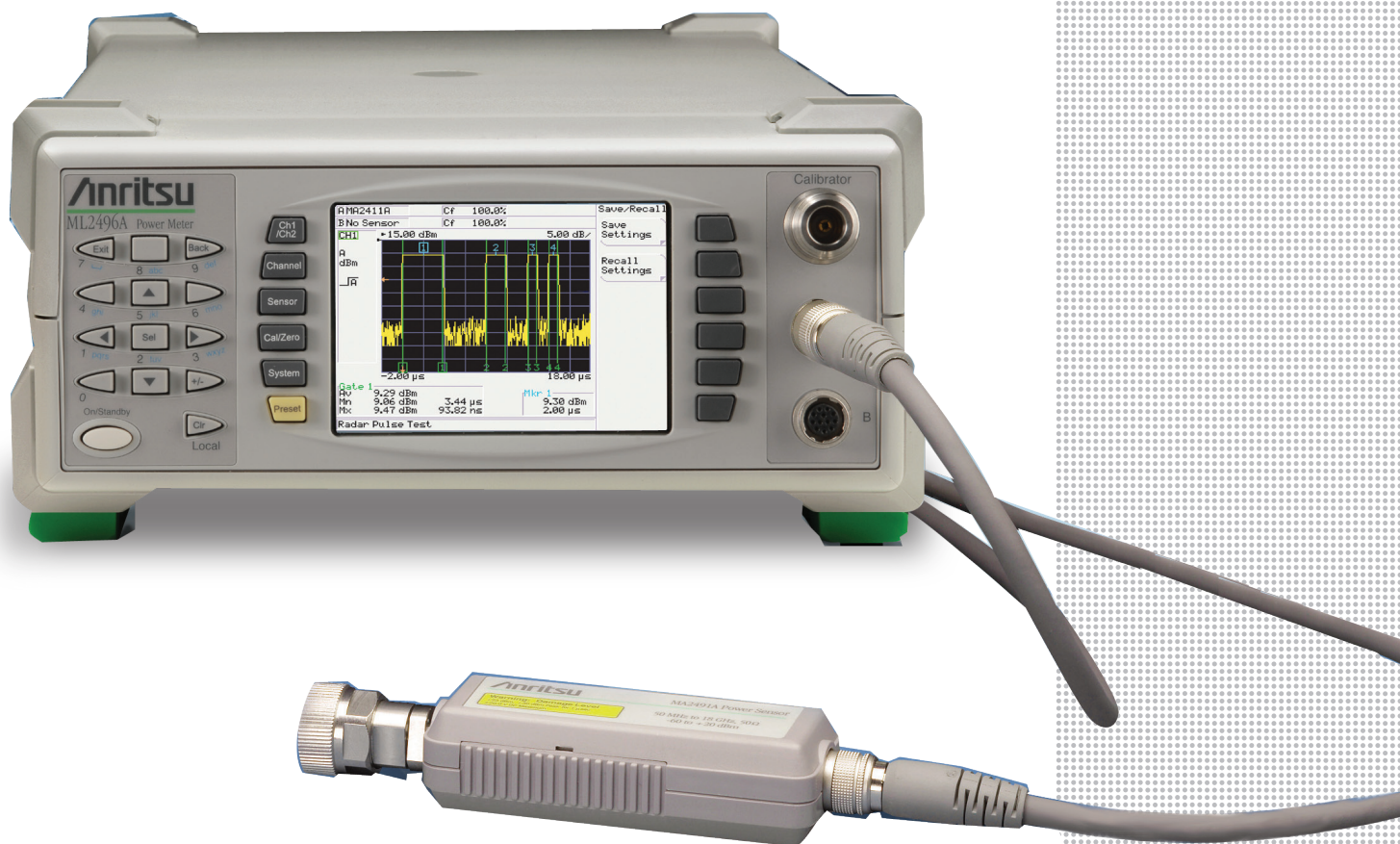


# Power Meters and Sensors

ML2430A CW Power Meter

ML2490A Pulse Power Meter

MA2400A/D and MA24000A Power Sensors



## Ideal solutions for average, peak, and pulse power measurements

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

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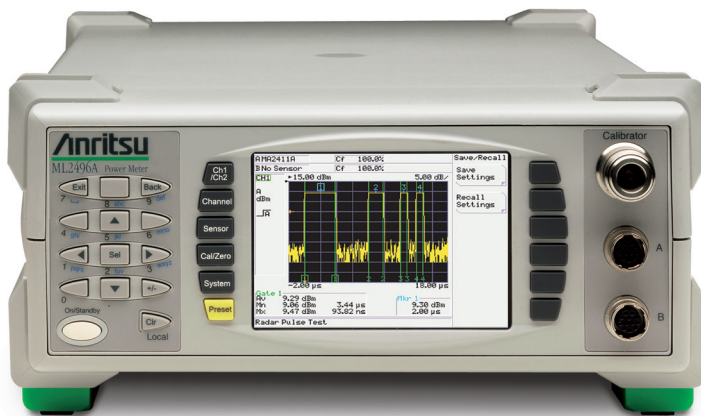
#### Power Meters

Anritsu offers a comprehensive range of power meters. The ML2490A series has the performance required for narrow fast rising-edge pulse power measurements (e.g., radar). The ML2430A series of power meters are designed for CW applications, offering a combination of accuracy, speed and flexibility in a low cost package.

#### Power Sensors

With seven different families of power sensors (including USB sensors\*) to choose from, you can trust you'll find the right combination for precision power measurement, whatever your application.

\*For more information on USB Sensors see "Microwave USB Power Sensors" Product Brochure/Technical Datasheet (11410-00504)



#### ML2490A Series

- **High Performance and Precision.** 65 MHz instrument bandwidth, with 1 ns measurement resolution for precise rise-time measurements of radar signals or for measuring the latest 4G Orthogonal Frequency Division Multiplexed (OFDM) signals.
- **High Speed Sampling.** Up to a 1 Gs/s sample rate produces accurate profiles of radar, LTE, W-CDMA, WLAN/ WiMAX and other demanding signals. Displays peak, average and crest factor of any input signal.
