discover...

ML2480A Series, Wideband Peak Power Meters

Anritsu

www.eu.anritsu.com

Discover What's Possible™

Anritsu Power Meters Give You More

High Reliability. Rugged, splash resistant chassis design handles drop shocks and rough field treatment. A front panel cover and softcase are optional for further environmental protection.

High Speed.
Wideband sensors have a video bandwidth of 20MHz and a rise time of 18ns. Ideal for all wireless and radar applications.

Preset.
Preset measurement set-ups for widely available wireless systems such as GSM,WCDMA, Bluetooth.

Trigger.
Comprehensive facilities offer precise triggering using internal or external sources. Continuous or single shot modes are available.

Colour Graphics Display:
Up to 64 Ms/s sample rate produces accurate profiles of Radar, WCDMA, WLAN and latest generation cellular systems.

Displays the peak, average and crest factor of any input signal.

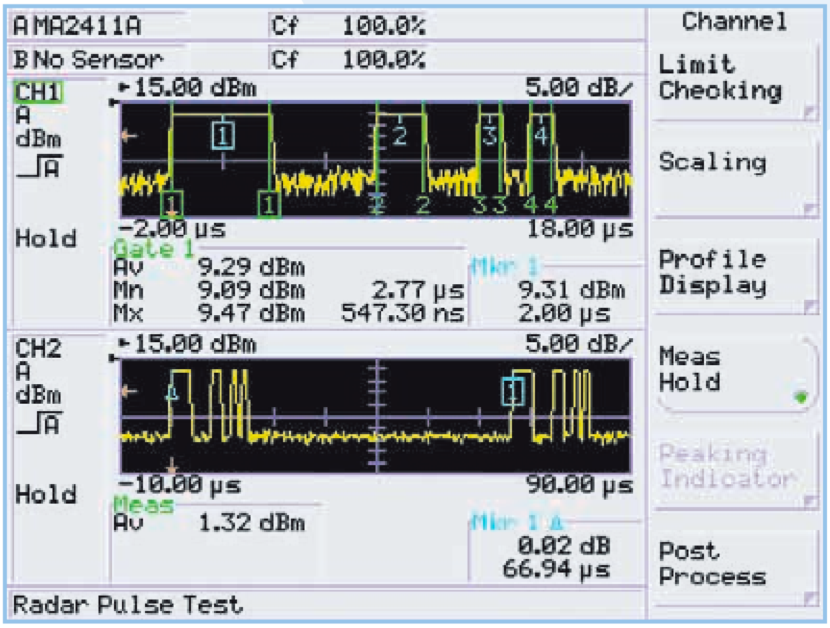
Softkeys. Menu driven operation simplifies test procedures.

Sensor EEPROM. All MA2400A/B Series sensors have built-in EEPROMs with factory Calibration Factor data.
Six User Calibration Factor Tables allow extra frequency points or compensation for couplers and power attenuators.

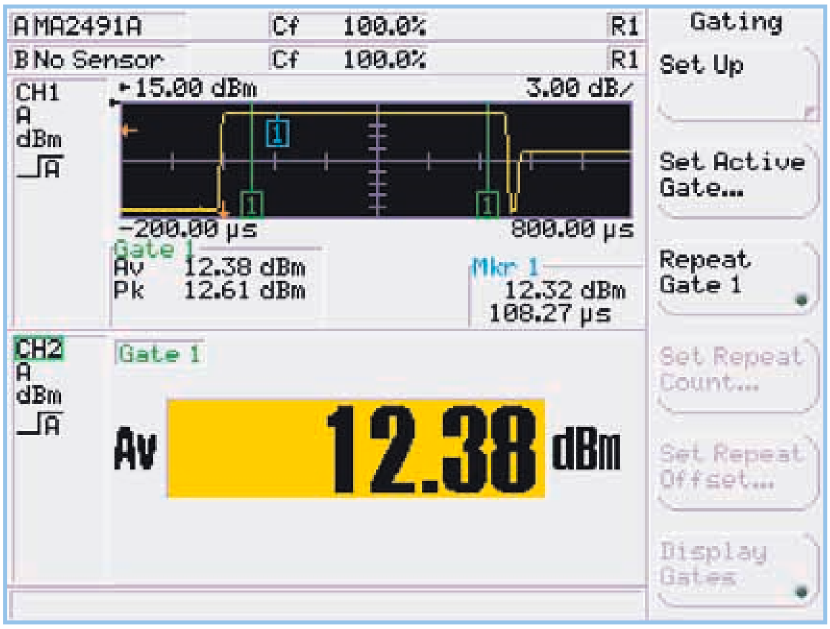
Sensor Inputs.
Sensor Inputs compatible with all Anritsu MA2400A series sensors.

Accuracy. Excellent return loss sensor design reduces typical mismatch uncertainty by half - improving accuracy and repeatability. Less SWR ripple in measurement data improves production yield and quality control.

The dual display channel gives complete flexibility and can provide two different perspectives on the measurement.



Examine the pulses in detail and capture the entire pulse train.



