ML2400A Power Meters & MA2400A/D Sensors

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

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 Wide-band 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.

With six different families of Power Sensors (including USB sensor) to choose from, you can trust you’ll find the right combination for precision power measurement, whatever your application.

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 Multiplex (OFDM) signals.

- **High Speed Sampling.** Up to 1 Gs/s sample rate produces accurate profiles of radar, W-CDMA, WLAN/WiMAX and latest generation cellular systems. Displays peak, average and crest factor of any input signal.

- **Trigger.** Comprehensive facilities offer 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, PRI.

- **External Video.** Provides 1/4 VGA signal to external monitor.

- **Ethernet Interface.** 10/100BaseT LAN Interface, allows remote control direct from a PC or Local/Wide-area network using Dynamic (Auto) or Static IP assignment.
Select the Optimum Power Meter for Your Application

ML2480A Series

- **20 MHz Instrument Bandwidth.** Designed for accurate peak and average power measurements on 3G (W-CDMA), WLAN and WiMAX technologies.

- **Continuous Wave (CW) Meter Mode.** High accuracy and high dynamic range CW power measurements—the 50 MHz/1 GHz calibrator calibrates all Anritsu sensors. Frequency is automatically selected.

- **Soft Keys.** Menu-driven operation simplifies test procedures.

- **Preset.** Built-in measurement set-ups for widely available wireless systems such as GSM, W-CDMA, WLAN and Bluetooth.

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.
Radar Systems

The high bandwidth and sample rate of the ML2480A and ML2490A provide accurate peak measurements on a variety of radar, radio-navigation and radio-location systems.

The ML2480A and ML2490A series has a number of features tailored for peak power measurement on pulsed systems. With a typical 8 ns rise time, and a 1ns resolution on the measurement, the ML2490A and MA2411B power sensor have 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.

Here are some more functionality highlights of ML2480A and ML2490A power meters:

- Automatic marker functions provide pulse rise time, fall time, off time and Pulse Repetition Interval. A delta marker can be set up to measure the droop of the pulse top.
- Trigger event display is available in the ML2490A 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.
Measurement Solutions for High-Speed Wireless Systems

WLAN / WiMAX Solutions

WLAN and WiMAX technologies are playing an increasingly significant role in the design and installation of high-speed networks. What’s more, these transmission technologies have developed faster than the traditional power meter, leaving users with inaccurate power measurements.

The ML2480A and ML2490A series have been designed to meet the challenge of today’s fast-paced WLAN and WiMAX technologies. Users can measure the peak power of current and future wideband OFDM systems (such as 802.11a/g and 806.16) and configure the display to measure Average, Peak and Crest Factor.

Dithered sampling ensures accurate measurements on wideband high data rate carriers under continuous transmission.

Users will no longer need to manually apply correction for peak power readings because the wide 65 MHz and 20 MHz video bandwidth enables high accuracy peak power measurements on the most demanding power envelope conditions.

Also, the wide bandwidth of the signal channel allows for accurate placement of the measurement gates. Users can hone in their analysis by taking advantage of the multiple gate facility and measuring precise selections of the signal such as the OFDM training sequence at the start of the 802.11g signal and the data payload section.

Other functions users can take advantage of:
- A built-in preset to instantly set up and measure continuous OFDM.
- CCDF, CDF and PDF supported statistical functions on the OFDM measurements.
Making GSM/EDGE/GPRS measurements as easy as 1, 2, 3

GSM/EDGE/GPRS Systems

The straightforward and seamless combination of the graphical display and the measurement gates makes GSM and PCS systems measurements so easy to take, it’s elementary.

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.

GPRS and GSM test modes take advantage of the power meter’s multiple gates. Users can repeat a GSM gate pattern up to eight times – allowing the power meter to capture and read back the power from each of the slots – giving up to eight simultaneous measurements.

Making EDGE measurements has never been easier or faster. The power meter’s high sample rate leads to improved settling time. And the use of the trigger hold-off facility prevents re-triggering on the symbol transitions. What’s more, PHS and IS136 systems can also be measured in this way – just as fast, and just as effective.

3G CDMA Systems

Designed to measure the peak power of all the major CDMA systems in the world, the ML2480A and ML2490A series covers all the system bases, including those that use Time Division Duplexing such as TD-SCDMA.

