML2430A Series		ML2480A Series		ML2490A Series		Comments
	ML2437A	ML2438A	ML2487A	ML2488A	ML2495A	ML2496A	
Reference Calibrator	1 mW						Power
	±1.2% per year, ±0.9% RSS						Power accuracy (Traceable to National Standards)
	50 MHz (nominal)		50 MHz, 1 GHz (optional)				Frequency
	<1%		<1% (50 MHz) <2% (1 GHz)				Frequency Accuracy
	<1.04		<1.12 (50 MHz) <1.2 (1 GHz)				VSWR
	N female						Connector type
Display	Monochrome LCD, with backlight and adjustable contrast		Color LCD			Display	
External Video Output	N/A				CRT 1/4 VGA		External Video Output
Parallel Printer Port	Compatible with Deskjet 540 and 340 Models. Other 500 Series and 300 Series and later are typically compatible. Also Canon BJC 80		N/A				
General	MIL-T28800F, class 3						
Non Volatile RAM Battery	Lithium (10 year life)		Lithium (5 year life)				
Battery Option	>6 hr usable with 3000 mAhr (NiMH) battery		N/A				
DC Power Requirements	12 to 24 VDC, Reverse protected to -40V Maximum input 30V		N/A				
AC Power Requirements	90 to 250 VAC, 47 to 440 Hz, 40 VA Maximum		90 to 250 VAC, 47 to 440 Hz				
EMI, EMC, Safety	Complies with requirements for CE marking EN 61326, EN61010-1						
Operating Temperature	0° C to 50° C						Mainframe only, see sensor specification for performance of sensors
Storage Temperature	-40° C to 70° C						
Moisture	Splash and rain resistant, 95% humidity non-condensing						
Dimensions	213 mm x 88 mm x 390 mm						Width x Height x Depth
Weight	3 kg (excluding battery option)		2.8 kg		3 kg		
Warranty	1 year Standard, 3 year Optional						

Power Sensor Specifications

	Frequency Range	CW Dynamic Range (dBm)	SWR	Rise Time ¹ (ms)	Sensor Linearity ⁶	RF Connector ²
Standard Diode Sensors						
MA2472D	10 MHz to 18 GHz	-70 to +20 CW Mode -30 to +20 (with ML2480A) -34 to +20 (with ML2490A) Pulse/Modulated Mode	<1.17; 10 to 150 MHz (MA2472D only) <1.90; 10 to 50 MHz	<0.004	1.8%, <18 GHz 2.5%, 40 GHz 3.5%, <50 GHz For MA2475D ⁴	N (m)
MA2473D	10 MHz to 32 GHz		<1.17; 50 to 150 MHz <1.12; 0.15 to 2 GHz <1.22; 2 to 12.4 GHz			K (m)
MA2474D	10 MHz to 40 GHz		<1.25; 12.4 to 18 GHz <1.35; 18 to 32 GHz <1.50; 32 to 40 GHz <1.63; 40 to 50 GHz			K (m)
MA2475D	10 MHz to 50 GHz		V (m)			

Temperature accuracy: <1% < 40 GHz, <1.5% <50 GHz, 5 to 50° C

High Accuracy Diode Sensors

MA2442D MA2444D	10 MHz to 18 GHz 10 MHz to 40 GHz	-67 to +20	<1.90; 10 MHz to 50 MHz <1.17; 10 MHz to 150 MHz (MA2442D only) <1.17; 50 MHz to 150 MHz <1.08; 150 MHz to 2 GHz <1.16; 2 GHz to 12.4 GHz <1.21; 12.4 GHz to 18 GHz <1.29; 18 GHz to 32 GHz <1.44; 32 GHz to 40 GHz <1.50; 40 GHz to 50 GHz	<0.004	1.8%, <18 GHz 2.5%, <40 GHz 3.5%, <50 GHz For MA2445D ⁵	N (m) K (m)
MA2445D	10 MHz to 50 GHz		V (m)			

Temperature accuracy: <1% < 40 GHz, 5 to 50°C

Universal Power Sensors

MA2481D MA2482D	10 MHz to 6 GHz 10 MHz to 18 GHz	-60 to +20	<1.17; 10 to 150 MHz <1.12; 0.15 to 2 GHz <1.22; 2 to 12.4 GHz <1.25; 12.4 to 18 GHz	<0.004 (with option 1 only)	10 MHz to 6 GHz 3% -60 to +20 dBm 6 to 18 GHz 3% -60 to 0 dBm 3.5% 0 to +20 dBm (1.8% CW with option 1)	N (m)
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Temperature accuracy: <1%, 5 to 50° C