- **Triggering.** Comprehensive circuitry provides precise triggering using internal or external sources. Continuous or single shot modes available.
- **Measurement Gates and Markers.** Multiple gates and markers for measuring: peak power, multi-pulse power, signal droop, rise-time and fall-time, pulse width, and Pulse Repetition Interval (PRI).
- **External Video (ML2490A).** Provides 1/4 VGA signal to external monitor (CRT or LCD).
- **Ethernet Interface (ML2490A).** 10/100BaseT LAN interface, allows remote control direct from a PC or local/ wide-area network using dynamic (automatic) or static IP assignment.

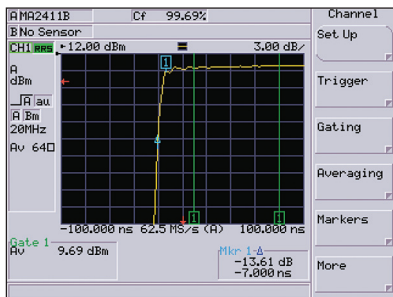
## Select the optimum Power Meter for your application

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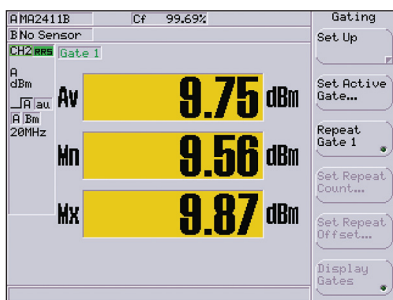


### ML2430A Series

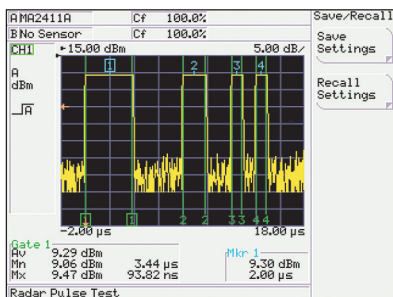
- **Fully-Featured General Purpose Power Meter.** Ideal for CW applications, offering a combination of speed, accuracy and flexibility in a low cost package.
- **Designed for Field Applications.** Portable and rugged splash-resistant chassis design handles the roughest field treatment. Add a front panel cover and soft case for further protection. There is also an optional NiMH battery, providing six hours continuous operation.
- **Graphics Display.** Provides graphical display of pulsed power or TDMA signals, displaying individual time slots. Frame triggering allows the user to measure the average power across a time slot.



High resolution for observing fast rising-edge signals.



Accurate CW measurements.