Users can configure the display 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.

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

The ML2480A and ML2490A series also allow the user to:

- See the actual power envelope variations in the signal via the high-speed profile display.
- Measure gain and output power of the amplifier under CDMA transmission conditions through the ML2488A dual input (in ratio mode).
- Leverage the wide bandwidth of the MA2411B and M2490/91A sensors and the power meter to easily measure multiple channel carriers in an allocated spectrum block.
Amplifier Measurements
Power amplifiers designed for peak applications, whether pulsed or CDMA, cannot operate at full peak power with CW test inputs. 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 ML2438/88/96A power meters are true dual channel meters, with two independent signal channels that eliminate multiplexing. Gain and output power are measured simultaneously. And fast responding diode sensors respond immediately to changes in power level to reduce total test time.

With the ML2496A and ML2488A 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 MG3690B synthesised generators or sweepers to form an integrated test solution for swept power and frequency measurements.

The MG3690B 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. Contact your Anritsu representative for PC-compatible software.
Dual Display Channel
Each display channel in the Anritsu ML2480/90A 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 µs) or repetitive (50 ns to 3.2 µs) sampling to build up the trace to 1 ns settable display resolution. The ML2480A provides up to 64 MS/s sampling with resolution of 16 ns. 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 phone systems or WLAN and tests all aspects of the pulse profile.

Settings Stores
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.

GPIB
Comprehensive command-set for full functionality over GPIB.

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).

Analog Outputs
Support corrected and scaled measurements or real-time dual channel output. Synthesiser interface controls include zero blanking.
PowerMax™ is a free graphical user-interface software, for the ML249xA Power Meter* series. PowerMax runs on a standard PC running Windows® 95 (or higher), and communicates with the power meter via Ethernet interface.

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

For PC requirements, see Technical Datasheet

PowerSuite™

Free software available for ML243xA and ML248xA 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 running Windows® 95 (or higher), via GPIB or RS232.

*Requires Anritsu ML249xA Wideband Peak Power meter, with firmware v2.20 or greater.
The sensors employ diodes and offer greater speed, sensitivity and dynamic range than thermal sensors. The sensors are based on 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, peak and crest measurements on signals with rapid amplitude change such as W-CDMA, WLAN, WiMAX and radar.

The pulse sensor MA2411B has been specifically designed for a wide video bandwidth of 65 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 wideband measurements on 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% making 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 minimizes input VSWR and are best used where the best 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 can be used for average power measurements on 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.

Sensor EEPROM

All MA2400A/D Series Power Sensors through 50 GHz store calibration data and model information within internal EEPROMS. The user calibration factor tables allow extra frequency points or compensation for couplers and power attenuators.

High Power Applications

Traditional high power sensors are expensive and have degraded accuracy specifications. What’s more, annual calibrations require more time and expense. Using the new User Calibration Factor Tables avoids these problems. They can easily reduce operating costs and save time:

- Any attenuator or coupler can be compensated by entering frequency and attenuation values into 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

<table>
<thead>
<tr>
<th>Sensors</th>
<th>Standard Diode</th>
<th>(High Accuracy) Diode</th>
<th>Universal</th>
<th>USB</th>
<th>Wideband</th>
<th>Pulse</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA2470D Series</td>
<td>MA2440D Series</td>
<td>MA2480D Series</td>
<td>MA24106A</td>
<td>MA249XA Series</td>
<td>MA2411B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Measurement</td>
<td>Average (RMS)</td>
<td>Average (RMS)</td>
<td>RMS</td>
<td>Average (RMS)</td>
<td>Average (RMS), Peak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Application (Examples)</td>
<td>CW, GMSK, GFSK, 8PSK</td>
<td>CW, GMSK</td>
<td>CW, GMSK, GFSK, 8PSK, QPSK, QAM</td>
<td>Any</td>
<td>CW, GMSK, 8PSK, QPSK, QAM</td>
<td>Pulse, QAM</td>
<td>Modulation</td>
</tr>
<tr>
<td>Compatible Power Meters</td>
<td>ML24xxA</td>
<td>ML24xxA</td>
<td>ML24xxA</td>
<td>Only requires PC with Windows 2000/XP, USB 2.0</td>
<td>ML2480A, ML2490A</td>
<td>ML2480A, ML2490A</td>
<td></td>
</tr>
</tbody>
</table>

Choose the right sensor and meter for your measurement application.
MA24106A power sensor is a highly accurate instrument that communicates with a PC using the Universal Serial Bus interface (USB). Its measurement capability mimics a traditional thermal (thermo-electric) power sensor, but has a wider dynamic range. Therefore, the MA24106A is ideal for measuring average (true RMS) power of any signal type or bandwidth, e.g. CW, multi-tone, and modulated RF waveforms such as 3G, 4G, and OFDM.