MA2480/01 Adds fast CW mode to Universal Power Sensors for high speed measurements of CW signal plus TDMA and pulse measurements

Wideband Sensors

MA2490A ³	50 MHz to 8 GHz	-60 to +20 CW Mode -25 to +20 (with ML2480A) -30 to +20 (with ML2490A) Pulse/Modulated Mode	<1.17; 50 to 150 MHz <1.12; 0.15 to 2.5 GHz <1.22; 2.5 to 8 GHz	<18 ns	<7% 50 to 300 MHz <3.5% 0.3 to 8 GHz	N (m)
MA2491A ³	50 MHz to 18 GHz		<1.17; 50 to 150 MHz <1.12; 0.15 to 2.5 GHz <1.22; 2.5 to 12.4 GHz <1.25; 12.4 to 18 GHz			<7% 50 to 300 MHz <3.5% 0.3 to 18 GHz

Temperature accuracy: <1% 10 to 45° C

Pulse Sensor

MA2411B Requires 1 GHz calibrator option 15 to be fitted	300 MHz to 40 GHz	-20 to +20 dBm	<1.15; 0.3 to 2.5 GHz <1.35; 2.5 to 26 GHz <1.50; 26 to 40 GHz	<8 ns <18 ns when used with ML2487/8A	<4.5% 0.3 to 18 GHz <7% 18 to 40 GHz	K (m)
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Temperature accuracy: <2% 10 to 45° C

¹ 0.0 dBm, room temperature with standard 1.5m sensor cable.

² Each MA2400A/D Series sensor incorporates precision RF connectors with hexagon coupling nut for attachment by industry standard torque wrench.

³ MA2490/1A and MA2411B sensors must be used with ML2480A or ML24950A Power Meters.

⁴ For Linearity on MA2475D only applicable to -70 to +15 dBm.

⁵ For Linearity on MA2445D only applicable to -67 to +15 dBm.

⁶ Sensor linearity specifications are ± value.

Pulse/modulated performance only specified with 1.5m sensor cable length option ML2400A-20 supplied as standard with the power meter.

Measurement Accuracy

Power measurement accuracy can be split into several parts. The table below shows how the measurement uncertainty is composed for several power sensors. The source is presumed to be a 16 GHz, 12.0 dBm signal with a source SWR of 1.5:1.

The uncertainties can be calculated as an RSS term as each parameter is independent. Alternatively they can be added together for a worst-case analysis.

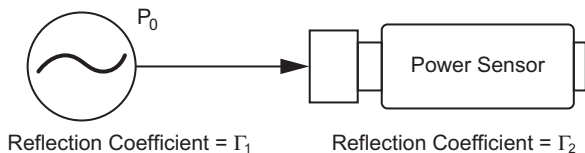
	MA2440D	MA2491A	MA2470D
Instrumentation Accuracy	0.50%	0.50%	0.50%
Sensor Linearity	1.80%	3.50%	1.80%
Noise, 256 Avg.	0.00%	0.00%	0.00%
Zero Set and Drift	0.00%	0.00%	0.00%
Mismatch Uncertainty	3.84%	4.49%	4.49%
Sensor Cal Factor Uncertainty	0.79%	1.59%	0.84%
Reference Power Uncertainty	1.20%	1.20%	1.20%
Reference to Sensor Mismatch Uncertainty	0.23%	0.31%	0.23%
Temperature Linearity	1.00%	1.00%	1.00%
RSS, Room Temp	4.51%	6.06%	5.09%
Sum of Uncertainties, Room Temp	8.36%	11.59%	9.06%
RSS	4.62%	6.14%	5.18%
Sum of Uncertainties	9.36%	12.59%	10.06%

The **Instrumentation accuracy** of 0.5% is a very small component of the overall uncertainty budget and describes the linear voltage measurement accuracy of the power meter.

Sensor linearity describes the relative response over the dynamic range of the sensor, and is included when the sensor is measuring power levels relative to the 0 dBm calibrator reference level. Temperature linearity is included when operating the sensor at other than room temperature.

Noise, Zero Set and Drift are all measured on the lowest power range of the power sensor. Different types of power sensors have different noise characteristics. Noise can be reduced by averaging.

Mismatch uncertainty is typically the largest component of the uncertainty budget – caused by the different impedances of the device under test and the sensor. To help resolve this issue, the sensor has been designed to have a good return loss over a wide frequency range, typically achieving significantly better results than the specification. In many cases the major contributing factor is the match of the source under test.



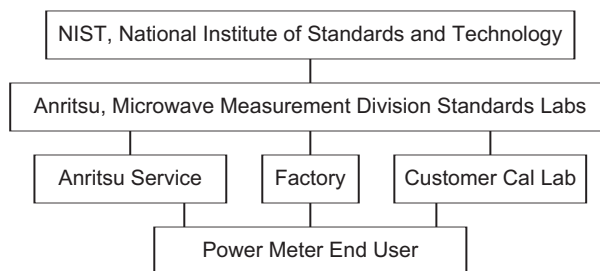
$$\begin{aligned} \% \text{ Mismatch Uncertainty} &= 100 [(1 \pm \Gamma_1 \Gamma_2)^2 - 1] \\ \text{dB Mismatch Uncertainty} &= 20 \log (1 \pm \Gamma_1 \Gamma_2) \end{aligned}$$

Mismatch is easily calculated in either dB or percentage terms from the source's and sensor's respective reflection coefficients.

The source match of the device under test can be improved by the use of precision attenuators with good return loss or by the use of external levelling with a high directivity coupler or splitter.

Connector damage has significant accuracy and repeatability effects, and is also the most common cause of sensor damage – although it is frequently undetected. Every MA2400A/D Series includes a hex nut connection for application of a calibrated torque wrench. Torque wrenches assure compliance with the quality requirement and result in more consistent measurements.

Sensor calibration factor uncertainty identifies the accuracy of the sensor's calibration relative to a recognized standard for absolute power level. Sensor calibration factor uncertainty is included in accuracy calculations for any absolute power measurement (in dBm or Watts) and for relative power measurements if the signals are different frequencies.



ML2400A Series is NIST traceable for more accurate, dependable measurements.

Reference power uncertainty specifies the maximum possible output drift of the power meter's 50 MHz, 0.0 dBm power reference between calibration intervals.

Reference power uncertainty and reference to sensor mismatch uncertainty do not generally impact relative power measurements.

See the Anritsu website (www.anritsu.com) for more information and tool to calculate measurement uncertainties.

Ordering Information

Power Sensor and Power Meter Selection Guide

Sensors	Standard Diode	Universal	Wideband	Pulse	(High Accuracy) Diode	Comments
	MA2470D Series	MA2480D Series	MA249xA Series	MA2411B	MA2440D Series	
Power measurement	Average (RMS)	RMS	Average (RMS), Peak	Average (RMS), Peak	Average (RMS)	
Measurement Application (examples)	CW, GMSK, GFSK, 8PSK	CW, GMSK, GFSK, 8PSK, QPSK, QAM	CW, GMSK, 8PSK, QPSK, QAM	Pulse, QAM	CW, GMSK	Modulation
	TDMA, FDMA, IS136	TDMA, FDMA, CDMA, OFDM	TDMA, FDMA, CDMA, OFDM, Radar	Radar, OFDM	TDMA, FDMA	Access Scheme
Compatible Power meter(s)	ML24xxA	ML24xxA	ML2490A, ML2480A	ML2490A, ML2480A	ML24xxA	

Choose the right sensor and meter for your measurement application.

Power Meter Models

ML2495A	Power Meter, Single Input
ML2496A	Power Meter, Dual Input
ML2487A	Power Meter, Single Input
ML2488A	Power Meter, Dual Input
ML2437A	Power Meter, Single Input
ML2438A	Power Meter, Dual Input

ML2400A–25	30m Sensor Cable
ML2400A–26	50m Sensor Cable
ML2400A–27	100m Sensor Cable
ML2400A–30	Extra Operation Manual ML2437/8A
ML2400A–98	Calibration to Z540, ISO Guide 25
ML2400A–99	Premium Calibration
ML2400A–30A	Option 30, Extra Operation/Prog manual (For use in Japan, only)

ML2490A Series

ML2490A–06	Rear Mount Input A
ML2490A–07	Rear Input A and Reference
ML2490A–08	Rear Mount Inputs A, B and Reference
ML2490A–09	Rear Mount Inputs A and B
ML2490A–33	Extra Operating Manual
ML2490A–34	Extra Programming Manual
ML2490A–37	Electronic Manuals (deletes paper version from shipment)
ML2490A–98	Calibration to Z540, ISO Guide 25
ML2490A–99	Premium Calibration

Options 1 to 5 above are mutually exclusive for any given ML2430A unit. Options 6, 7, 8 and 9 above are mutually exclusive for any given ML2430A. Pulse/modulated performance only specified with 1.5M sensor cable length option

Software upgrades, Labview drivers and application notes can be downloaded from the Anritsu web site at www.Anritsu.com

Standard Accessories

Power Cord for Destination
One 1.5 m sensor cord per meter input
Operation Manual
GPIB Manual
Certificate of calibration, also included with sensors

ML2480A Series

ML2480A–06	Rear Mount Input A
ML2480A–07	Rear Input A and Reference
ML2480A–08	Rear Mount Inputs A, B and Reference
ML2480A–09	Rear Mount Inputs A and B
ML2480A–15	Factory Fitted 50MHz and 1GHz Calibrator (required by MA2411B Sensor)
ML2480A–15R	Retro Fit Calibrator Kit
ML2480A–33	Extra Operating Manual ML2487/8A
ML2480A–34	Extra Programming Manual ML2487/8A
ML2480A–35	Extra Operating Manual: Japanese
ML2480A–36	Extra Programming Manual: Japanese
ML2480A–37	Electronic Manuals only (deletes paper version from shipment)
ML2480A–98	Calibration to Z540, ISO Guide 25
ML2480A–99	Premium Calibration
ML2400A–32A	Maintenance Manual ML2480/90A Series
ML2400A–31A	Option 31, Extra Operation/Prog manual ML2480A

Optional Accessories

760–209	Hardside Transit Case
D41310	Soft Carry Case with Shoulder Strap
MA2418A	50 MHz Reference Oscillator with Power Supply
ML2400A–01	Rack Mount, single unit
ML2400A–03	Rack Mount, side by side
ML2400A–05	Front Bail Handle
ML2400A–12	Front Panel Cover
ML2400A–20	Spare 1.5m Sensor Cable
ML2400A–21	0.3m Sensor Cable
ML2400A–28	RS232 Bootload Cable
ML2400A–29	Bulkhead Adapter
ML2419A	Range Calibrator
MA2497A	Agilent/HP 84xxA Series Sensor Adaptor

Options 1, 3 and 5 are mutually exclusive for any given ML2480/90A. Options 6, 7, 8 and 9 are mutually exclusive for any given ML2480/90A.

ML2430A Series

10585–00003	Maintenance Manual ML2400A Series
ML2400A–33	Extra Operating & Programming Manual ML2437/8A
MA2499B	Anritsu 4700 & 4600 Series Sensor Adapter
ML2400A–06	Rear Mount Input A on ML2437A
ML2400A–07	Rear Input A and Reference on ML2437A
ML2400A–08	Rear Mount Inputs A, B and Reference
ML2400A–09	Rear Mount Inputs A and B on ML2438A
ML2400A–11	NiMH Battery with Desktop Charger
ML2400A–11A	NiMH Battery with Desktop Charger (for use in Japan only)
ML2400A–22	3m Sensor Cable
ML2400A–23	5m Sensor Cable
ML2400A–24	10m Sensor Cable

Power Sensor Models

MA2470D	Standard Diode Series
MA2480D	Universal Diode Series
MA249xA	Wideband Diode Series
MA2411B	Pulse Sensor
MA2440D	High Accuracy Diode Series

PowerSuite

Free software available for all the power meters. Continuously view measurement traces on your PC in real-time, or archive data and plots for later analysis. PowerSuite runs on a standard PC running Windows® 95 (or higher), via GPIB or RS232.

See your Anritsu Representative or Components catalogue for available Attenuators, Limiters, Coaxial adapters, Waveguide-to-Coaxial adapter, Splitters & Dividers, Loads, Bridges, Open/Shorts, and Calibrated Torque wrenches.