Examine pulses in detail and capture the entire pulse train.

## Radar Systems

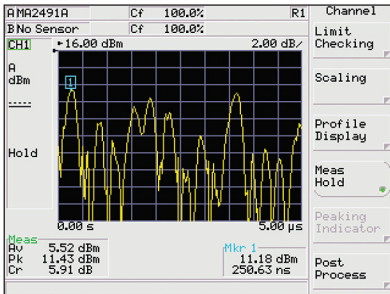
The high bandwidth and sample rate of the ML2490A provide accurate peak measurements on a variety of radar, radio-navigation and radio-location systems.

The ML2490A series has a number of features tailored for peak power measurement on pulsed systems. With a typical 8 ns rise-time, and a 1 ns resolution on the measurement, the ML2490A power sensor has the performance to look at the rising-edge of radar signals.

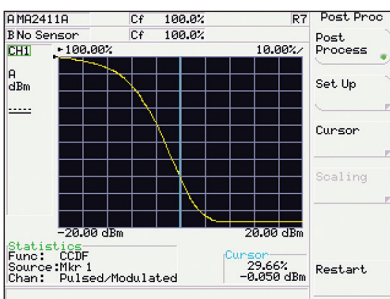
Another benefit of the power meter is that it can be easily set up to trigger on a pulse or sequence of pulses. Users can set up to four independent gates to measure the average, max, and min powers on a sequence of pulses. The data for the max and min includes the timestamp and gives the user automatic display of the position and value of the maximum overshoot and minimum undershoot in each pulse.

## Additional functionality highlights of the ML2490A power meter:

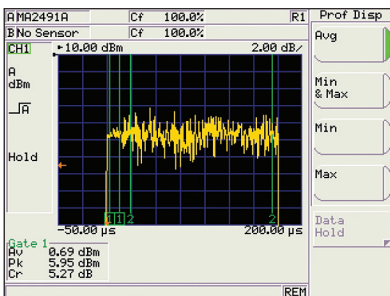
- Automatic marker functions provide pulse rise-time, fall-time, off time and Pulse Repetition Interval (PRI). A delta marker can be set up to measure the droop of the pulse top.
- Trigger event display is available as either arrows on the border of the screen or as an adjustable trigger event waveform. All timings for the gates and markers are taken from the trigger event.
- Read true output power – The offset table function corrects the power meter reading when the power meter is being used with a coupler or high power attenuator in a radar test system.



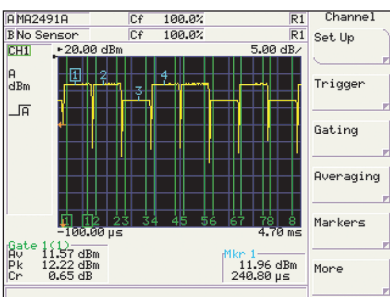
Determine signal crest factor with ease.



Built-in statistical analysis tool.



Measurement gates and markers for observing precise sections of the signal.



EDGE and GPRS measurements made simple.

### OFDM-based Solutions

OFDM-based technologies are playing an increasingly significant role in the design and installation of high-speed networks.

The ML2490A series has been designed to meet the challenge of today's fast-paced technology change. Users can measure the peak power of wideband OFDM systems (such as WLAN, WiMAX, and LTE) and configure the display to measure average and peak power. CCDF, CDF and PDF statistical functions for OFDM measurements are also available. Dithered sampling ensures accurate measurements on wideband, high-data rate carriers when continuously transmitting.

The wide bandwidth of the signal channel allows for precise placement of measurement gates. Users can hone in their analysis by taking advantage of the multiple gate facility and measuring precise sections of the signal, such as the OFDM training sequence at the start of the 802.11g signal and the data payload section. Or users can take advantage of a built-in preset to instantly set up and measure continuous OFDM signals.

### 3G CDMA Systems

Designed to measure the peak power of all the major CDMA systems in the world, the ML2490A series covers all your requirements, including those associated with Time Division Duplexing such as TD-SCDMA.

Users can configure the display to measure average and peak power as well as 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.

### GSM/EDGE/GPRS Systems

For GSM systems, 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 a pass or fail indication. The display shows the results from the active gate, indicating the average power within the burst.

### Amplifier Measurements

Power amplifiers designed for peak applications, whether pulsed or CDMA, cannot operate at full peak power under CW test conditions. The gain and output power can only be measured accurately using a peak power meter under representative conditions.