- True RMS detection over a 63 dB dynamic range enables accurate CW and modulated power measurements
- Wide variety of applications including installation & maintenance, manufacturing, R&D.
- High damage power levels (+33 dBm) and ESD protection (3.3 kV) provides ruggedness and reliability
- Low current consumption (100 mA) preserves laptop battery life
- Eliminating the need for a reference calibrator reduces test time and handling in production
- One year calibration cycle and worldwide service centers ensure reduced downtime
- Compatible with Spectrum Master, VNA Master, BTS Master, and Economy Benchtop Spectrum Analyzer (MS271xB).
The sensor employs a “dual-path” architecture to achieve 63 dB of dynamic range. Highly accurate modulation measurements are facilitated by keeping the diode detectors in the “square law region” and by choosing the output of the appropriate detector path. A built-in attenuator provides excellent SWR performance thus minimizing mismatch error. The presence of a microcontroller along with signal conditioning circuitry, ADC, and power supply in the sensor makes it a complete miniature power meter. The Anritsu Power Meter application for personal computers running Microsoft® Windows® can be used to control and operate the sensor providing the user with a familiar power meter interface with advanced features.

Rugged for Field Use

The MA24106A power sensor provides lab performance accuracy in a rugged and portable field solution. Measurement accuracy over a wide temperature range is maintained by internally stored calibration factors with temperature compensation, thus making it perfect for base station installation and maintenance applications. Field and service technicians will appreciate the small size and light weight as they can carry it in their shirt pocket or laptop case. A very easy to use PC application with a large display makes operation straightforward for users with limited training. The high damage level (+33 dBm) and ESD protection (3.3 kV) provides ruggedness to this high performance sensor. Since the MA24106A is a low power device, laptop battery life is preserved.

Fast and Flexible for Production

The MA24106A facilitates lab quality measurements on the production floor for a fraction of the cost of traditional power meters. Valuable rack space is saved since the sensor is connected directly to a PC, eliminating the need for a bench top power meter. Sensor speed is optimized for best accuracy and noise performance making it suitable for a wide variety of ATE applications. Multiple sensors can be connected and remotely controlled via a single PC allowing flexibility to match specific measurement needs. The reference calibrator typically needed by power meters has been eliminated, minimizing test station complexity, sensor handling and reducing test times.

The offset table provides the ability to correct for the frequency response of RF devices present between the sensor and the DUT, thus providing better accuracy than just using a fixed offset. A simple interface allows entry of different offset values versus frequency. An unlimited number of offset tables can be stored on a PC’s hard disk and easily recalled. The offset table employs linear interpolation to estimate offset correction for frequencies between user specified entries.
The MA24106A is an ideal general purpose R&D tool due to its low cost, ability to measure True RMS power on a variety of RF waveforms, wide dynamic range, and power accuracy regardless of modulation bandwidth. Its compact size makes it an alternative to traditional bench top instruments. Accuracy is assured because the calibration data is stored directly in the sensor and all necessary corrections (frequency and temperature) are done internally. The standards used to calibrate this sensor are directly traceable to NIST and periodic calibrations are supported by Anritsu’s service centers worldwide.

The Anritsu Power Meter software provides an intuitive interface to control the sensor, with advanced features such as average power versus time display. Multiple instances of the PC application can be started to make measurements using several sensors to support sophisticated test setups.

The power graph plots power with respect to time. It is useful for drift testing, circuit tuning, or circuit monitoring as external stimuli are changed. The graph is continuously updated in real time at ten measurements per second.