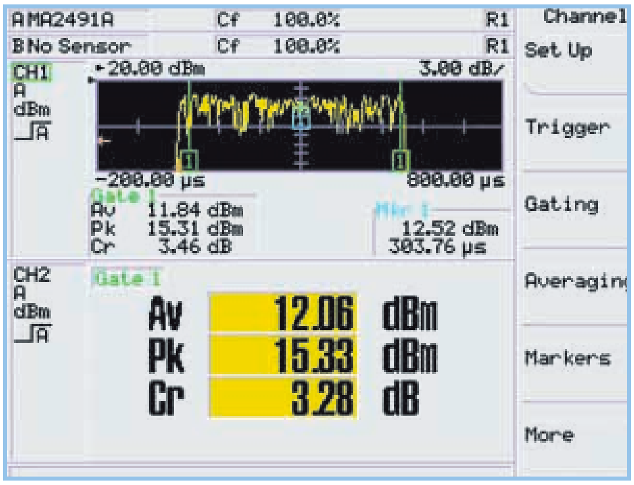
Use the readout facility to enhance the display.

Accuracy, speed, flexibility, ML2488A has It all...

FEATURES

Dual Display Channel

The ML2480A supports dual display channels. Each display channel can be set up to make a measurement and can use any selection or combination of the sensor inputs. The instrument can be configured to view one display channel or two. The instrument can be switched between display channels quickly and simply via the CH1/CH2 Hard 'hot' key on the front panel. The user can choose to view the measurement results as a graph profile or numerical readout.



Measurement Gates

At the heart of the new power meter's signal processing lies the measurement gate facility. The new power meter supports up to 4 independently set gates or 8 gates repeated in a pattern. The gate allows the user to capture the relevant information from the signal under test. The wide bandwidth and high speed sampling allow the positioning of the gate very accurately within the signal profile. The user can choose between several measurements performed within the gate. Average, peak, crest, max and min are available as selections for the output.

The max and min data are time stamped so that the position of these signals is recorded within the gate and can be used to record the overshoot and undershoot of a pulsed signal.

Exclusion zones within the measurement gate are also available. Termed “fences”, these can be used to exclude sections of the signal from the measurement gate which is particularly useful for excluding mid-burst training sequences. Each gate has a switchable fence associated with it.

Markers

Four independent markers are available for denoting points of interest on the signal profile. The active marker can be scrolled directly from the front panel. A delta marker can be set independently from the active marker, to read the difference or the average power result. The delta marker can be linked to provide continuous scrolling through the signal.

Special marker features.

A set of specialised automatic marker functions has been provided to ease the measurement of pulsed systems. These functions are automatic pulse rise time, pulse fall time, off time and pulse repetition interval.

Trigger facilities

High speed measurements require precise triggering. The ML2480A series offer the following trigger modes.
Continuous, internal trigger on the rising or falling edge of either input A or input B and external TTL trigger.
The external trigger allows the power meter to be synchronised to external equipment. Data collection can be delayed for a pre-determined time before or after the trigger point. The trigger facility incorporates a settable hold-off facility that prevents the trigger from being re-armed and re-triggering on a noisy signal. A pre-trigger facility allows the capture and display of pre-trigger information on the signal. The single shot trigger facility can be used to capture specific one-off events.

Test Limits

The ML2480A series has two different types of automatic test limits. For many applications a simple power limit can be set up to test the upper and /or lower boundaries of the signal. For pulsed systems such as RADAR, TDMA phone systems or WLAN, a time varying limit line can be set up to test all aspects of the pulse profile. The power meter can be set up to indicate pass or fail and to hold the measurement display on failure which is important when trying to track down intermittent faults. An internal limit editor enables the user to create and select his or her own limit profiles.

Presets

The ML2480A offers a number of radio system presets. Each preset configures the power meter settings to measure a radio system. GSM, GPRS, WCDMA, WLAN and Bluetooth are some examples of radio systems supported by this facility.

Settings stores

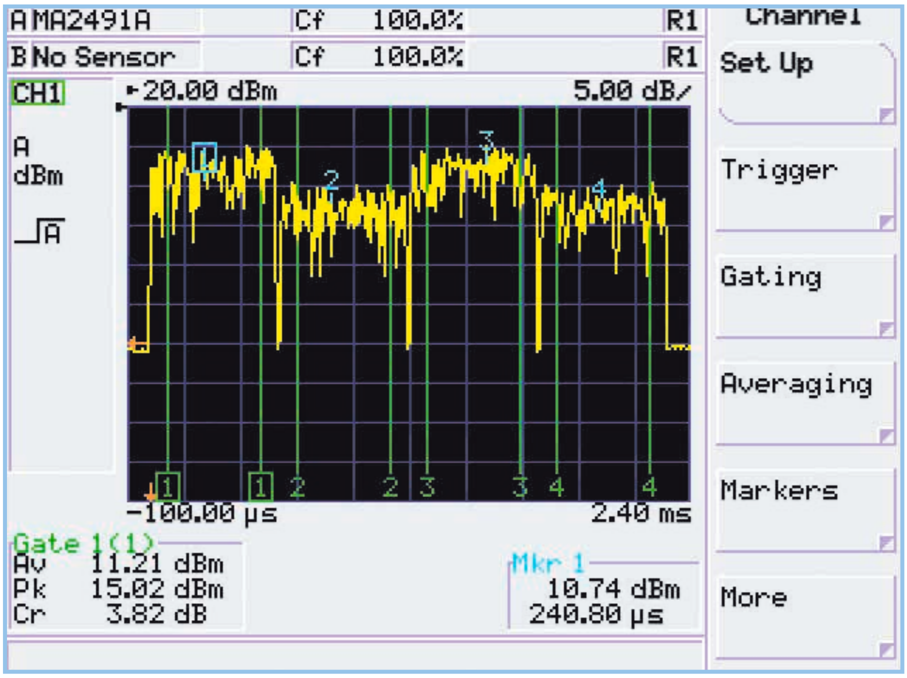
The power meter has 20 settings stores. These provide a convenient way of having application specific measurement set-ups for easy recall by the user.

Remote Interfaces

The ML2480A series supports GPIB and RS232 as standard. USB and Ethernet will be available as options.

Secure mode

The ML2480A series has a secure mode for operations in security sensitive areas. Once activated, the secure mode wipes all information stored in the non-volatile memory on power up.



Designed For Your Application...

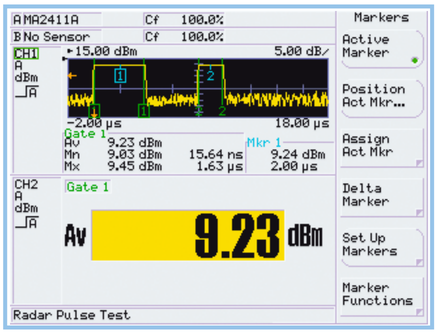
Radar Systems

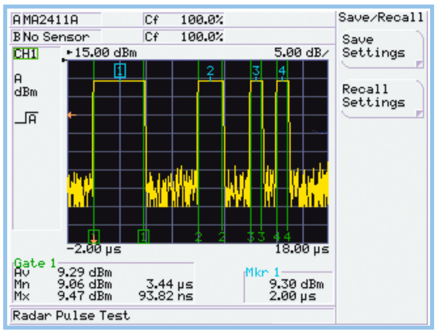
The high bandwidth and sample rate of the ML2480A provide accurate peak measurements on a variety of RADAR, Radio Navigation and Radio Location systems.

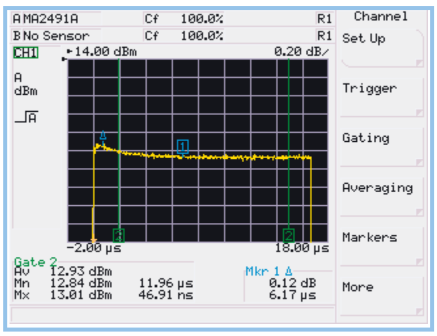
The ML2480A series has a number of features tailored for peak power measurement on pulsed systems. The power meter can be easily set up to trigger on a pulse or sequence of pulses. Up to four independent gates can be set to measure the average, max and min powers on a sequence of pulses. The data for the max and min includes the timestamp and gives the user automatic display of the position and value of the maximum over-shoot and minimum undershoot in each pulse.

A set of automatic marker functions gives pulse rise time, fall time, off time and Pulse Repetition Interval. The Delta marker can be set up to measure the droop of the pulse top. A single shot trigger is available to capture one-off pulse events.

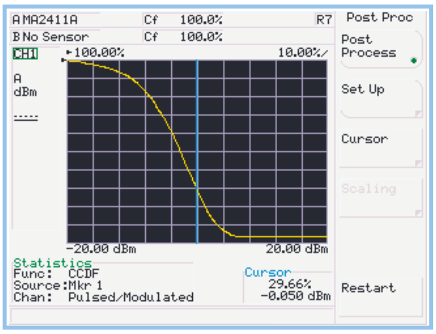
The offset table function corrects the power meter reading to read the true output power when the power meter is being used with a coupler or high power attenuator in the radar test system.

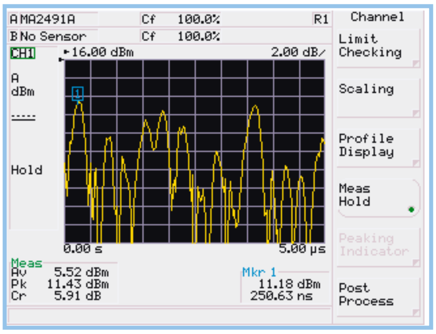


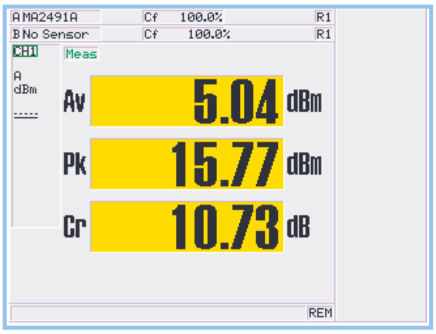




3G CDMA Systems







The ML2480A series has been designed to measure the peak power of all the major CDMA systems in the world including those that use Time Division Duplexing such as TD-SCDMA.

The display can be configured to measure Average, Peak and Crest Factor during the measurement period for FDD systems. TDD systems can be displayed as a graph profile and the measurement gates can be set to measure and display the peak and crest factor during the data payload transmission.

CCDF, CDF and PDF statistical functions are supported on the CDMA measurements and enable the designers of power amplifiers to correctly estimate the margins on the peak power handling capabilities of the amplifiers.

The high-speed profile display allows the engineer or test manager to see the actual power envelope variations in the signal. The dual input ML2488A in ratio mode can measure the gain and the output power of the amplifier under CDMA transmission conditions.

Multi carrier measurements make stringent demands on power measurement. The 20MHz bandwidth of the sensor and the power meter are ideally suited for measuring multiple channel carriers in an allocated spectrum block.

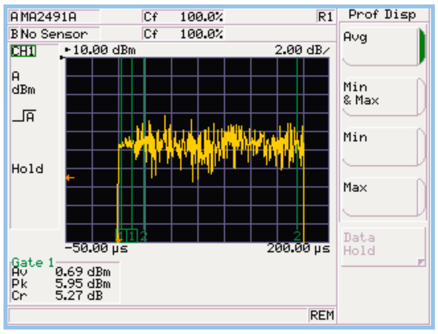
Designed For Your Application...

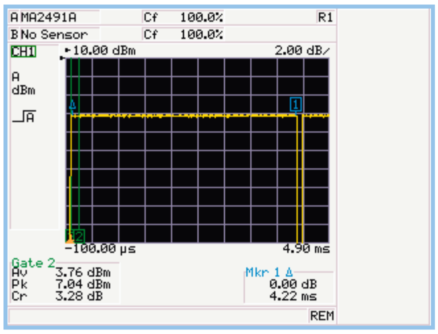
W-LAN Solutions

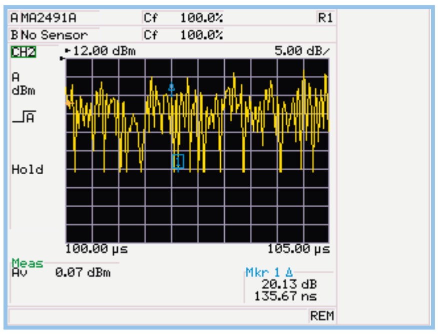
WLAN technology plays an increasing significant part in the design and installation of high speed network access. WLAN transmission technologies have developed faster than the traditional power meter, leaving users with inaccurate power measurements.

The ML2480A series is the ideal power meter for all variants of the 802.11 WLAN specification including the 54Mb/s a/g variants. The 20MHz bandwidth allows users for the first time to get an accurate peak power reading without having to resort to manual correction of the peak reading due to bandwidth limitations.

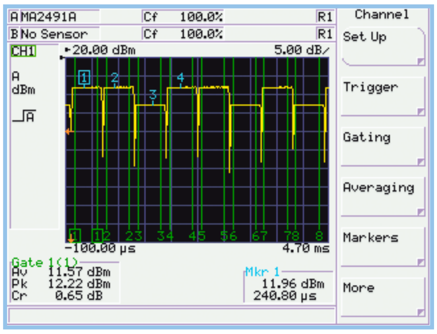
The wide bandwidth of the signal channel allows for the accurate placement of the gates. The multiple gate facility can be used to measure precise selections of the signal such as the OFDM training sequence at the start of the 802.11g signal and the data payload section. Max and average profile display show the peak excursions of the signal under test.

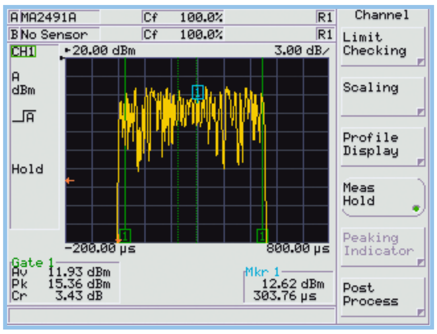


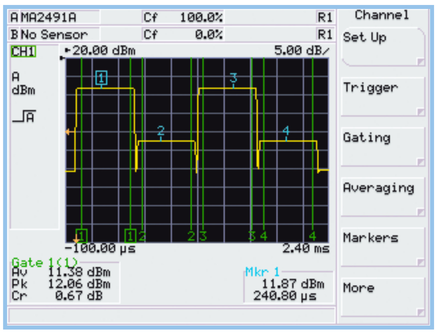




GSM/EDGE/GPRS Systems







The graphical display and the measurement gate makes the measurement of GSM and PCS systems straightforward.

The power meter is set up to trigger on the GSM pulse. The active gate is set up to measure the power within the 10% to 90% section of the burst profile in order to meet the specified limits. An automatic limit can be used to give pass or fail indication. The display shows the results from the active gate, indicating the average power within the burst.

GPRS and GSM test modes can be tested easily with the use of the multiple gates. A GSM gate pattern can be repeated up to 8 times to allow the power meter to capture and read back the power from each of the slots, giving up to 8 simultaneous measurements.

EDGE measurements are quick and simple to make. The high sample rate leads to improved settling time and the use of the trigger hold-off facility prevents re-triggering on the symbol transitions. PHS and IS-136 systems can also be measured quickly and effectively in this way.

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 16GHz, 12.0dBm with a source SWR of 1.5:1.

Sensor Model Series	MA2420A/B	MA2470A	MA2491A
Instrumentation Accuracy	0.50%	0.50%	0.5%
Sensor Linearity	1.30%	1.80%	3.5%
Noise, 256 Avg	0.00%	0.00%	0.0%
Zero Set and Drift	0.00%	0.00%	0.0%
Mismatch Uncertainty	3.87%	4.49%	4.49%
Sensor Cal Factor Uncertainty	0.83%	0.84%	1.59%
Reference Power Uncertainty	1.20%	1.20%	1.20%
Reference to Sensor Mismatch Uncertainty	0.23%	0.23%	0.31%
Temperature Linearity, + 20 C	1.00%	1.00%	1.00%
RSS, Room Temp	4.19%	5.09%	6.06%
Sum of Uncertainties, Room Temp	7.73%	9.06%	11.59%
RSS Over Temperature	4.31%	5.18%	6.14%
Sum of Uncertainties	8.73%	10.06%	12.59%

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.

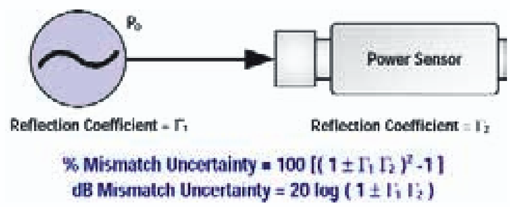
The linearity of the sensor describes the relative response over the dynamic range of the sensor, it is included when the sensor is measuring power levels relative to the 0 dBm calibrator reference level. Temperature linearity is included when operating the sensor at other than room temperature.

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

The largest component of the uncertainty budget is typically the mismatch error caused by the different impedances of the device under test and the sensor. The sensor has been designed to have a good return loss over a wide frequency range, and typically achieves significantly better results than the specification. In many cases the major contributing factor is the match of the source under test. The source match 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.

Sensor calibration factor uncertainty identifies the accuracy of the sensor's calibration relative to a recognised 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.

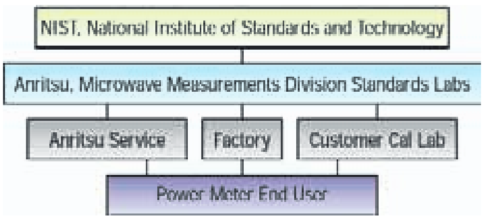
Reference power uncertainty specifies the maximum possible output drift of the power meter's 50 MHz, 0.0 dBm power reference between calibration intervals. Reference power uncertainty and sensor to reference mismatch uncertainty do not generally impact relative power measurements.



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

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

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.



ML2400A Series measurements are NIST traceable.

ML2430A Series

ML2430A Series Power Meters Ideal for CW applications

The ML2430A Series Power Meters combine the advantages of thermal meter accuracy, diode meter speed and peak power meter display graphics.

The result is a single instrument that samples at more than 35k per second and achieves 90 dB dynamic range with a single sensor.

The ML2430A Series includes graphics display capability as a standard feature. The ruggedized housing and optional high-capacity NiMH battery bring laboratory quality accuracy to field service applications.

Accessories

ML2419A Range Calibrator

Reduce annual calibration expense with Anritsu's precision range calibrators.

The ML2419A Range Calibrator verifies the ML2400A Series Power Meter's measurement channels.

The meter's 50 MHz oscillator level is verified by comparison method. When the calibrator is connected, user operation prompts appear on the meter's screen.

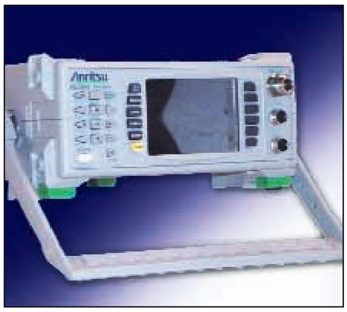
Soft Carry Case

The soft carry case protects the power meter and has pockets for all common accessories making it the ideal carry bag for field use.

50MHz Reference Oscillator

When power sensors must be located a long distance from the power meter, the MA2418A Reference Oscillator provides a remote, traceable 0dBm power reference.

MA2418A is DC powered from a 16 to 24 volt jack plug.



Bail Arm and Protective Front Cover

A bail arm is available as a convenient carry handle and is suitable for angling the meter on a workbench.

Accessories

Power Attenuators

Model	Frequency Range	Rating	Connectors
42N50-20	dc - 18 GHz	20 dB, 5W, 50 ohm	N male to N female
42N50-30	dc - 18 GHz	30 dB, 50W, 50 ohm	N male to N female
42KC-20	dc - 40 GHz	20 dB, 5W, 50 ohm	K male to K female

Precision Attenuators

Model	Frequency Range	Rating	Connectors
41KC-3	dc - 40 GHz	3 dB, 2W, 50 ohm	K male to K female
41KC-6	dc - 40 GHz	6 dB, 2W, 50 ohm	K male to K female
41KC-10	dc - 40 GHz	10 dB, 2W, 50 ohm	K male to K female
41KC-20	dc - 40 GHz	20 dB, 2W, 50 ohm	K male to K female
41V-3	dc - 60 GHz	3 dB, 2W, 50 ohm	V male to V female
41V-6	dc - 60 GHz	6 dB, 2W, 50 ohm	V male to V female
41V-10	dc - 60 GHz	10 dB, 2W, 50 ohm	V male to V female
41V-20	dc - 60 GHz	20 dB, 2W, 50 ohm	V male to V female

Coaxial RF Limiters

Wideband limiters protect power sensors from damage due to excessive RF power. The limiters have low insertion loss to preserve the power sensor's sensitivity. High quality return loss minimizes mismatch uncertainty degradation and ensures a flatter insertion loss versus frequency characteristic. The insertion loss response should be loaded into the MA2400A/B power sensor's User Calibration Factor Table; however, it is important to note that the limiters large signal response, beginning at about + 10 dBm, is different from the limiter's small signal frequency response.

Inexpensive RF limiters protect sensors against damage from excessive input power.

Model	Frequency Range	Rating	Connectors
1N50C	0.01 - 18 GHz	5W, 50 ohm	N male to N female
1K50A	0.01 - 20 GHz	5W, 50 ohm	K male to K female
1K50B	0.01 - 26 GHz	3W, 50 ohm	K male to K female

Precision Coaxial Adapters

Model	Frequency Range	Connectors
510-90	DC - 3.3 GHz	N male to 7/16 DIN female
510-91	DC - 3.3 GHz	N female to 7/16 DIN female
510-92	DC - 3.3 GHz	N male to 7/16 DIN male
510-93	DC - 3.3 GHz	N female to 7/16 DIN male
K220B	DC - 40 GHz	K male to K male
K222B	DC - 40 GHz	K female to K female
K224B	DC - 40 GHz	K male to K female

Coaxial Adapters

Model	Frequency Range	Connectors
1091-26	DC to 18 GHz	N male to SMA male
1091-27	DC to 18 GHz	N male to SMA female
1091-80	DC to 18 GHz	N female to SMA male
1091-81	DC to 18 GHz	N female to SMA female

Power Splitters

Model	Frequency Range	Connectors
1091-28	DC - 18 GHz	N female - N female/N female
K241B	DC - 26.5 GHz	K male - K female/K female
K241C	DC - 40 GHz	K male - K female/K female
V241C	DC - 60 GHz	V male - V female/V female

Power Dividers

Model	Frequency Range	Connectors
1091-29	DC - 18 GHz	N male - N female/N female
K240B	DC - 26.5 GHz	K female - K female/K female
K240C	DC - 40 GHz	K female - K female/K female
V240C	DC - 60 GHz	V female - V female/V female

Precision Loads

Model	Frequency Range	Connectors
28N50-2	DC - 18 GHz	N male
28NF50-2	DC - 18 GHz	N female
28A50-1	DC - 18 GHz	GPC-7
28K50	DC - 40 GHz	K male
28KF50	DC - 40 GHz	K female
28V50B	DC - 67 GHz	V male
28VF50B	DC - 67 GHz	V female

RF Bridges and Open/Shorts

Model	Description	Frequency Range	Connectors
60N50-1	RF Bridge, 46 dB	0.005 - 2.0 GHz	N male
60NF50-1	RF Bridge, 46 dB	0.005 - 2.0 GHz	N female
87A50-1	RF Bridge, 38 dB	2.0 - 18 GHz	GPC-7
22A50	Open/Short	DC - 18 GHz	GPC-7
22N50	Open/Short	DC - 18 GHz	N male
22NF50	Open/Short	DC - 18 GHz	N female

Calibrated Torque Wrenches

Model	Description
01-201	Calibrated torque wrench for K and V connectors
01-204	Calibrated torque wrench for N connector

Precision Waveguide to Coaxial Adapters

Contact your local Anritsu sales office for details of our range of precision waveguide to coaxial adapters.

Specifications

SPECIFICATIONS

Frequency Range
100 KHz to 65GHz, sensor dependant

Power Sensors
Meter compatible with the MA2400 A/B series sensors

Sensor Dynamic Range
-70dBm to +20dBm for standard MA2400 A/B Sensor Range

Power Measurement Range
-70 to +200dBm dependent upon sensor range, external coupler or attenuator

CHANNEL BANDWIDTH

20MHz - CW and lower bandwidth mode sensors supported

Sampling Rate
Up to 64MS/s dependent upon settings

Instrumentation Accuracy
<0.5%
±0.02dB absolute Accuracy
±0.04dB relative Accuracy

Display Resolution
Selectable from 0.1 to 0.001dB

Display Units
Linear: nW to W, %
Log: dBm, dBW, dB

POWER REFERENCE

Output Level
1.00mW, Nominal 50MHz,Traceable to National Standards

Connector
Type N female - VSWR 1.04

SENSOR/CHANNEL CONTROL

Operating Modes:
Readout, Dual Display Channel
RF power.

Profile: CDMA Average, Peak Power, Crest factor CDF,PDF and CCDF

Limit Lines
Simple pass/ fail for CW Profile shape for pulsed and TDMA systems, Profiles can be stored in the instrument.

Markers
4 Markers: Delta Marker, Marker to Max/Min, Pulse Rise/Fall time, off period and Pulse Repetition Interval.

Gates
4 Independently set Gates or 8 Repeated Gates.

1 Fence per Measurement Gate
Gate Measurement supports Average, Peak, Crest, Max and Min .

TRIGGERING

Trigger Sources
Continuous, Internal, External TTL, GPIB or external Bus.

Delay Range
0-999ms

Delay Resolution
0.5% of display period or 1ns

Internal Trigger Range
-15dBm to +20dBm
Selectable to -25dBm

SYSTEM CONFIGURATION

Display
LCD, Color

Save / Recall
20 settings stores
Preset accessible on Front Panel
Offset tables

Secure Mode
Wipes non volatile memory on power up when active.

Interfaces
GPIB Speed >400 readings/sec in CW mode.

GENERAL SPECIFICATIONS

General
MIL-T28800E, Type 3, class 5, Style E

Operating Temperature Range
0 to +50C

Storage Temperature Range
-40 to +70C

Power Requirements
AC
90V to 250VAC, 47 to 440Hz

EMI
Complies with requirements for CE Marking

Warranty
1 year Standard
3 year Optional

Dimensions
Size: 213mm (8.39 inches) wide, 88mm (3.46 inches) high, 390mm (9.84 inches) deep.
Weight: 2.8kg.

Specifications

Power Sensor Specifications

Model	Frequency Range	Dynamic Range (dBm)	SWR	Rise Time[1] (ms)	Sensor Linearity	RF Conn[2]
Standard Diode Sensors						
MA2472B	10 MHz - 18 GHz	- 70 to + 20	< 1.17; 10 - 150 MHz MA2472B only < 1.90; 10 - 50 MHz < 1.17; 50 - 150 MHz < 1.12; 0.15 - 2 GHz < 1.22; 2 - 12.4 GHz < 1.25; 12.4 - 18 GHz < 1.35; 18 - 32 GHz < 1.50; 32 - 40 GHz < 1.63; 40 - 50 GHz	< 0.004	1.8%, < 18 GHz 2.5%, < 40 GHz 3.5%, < 50 GHz For MA2475A see note 5	N (m)
MA2473A	10 MHz - 32 GHz					K (m)
MA2474A	10 MHz - 40 GHz					K (m)
MA2475A	10 MHz - 50 GHz					V (m)
Fast Thermal Sensors						
MA2421A	0.1 MHz - 18 GHz	- 30 to + 20	< 1.10; 0.1 MHz - 2 GHz < 1.15; 2 - 12.4 GHz < 1.20; 12.4 - 18 GHz	< 4.0	1.3%, < 18 GHz 1.5%, < 40 GHz 1.8%, < 50 GHz	N (m)
MA2422B	10 MHz - 18 GHz		< 1.90; 10 - 50 MHz < 1.17; 50 - 150 MHz < 1.10; 0.15 - 2 GHz < 1.15; 2 - 12.4 GHz < 1.20; 12.4 - 18 GHz < 1.25; 18 - 32 GHz < 1.30; 32 - 40 GHz < 1.40; 40 - 50 GHz			N (m)
MA2423B	10 MHz - 32 GHz					K (m)
MA2424B	10 MHz - 40 GHz					K (m)
MA2425B	10 MHz - 50 GHz					V (m)
High Accuracy Diode Sensors						
MA2442B	10 MHz - 18 GHz	- 67 to + 20	< 1.90; 10 - 50MHz < 1.17; 50 - 150MHz ** < 1.08; 0.15 - 2GHz < 1.16; 2 - 12.4GHz < 1.21; 12.4 - 18GHz < 1.29; 18 - 32GHz < 1.44; 32 - 40GHz < 1.50; 40 - 50GHz	< 0.004	1.8%, < 18 GHz 2.5%, < 40 GHz 3.5%, < 50 GHz For MA2445A see note 6	N (m)
MA2444A	10 MHz - 40 GHz					K (m)
MA2445A	10 MHz - 50 GHz					V (m)
Fast Diode Sensors						
MA2468B	10 MHz - 6 GHz	-60 to + 20	< 1.90; 10 - 50 MHz < 1.17; 50 - 150 MHz < 1.12; 0.15 - 2 GHz < 1.22; 2 - 12.4 GHz < 1.25; 12.4 - 18 GHz	< 0.0006	1.8%	N (m)
MA2469C	10 MHz - 18 GHz					
Universal Power Sensors						
MA2481B	10 MHz - 6 GHz	-60 to + 20	< 1.17; 10 - 150 MHz < 1.12; 0.15 - 2 GHz < 1.22; 2 - 12.4 GHz < 1.25; 12.4 - 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)
MA2482A	10 MHz - 18 GHz					
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	50 MHz - 8 GHz	-60 to +20 CW Mode	<1.17; 50 to 150 MHz <1.12; 0.15 to 2.5 GHz <1.22; 2.5 to 8 GHz	<18ns	<7% 50 to 300 MHz <3.5% 0.3 to 8 GHz	N(m)
MA2491A	50 MHz - 18 GHz	-60 to +20 CW Mode	<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	<18ns	<7% 50 to 300 MHz <3.5% 0.3 to 18 GHz	N(m)
Pulse Sensor						
MA2411A	300 MHz - 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	<8ns <18ns when used with ML2487/8A	<4.5% 0.3 to 18 GHz <7% 18 to 40 GHz	K(m)

1. 0.0 dBm, room temperature.
2. Each MA2400A/B Series sensor incorporates precision RF connectors with hexagon coupling nut for attachment by industry standard torque wrench.
3. MA2460A/B Fast Diode Sensors must be used with ML2407/08A Power Meters for NCDMA and Fast Pulse measurements.
4. MA2490/1A and MA2411A sensors must be used with ML2487/8A Power Meters.
5. For Linearity on MA2475A only applicable to -70 to +15dBm.
6. For Linearity on MA2445A only applicable to -67 to +15dBm.
7. MA2411A requires 1GHz calibrator, option ML2480A-15.

** <1.17; 10MHz to 150MHz applies to MA2442B only.

Ordering Information

Models

ML2487A	Power Meter, Single Input
ML2488A	Power Meter, Dual Input

Included Accessories

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

Options and Accessories

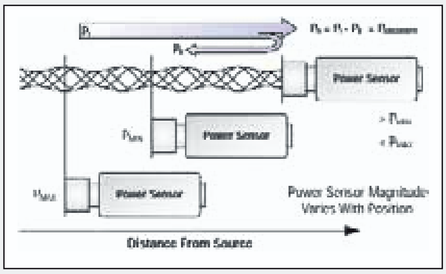
ML2400A-01	Rack Mount, single unit
ML2400A-03	Rack Mount, side by side
ML2400A-05	Front Bail Handle
ML2400A-06	Rear Mount input A
ML2400A-07	Rear Input A and Reference
ML2400A-08	Rear Mount inputs A,B and Reference
ML2400A-09	Rear Mount Inputs A and B
ML2400A-12	Front Panel Cover
ML2480A-15	1GHz Calibrator (for use with MA2411A Sensor)
ML2480A-16	Ethernet and USB
ML2480A-17	Blank Front Panel
ML2400A-20	Spare 1.5m Sensor Cable
ML2400A-21	0.3m Sensor Cable
ML2480A-33	Extra Operating manual ML2487/8A
ML2480A-34	Extra Programming Manual ML2487/8A
ML2480A-37	Electronic Manuals only - deletes paper version from shipment.
ML2480A-98	Premium Cal to Z540 ISO guide 25
ML2480A-99	Service Cal to Z540 ISO guide 25
760-209	Hardside Transit Case
D41310	Soft Carry Case with Shoulder Strap
MA2418A	50MHz Reference Oscillator with Power Supply

Options 1 to 5 above are mutually exclusive for any given ML2400A unit.
Options 6,7, 8 and 9 above are mutually exclusive for any given ML2400A.
Options 25, 26, 27 can not be used with ML2400A

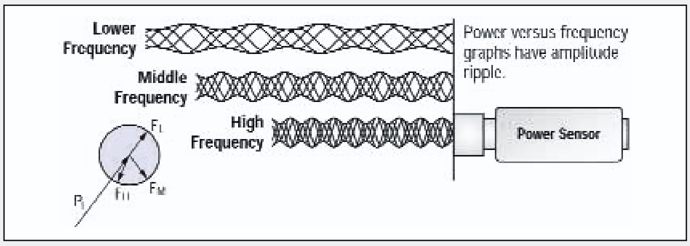
Understanding SWR and Mismatch Uncertainty.

Return Loss, SWR, and reflection coefficient describe a device's impedance match characteristic. When two devices of differing impedance are mated, energy from the output of the source device suffers incomplete transfer to the power sensor.

The partial reflections of microwave energy create a standing wave, hence the term standing wave ratio, SWR. A standing wave's impact upon power measurement accuracy is analogous to moving the power sensor along the transmission line. The load within the power sensor detects more or less signal power depending upon these vector additions and subtractions. Thus, without knowledge of the vector reflection characteristics, it is not possible to know exactly where maxima and minima occur. The range of the minima and maxima are mismatch uncertainty.



Standing waves are created when impedance mismatch causes RF signal reflections. The magnitude of the standing wave varies along the transmission line as the incident signal and reflected signal add and subtract vectorially.



In most test systems, the power sensor is attached at a fixed point on a transmission line. However, the effects of standing waves are still present because the position of the maxima and minima change as the frequency increases. At some point in a swept frequency measurement, in phase addition and subtraction is likely to occur. For this reason, mismatch uncertainty is calculated as a likely worst case value. When performing this calculation it is reasonable to neglect data sheet reflection specifications in favor of actually measuring the reflection magnitudes of the test components. Evaluating the actual reflection magnitudes within a test setup helps identify other causes of measurement variation. This practice is also a very effective means of identifying damage in coaxial connectors.

$$\text{Reflection Coefficient} = \Gamma = \frac{\text{VSWR} - 1}{\text{VSWR} + 1} = 10^{-(\text{Return Loss})/20}$$

The numerical values for reflection characteristics are mathematically related.

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