For the precise characterization of amplifier output power and gain, the ML2438A/88B/96A power meters are true dual channel meters, with two independent signal channels that eliminate the need for multiplexing. Gain and output power are measured simultaneously. Fast responding diode sensors respond immediately to changes in power level to reduce total test time.

With the ML2496A users can also make Power-Added Efficiency (PAE) measurements. The amplifier bias voltage can be entered manually or over GPIB and the bias current can be measured using a current probe connected directly to the power meter.

### Return Loss Measurements

Take advantage of the power meter's dual inputs to measure the return loss of an amplifier under correct operating conditions.

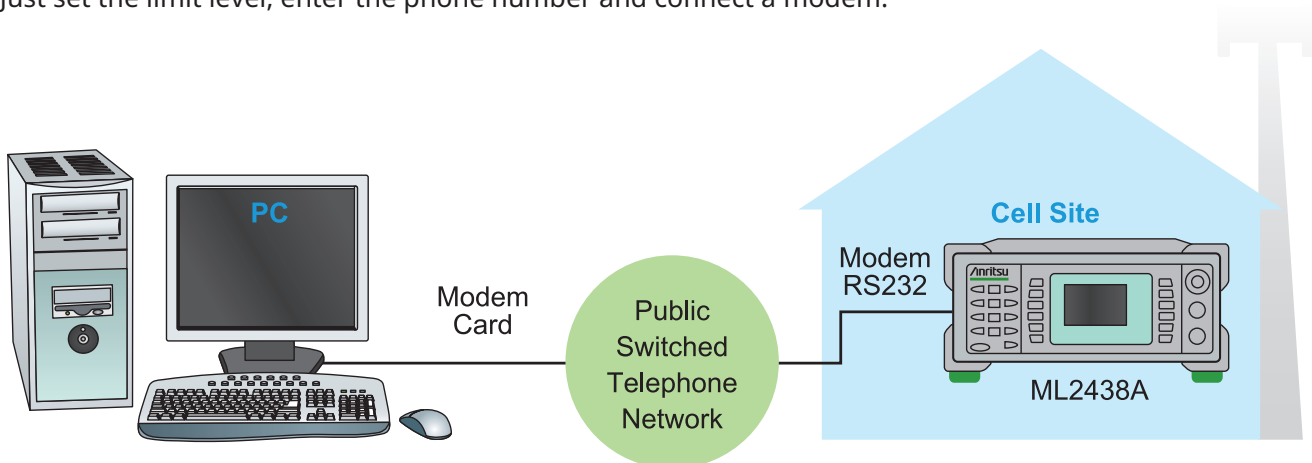
### Frequency Sweep and Power Sweep

The Anritsu ML2400A series of power meters are designed to function with Anritsu MG3690C synthesized generators to form an integrated test solution for swept power and frequency measurements.

The MG3690C requires Analog Sweep Option 6 to be fitted for this function.

### Remote Monitoring

The ML2430A series automatically calls a pre-entered phone number whenever a limits threshold is exceeded. Just set the limit level, enter the phone number and connect a modem.



The ML2430A's data acquisition settings can also adjust to monitor average power or the burst power of specific timeslots. The RS232 port uses the same commands as the GPIB.

## Features loaded into every Power Meter

### Dual Display Channel

Each display channel in the Anritsu ML2490A Power Meter is a measurement set up and can use any selection or combination of the sensor inputs. View one display channel or two. Switch between display channels quickly via the front panel hard 'hot' key. The user can also choose to view the measurement results as a graph profile or numerical readout.

### Sampling Modes

The ML2490A series power meter automatically chooses between continuous (time capture above 3.2  $\mu$ s) or repetitive (50 ns to 3.2  $\mu$ s) sampling to build the trace to 1 ns settable display resolution. The user may also opt to adjust the sample rate directly.

### Test Limits

- A simple power limit can be set up for many applications to test the upper and/or lower boundaries of the signal.
- A time varying limit line can be set up for pulsed systems such as radar, TDMA cellular systems or WLAN to test all aspects of the pulse profile.

### Set-up Recall

Conveniently recall application-specific measurement set-ups.

### Secure Mode

The power meter series have a secure mode for operation in security sensitive environments. On activation, the secure mode wipes all information stored in the non-volatile RAM on power up.

### GPIO

Comprehensive c-ommand-set for full functionality over GPIO.

### RS232

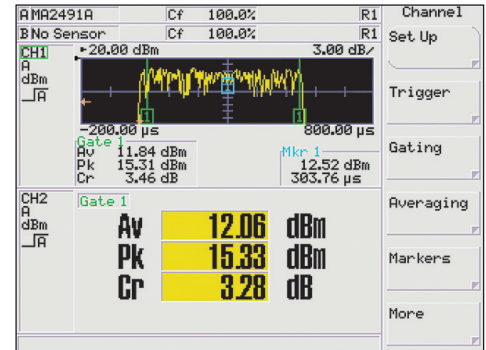
For control and firmware updates.

### Analog Voltage Input

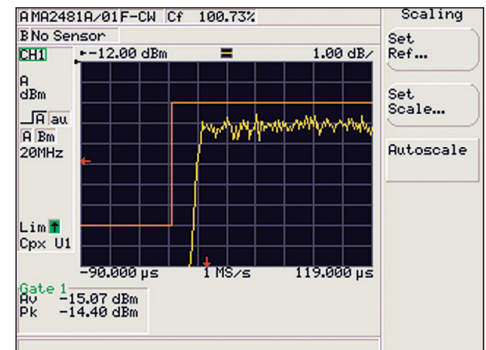
Measures voltage or accepts the V/GHz signal from a synthesiser for automated sensor calibration factor correction or Power Added Efficiency (PAE) measurements.

### Analog Outputs

Supports corrected and scaled measurements or real-time dual channel output. Synthesiser interface controls include zero blanking.



Flexible measurement display.



Time-varying limits, user-defined or Preset.

## PowerMax™ – PC remote user interface

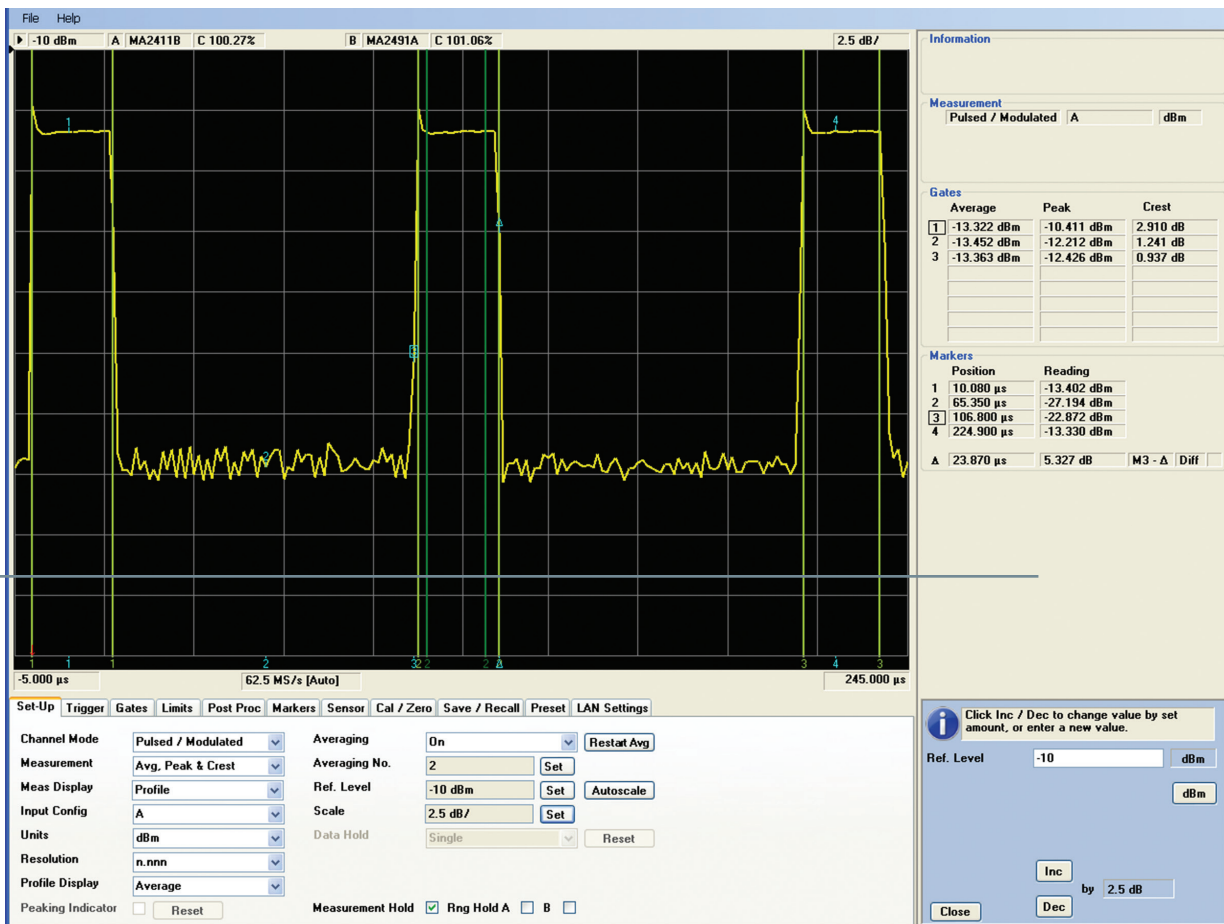
PowerMax™ is a free graphical user-interface software program, for the ML2490A Power Meter\* series. PowerMax runs on a standard PC\*\* and communicates with the power meter via an Ethernet interface.

PowerMax provides an enhanced visualization of an instrument display and simplified remote control, allowing:

- Continuous view of measurement traces in real-time
- Multiple gates and markers readings displayed at-a-glance
- Archiving or printing of data and plots for future analysis



Ethernet software for use with the ML249xA power meter



## PowerSuite™

Free software is available for ML243xA power meters to -continuously view measurement traces on the PC in real-time or archive data and plots for future analysis. PowerSuite runs on a standard PC\*\* via GPIB or RS232.

\*Requires firmware v2.20 or greater.

\*\*For PC requirements, see Technical Datasheet

## Discover a comprehensive range of Power Sensors



The Anritsu family of power sensors designed to cover a wide range of measurement applications.



### Power Sensors for every application

Anritsu's power sensors have been designed with just one thing in mind: everything. The range of sensors provide frequency coverage to 50 GHz, with dynamic range up to 90 dB, and includes both diode and thermal based technologies.

The Anritsu diode-based sensors offer speed, sensitivity, and dynamic range with designs using half- or full-wave diode rectifiers constructed from zero-bias Schottky diodes. The rectifier output is low-pass filtered, forming an envelope detector. This post-detection bandwidth is sometimes referred to as the video bandwidth and is a measure of how quickly the power sensor can respond to a changing input signal, such as a radar pulse or a multi-carrier OFDM signal.

### Pulse and Wideband Sensors: MA2490/91A and MA2411B

The MA2490A and MA2491A have been designed as dual-purpose, wideband and CW sensors. An FET switch is used to chop the signal from the sensor, to improve stability at low power levels, in CW mode. These sensors have 20 MHz video bandwidth (and 18 ns rise-time in the pulse modulated mode), and can be used to make average and peak power factor measurements on signals with rapid amplitude change, such as those in 3G/4G, WLAN, WiMAX and radar systems.

The MA2411B pulse sensor has been specifically designed for a wide video bandwidth of 50 MHz, providing a fast rise-time of better than 8 ns. This power sensor does not contain a FET switch for low-level CW applications. Use this sensor for the most demanding rising-edge measurements, such as radar and OFDM, multi-carrier signals.

### Standard Diode Sensors: MA2470D

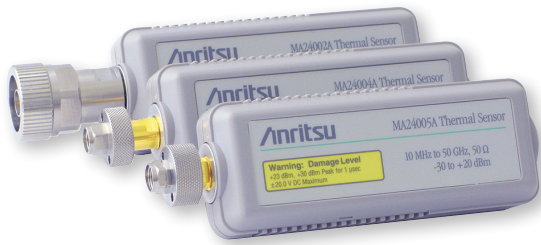
Designed for high dynamic range, high accuracy CW and TDMA measurements, these power sensors have 90 dB dynamic range and linearity better than 1.8%. This makes them the choice for precision measurements. The rise-time of these sensors is fast enough for power measurements on GSM and similar TDMA systems that use GMSK modulation.

### High Accuracy Diode Sensors: MA2440D

With its built in 3 dB attenuator, the MA2440D sensors minimize input VSWR. They are typically used when high measurement accuracy is required over a large dynamic range, for example when measuring amplifiers. High accuracy diode sensors have a dynamic range of 87 dB compared to the 90 dB of standard diode sensors. In all other respects, the performance of the sensors is identical to the standard diode sensor.

### Universal Power Sensors: MA2480D

The MA2480A series are true RMS sensors with a dynamic range of 80 dB. These power sensors are modulation independent and can be used for average power measurements on a wide variety of signals, including multi-tone or W-CDMA signals. The sensor architecture consists of three pairs of diodes, each one configured to work in its square law region over the dynamic range of the sensor. Option 1 provides TDMA measurement capability, calibrating one of the diode pairs for linearity over a wide dynamic range.



### Thermal Power Sensors: MA24000A

The Anritsu MA24000A series thermal sensors provide excellent power measurement accuracy over 50 dB of dynamic range. Thermal sensors use Seebeck elements, where the combined effect of a thermal gradient and charge migration between dissimilar metals gives a true reading of the average power of any incident waveform. Anritsu thermal sensors have class leading SWR and a built

### Sensor EEPROM

The family of Anritsu power sensors store calibration data and model information within internal EEPROMS. User calibration factor tables allow frequency points or compensation for test system loss, including that from couplers and attenuators.

#### High Power Applications

Traditional high-power sensors are expensive and have degraded accuracy specifications. Having additional specialized sensors lead to more annual calibrations requiring more down time and expense. Using user calibration factor tables coupled with a precision high power attenuator avoids these problems and eliminates the need for specialized, high-power. Users can easily reduce operating costs and save time:

- Compensation can be made for any precision attenuator or coupler by entering frequency and attenuation values into the user calibration factor table in the internal EEPROM.
- The attenuation device can be semi-permanently attached. The power meter automatically applies compensation during the 0.0 dBm, 50 MHz calibration reference process.
- User calibration factor tables are easily deactivated – allowing the power sensor to be used as a stand-alone device.
- Up to six tables can be stored.

### Sensor and Power Meter Selection

Sensors	Standard Diode	(High Accuracy) Diode	Universal	Wideband	Pulse	Thermal
	MA2470D Series	MA2440D Series	MA2480D Series	MA249XA Series	MA2411B	MA2400xA
Power Measurement	Average (RMS)	Average (RMS)	Average (RMS)	Average (RMS), Peak	Average (RMS), Peak	Average (RMS)
Measurement Application (Examples)	CW, GMSK, GFSK, 8PSK	CW, GMSK	CW, GMSK, GFSK, 8PSK, QPSK, QAM	CW, GMSK, 8PSK, QPSK, QAM	Pulse, QAM	Any modulation
	TDMA, FDMA, IS136	TDMA, FDMA	TDMA, FDMA, CDMA, OFDM, Radar	TDMA, FDMA, CDMA, OFDM, Radar	Radar, OFDM	Any access scheme
Compatible Power Meters	ML24xxA/B	ML24xxA/B	ML24xxA/B	ML2490A	ML2490A	ML24xxA/B

## Ordering information

### Power Meter Models

ML2495A	Pulse Power Meter, Single Input
ML2496A	Pulse Power Meter, Dual Input
ML2437A	CW Power Meter, Single Input
ML2438A	CW Power Meter, Dual Input

### ML2490A Series

ML2400A-05	Front Bail Handle
ML2490A-06	Rear Mount Input A on ML2495A
ML2490A-07	Rear Mount Input A and Reference on ML2495A
ML2490A-08	Rear Mount Inputs A, B and Reference on ML2496A
ML2490A-09	Rear Mount Inputs A, B on ML2496A
ML2490A-98	Calibration to Z540, ISO Guide 25
ML2490A-99	Premium Calibration

113000-00239-ja Programming Manual: Japanese (soft copy only)

13000-00164 Maintenance Manual ML2490A (hard copy)

13000-00238 Operation Manual ML2490A (hard copy)

13000-00238-ja Operating Manual: Japanese (soft copy only)

13000-00239 Programming Manual ML2490A (hard copy)

13000-00239-ja Programming Manual: Japanese (soft copy only)

Options 5, 2400-82, and 2400-83 are mutually exclusive for any given ML2490A.

Options 6, 7, 8 and 9 are mutually exclusive for any given ML2490A.

### ML2430A Series

ML2400A-05	Front Bail Handle
ML2400A-06	Rear Mount Input A on ML2437A
ML2400A-07	Rear Mount Input A and Reference on ML2437A
ML2400A-08	Rear Mount Inputs A, B and Reference on ML2438A
ML2400A-09	Rear Mount Inputs A and B on ML2438A
2000-1603	NiMH Battery
2000-996-R	Desktop Battery Charger with Power Supply
2000-1534-R	Desktop Battery Charger (for use in Japan only)
2000-1538-R	3m Sensor Cable
2000-1539-R	5m Sensor Cable
2000-1540-R	10m Sensor Cable
2000-1541-R	30m Sensor Cable
2000-1542-R	50m Sensor Cable
2000-1543-R	100m Sensor Cable
2000-1545	Bulkhead Adapter
10585-00001	Operation and Programming Manual ML2437/8A (hard copy)
10585-00001-ja	Operation and Programming Manual: Japanese (soft copy only)
10585-00003	Maintenance Manual ML2400A Series (hard copy)
ML2400A-98	Calibration to Z540, ISO Guide 25
ML2400A-99	Premium Calibration
ML2400A-30A	Option 30, Operation/Prog Manual (for use in Japan only)

Options 5, 2400-82, and 2400-83 are mutually exclusive for any given ML2430A unit.

Options 6, 7, 8 and 9 are mutually exclusive for any given ML2430A unit.

### Standard Accessories

PowerMax (ML249xA only)

PowerSuite (ML243xA only)

Power Cord for destination country

One 1.5 m sensor cord per meter input

Operation Manual (soft copy only; hard-copy available for order)

Programming Manual (soft copy only; hard-copy available for order)

Certificate of Calibration (also included with sensors)

### General Options and Accessories

760-209	Hardside Transit Case
D41310	Soft Carry Case with Shoulder Strap
2400-82	Rack Mount, single unit
2400-83	Rack Mount, side-by-side
2000-1535	Front Panel Cover
2000-1536-R	0.3m Sensor Cable
2000-1537-R	Spare 1.5m Sensor Cable
2000-1544	RS232 Bootload Cable

### Power Sensor Models

MA2472D	Standard Diode Sensor (10 MHz to 18 GHz, -70 dBm to 20 dBm)
MA2473D	Standard Diode Sensor (10 MHz to 32 GHz, -70 dBm to 20 dBm)
MA2474D	Standard Diode Sensor (10 MHz to 40 GHz, -70 dBm to 20 dBm)
MA2475D	Standard Diode Sensor (10 MHz to 50 GHz, -70 dBm to 20 dBm)
MA2442D	High Accuracy Diode Sensor (10 MHz to 18 GHz, -67 dBm to 20 dBm)
MA2444D	High Accuracy Diode Sensor (10 MHz to 40 GHz, -67 dBm to 20 dBm)
MA2445D	High Accuracy Diode Sensor (10 MHz to 50 GHz, -67 dBm to 20 dBm)
MA2481D	Universal Sensor (10 MHz to 6 GHz, -60 dBm to 20 dBm)
MA2482D	Universal Sensor (10 MHz to 18 GHz, -60 dBm to 20 dBm)
MA2490A	Wideband Sensor (50 MHz to 8 GHz, -60 dBm to 20 dBm)
MA2491A	Wideband Sensor (50 MHz to 18 GHz, -60 dBm to 20 dBm)
MA2411B	Pulse Sensor (300 MHz to 40 GHz, -20 dBm to 20 dBm)
MA24002A	Thermal Sensor (10 MHz to 18 GHz, -30 dBm to 20 dBm)
MA24004A	Thermal Sensor   (10 MHz to 40 GHz, -30 dBm to 20 dBm)
MA24005A	Thermal Sensor (10 MHz to 50 GHz, -30 dBm to 20 dBm)

See your Anritsu representative or components catalogue for available attenuators, limiters, coaxial adapters, waveguide-to-coaxial adapter, splitters and dividers, loads, bridges, open/shorts, and calibrated torque wrenches.

For complete power meter and sensor specifications; technical datasheet p/n: 11410-00423.

Software upgrades, drivers and application notes can be downloaded from the Anritsu web site at [www.anritsu.com](http://www.anritsu.com)

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Anritsu utilizes recycled paper and environmentally conscious inks and toner.



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