Data logging is also available for recording power versus time to a hard disk or other storage media. This is useful for long term drift studies, environmental testing, and trend analysis. A user defined logging interval allows acquisition speed to match test requirements. Data are stored as a comma separated value (.csv) that can be opened in Microsoft® Excel® facilitating custom analysis.
**Ordering Information**

### 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

#### ML2490A Series

- **ML2490A-06** Rear Mount Input A on ML2495A
- **ML2490A-07** Rear 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-37** Electronic Manuals (deletes paper version from shipment)
- **ML2490A-98** Calibration to Z540, ISO Guide 25
- **ML2490A-99** Premium Calibration
- **13000-00238** Extra Operating Manual
- **13000-00239** Extra Programming Manual

#### ML2490A-37 Electronic Manuals (deletes paper version from shipment)

- **ML2490A-98** Calibration to Z540, ISO Guide 25
- **ML2490A-99** Premium Calibration
- **13000-00238** Extra Operating Manual
- **13000-00239** Extra Programming Manual

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- **ML2490A-98** Calibration to Z540, ISO Guide 25
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#### ML2490A-99 Premium Calibration

- **ML2490A-06** Rear Mount Input A on ML2487A
- **ML2490A-07** Rear Input A and Reference on ML2487A
- **ML2490A-08** Rear Mount Inputs A, B and Reference on ML2488A
- **ML2490A-09** Rear Mount Inputs A, B on ML2488A
- **ML2490A-15** Factory Fitted 50MHz and 1GHz Calibrator (required by MA2411B Sensor)
- **ML2490A-15R** Retro Fit Calibrator Kit (for use in Japan only)
- **ML2490A-37** Electronic Manuals only (deletes paper version from shipment)
- **ML2490A-98** Calibration to Z540, ISO Guide 25
- **ML2490A-99** Premium Calibration
- **13000-00238** Extra Operating Manual
- **13000-00239** Extra Programming Manual

#### ML2490A-98 Calibration to Z540, ISO Guide 25

- **ML2490A-99** Premium Calibration
- **13000-00238** Extra Operating Manual
- **13000-00239** Extra Programming Manual

#### ML2490A-99 Premium Calibration

- **ML2490A-06** Rear Mount Input A on ML2437A
- **ML2490A-07** Rear Input A and Reference on ML2437A
- **ML2490A-08** Rear Mount Inputs A, B and Reference on ML2438A
- **ML2490A-09** Rear Mount Inputs A and B on ML2438A
- **ML2490A-11** NiMH Battery with Desktop Charger
- **ML2490A-11A** NiMH Battery with Desktop 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** Extra Operation and Programming Manual ML2437/8A
- **10585-00003** Maintenance Manual ML2400A Series
- **ML2400A-01** Rack Mount, single unit
- **ML2400A-03** Rack Mount, side by side
- **ML2400A-05** Front Bail Handle
- **ML2419A** Range Calibrator

#### ML2430A Series

- **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 on ML2438A
- **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)
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- **ML2419A** Range Calibrator

### Standard Accessories

- **PowerMax (ML249xA only)**
- **PowerSuite (ML243xA & ML248xA)**
- **Power Cord for destination country**
- **One 1.5m sensor cord per meter input**
- **Operation Manual**
- **Programming Manual**
- **Certificate of calibration (also included with sensors)**

### General Options and Accessories

- **760-209** Hardside Transit Case
- **D41310** Soft Carrying Case with Shoulder Strap
- **2000-1535** Front Panel Cover
- **2000-1536-R** 0.3m Sensor Cable
- **2000-1537-R** 1.5m Sensor Cable
- **2000-1538-R** 5m Sensor Cable
- **2000-1539-R** 10m Sensor Cable
- **2000-1540-R** 30m Sensor Cable
- **2000-1541-R** 50m Sensor Cable
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### 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, −80 dBm to 20 dBm)
- **MA2411B** Pulse Sensor (300 MHz to 40 GHz, −20 dBm to 20 dBm)
- **MA24106A** True-RMS USB power sensor (50 MHz to 6 GHz, −40 dBm to 20 dBm)

### General Options and Accessories (USB Sensor)

- **2000-1566-R** 1.8 meter USB A to Mini-B cable
- **2300-512** MA24106A Installation CD

### Available Options (USB Sensor)

- **MA24106A-097** Option 97, Accredited calibration
- **MA24106A-098** Option 98, Standard calibration to Z540, ISO Guide 25
- **MA24106A-099** Option 99, Premium calibration

For complete power meter and sensor specifications:
