# Power and Energy Measurement Overview

## Compatibility Chart for Our Most Popular Meters and Sensors

### POWER

**Meters**

LabMax-Pro

LabMax-TOP and -TO

FieldMate

FieldMaxII-TOP and -TO

Standard Mode

Standard Mode + High Speed

Standard Mode

Thermal SmartSensor Adapter

PowerMax-Pro

PM & PS Model Thermopile Sensors/OP-2 Model Optical Sensors

LM Model Thermopile Sensors/LM-2 Model Optical Sensors

**Sensors**

### ENERGY

**Meters**

LabMax-Pro

FieldMaxII-TOP and -P

LabMax-TOP

EnergyMax Pyroelectric Energy Sensors

**Sensors**

Power Meters compatible with PM & PS Model Thermopile Sensors

Power Meter compatible with LM Model Thermopile Sensors

Power Meters need the Thermal SmartSensor Adapter to use LM Model Thermopile Sensors

# LabMax-Pro SSIM

## Laser Power and Energy Meter




LabMax-Pro SSIM Laser Power and Energy Meter

**Features**

- **Laser power and energy meter**
- **Compatible with PowerMax-Pro and PM Model thermopiles**
- **High speed sampling for laser pulse analysis**
- **USB and RS-232 interfaces**
- **Windows PC application**
- **Direct host commands support OEM integration**
- **Windows 7 and 8 compatible (32 and 64-bit)**

The LabMax-Pro represents the next generation of Coherent's groundbreaking LabMax line. This power meter combines the power and versatility of the LabMax, with two new higher speed sampling modes when used with PowerMax-Pro technology. High speed mode increases the continuous sampling rate to 20 kHz, enabling analysis of laser pulse trains common in medical and microwelding applications. Snapshot mode provides burst sampling at a rate of 625 kHz, enabling users to view and analyze the temporal pulse trace of modulated lasers common in various commercial cutting, engraving and drilling applications.

In the traditional 10 Hz sampling mode, PowerMax-Pro sensors provide an instant power reading, much like a photodiode but at very high powers. Legacy thermopiles are also compatible with the 10 Hz sampling mode, just like in past meters.

The product includes a new Windows-based PC application that enables a wide range of analysis functions including statistics and histogram, trending, tuning, data logging, as well as a new ability to zoom in on detailed pulse shapes and pulse bursts using PowerMax-Pro technology. The software interface allows for flexible sizing of informational panes within the application, in which contents are auto-sized dynamically as the panes are adjusted, allowing the user to size the information of greatest importance.

Data is analyzed on the PC through USB or RS-232 interfaces through the Windows PC application, or directly through host commands. Since the LabMax-Pro interfaces via USB and utilizes Windows, the LabMax-Pro can be interfaced to tablets that operate on the Windows 8 platform. This unique capability gives users flexibility to display data and allow state-of-the-art color and touch screen displays.

In addition to PC interfacing, LabMax-Pro SSIM also includes an analog output with user-selectable voltages of 0 to 1V, 2V, or 4V. Triggering can be achieved with an external trigger input or an internal trigger that is user adjustable.

The meter is configured as a module for direct PC control and is compatible with PM model thermopiles and PowerMax-Pro sensors.

A sensor is just part of a measurement system, and can only deliver high quality data if it is matched with electronics to properly acquire, condition and process the raw signal from the sensor. Coherent has developed the LabMax-Pro SSIM laser power meter specifically to fully capitalize on the inherent capabilities of PowerMax-Pro sensors.

To minimize user cost and maximize flexibility, the LabMax-Pro is packaged as a Smart Sensor Interface Module (SSIM) that interfaces with a host computer through either USB or RS-232. LabMax-Pro PC, a new Windows PC application, then enables instrument control and displays measurement results, including laser tuning and pulse shape visualization, on a host computer. The software also performs a wide range


LabMax-Pro SSIM
Laser Measurement System

# LabMax-Pro SSIM

## Laser Power and Energy Meter

of analysis functions such as live statistics, histograms, trending and data logging. In addition, a complete set of host commands can be sent through either the USB or RS-232 interface which is particularly useful for embedded applications.

**High Speed Sampling for Pulse Visualization**
The standard operating mode of the LabMax-Pro SSIM utilizes a typical 10 Hz sampling rate. At this data rate, it allows PowerMax-Pro sensors to provide an instant power reading, much like a photodiode, but, of course, taking advantage of the sensor's ability to directly read very high powers. High volume processes that use high repetition rate or quasi-CW lasers, such as picosecond and femtosecond lasers, can benefit significantly from fast power measurements. Time currently spent monitoring the process with thermopiles can be spent processing parts, and with such rapid measurements, the process can be monitored more frequently. Instead of spending up to a minute or more taking a reading, the measurement can be performed in less than a second with PowerMax-Pro technology, enabling throughput improvement with very little engineering investment.

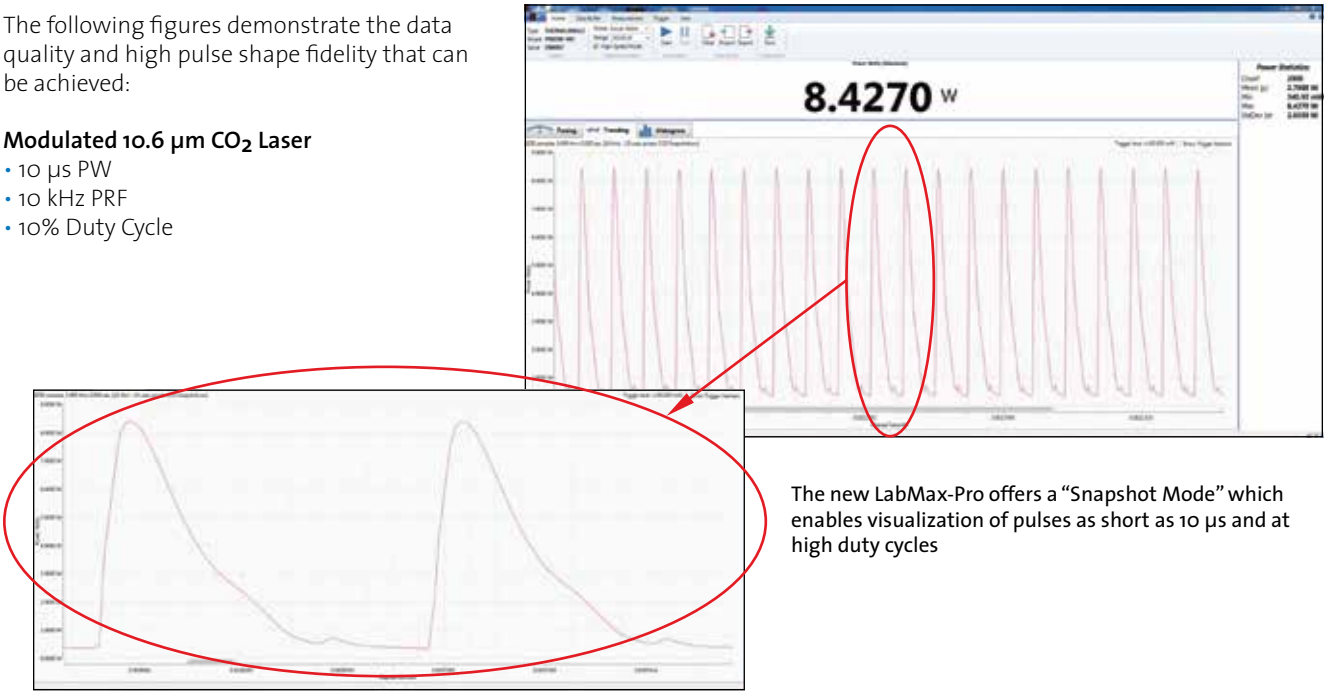
The standard operating mode is best used to measure the power of CW lasers, or the average power of high repetition rates lasers. Two High Speed sampling modes have been implemented in the meter electronics and software to fully exploit the rapid response speed of PowerMax-Pro sensors for measuring modulated lasers operating between these two extremes. These modes enable advanced analysis of high power, modulated lasers in a way that has never been possible before.

The first High Speed mode utilizes a continuous data sampling rate of 20 kHz, allowing pulse shape analysis of modulated lasers with repetition rates of up to 2 kHz. These types of pulse trains are common in many laser-based medical treatments and some materials processing applications such as micro welding.

The second High Speed mode is called "Snapshot Mode," which provides burst sampling at a rate of 625 kHz for a period of time up to 384 milliseconds. This is fast enough to enable visualization of the pulse shape of the modulated lasers common in various commercial cutting, engraving and drilling applications, as well as long pulses and pulse trains used in aesthetic medical applications. This type of temporal visualization offers new insight into the true performance of the laser previously masked by slow thermopiles.
This new informationIt provides developers with more repeatable methods to transfer processes from engineering to manufacturing and to control and monitor the process once it's up and running. Many thermal-based materials processing applications can be better controlled with this information, leading to faster processing with higher yield; at the same time, the quality of laser produced features can be enhanced.

The following figures demonstrate the data quality and high pulse shape fidelity that can be achieved:

**Modulated 10.6 µm $CO_2$ Laser**
- 10 µs PW
- 10 kHz PRF
- 10% Duty Cycle



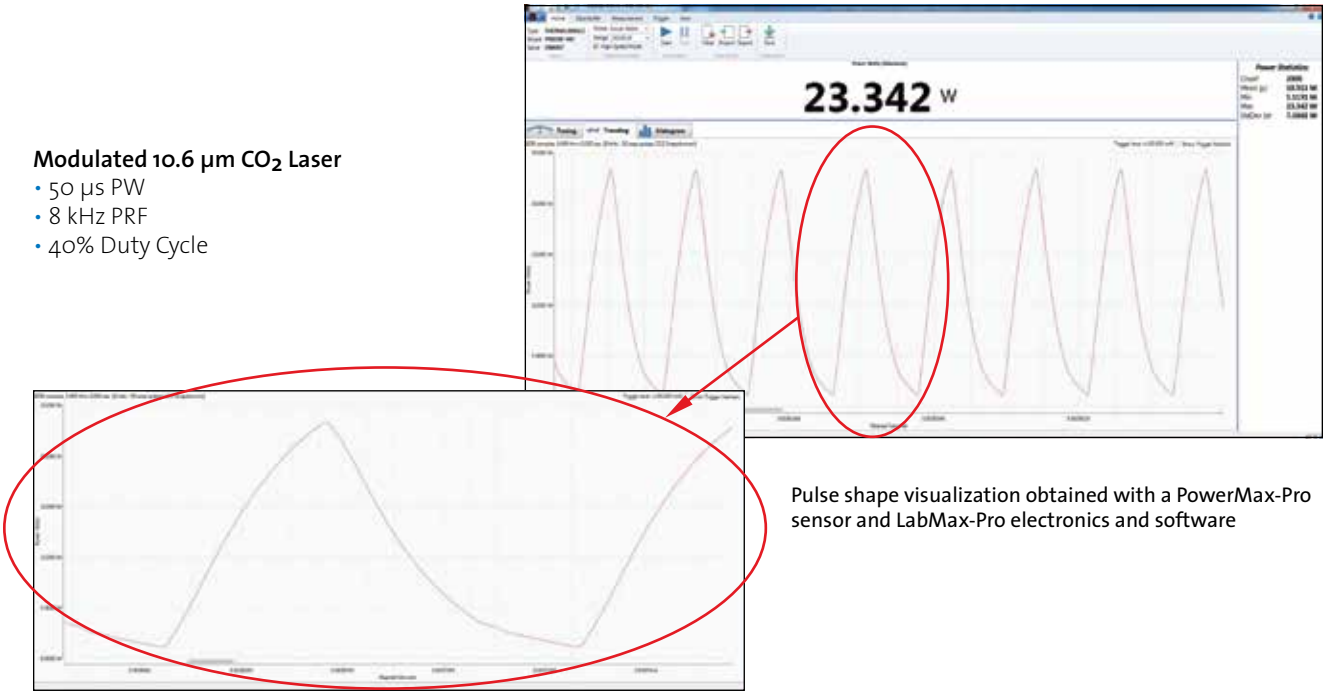

The new LabMax-Pro offers a "Snapshot Mode" which enables visualization of pulses as short as 10 µs and at high duty cycles

# LabMax-Pro SSIM

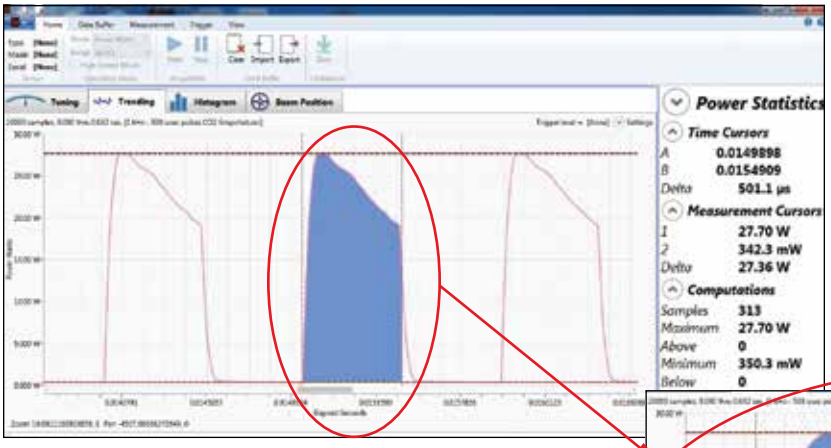
## Laser Power and Energy Meter



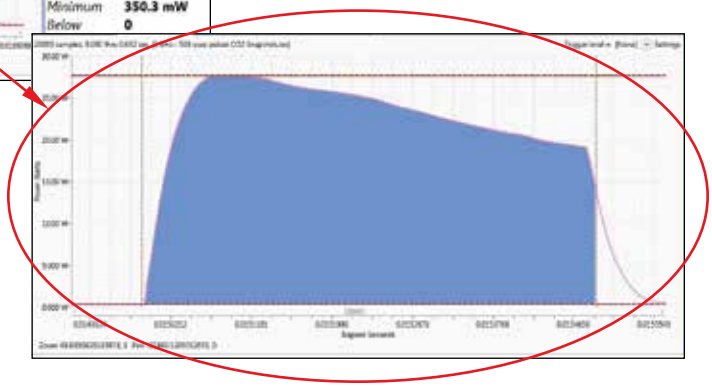
**Modulated 10.6 µm $CO_2$ Laser**
- 50 µs PW
- 8 kHz PRF
- 40% Duty Cycle




Pulse shape visualization obtained with a PowerMax-Pro sensor and LabMax-Pro electronics and software




**Modulated 10.6 µm $CO_2$ Laser**
- 500 µs PW
- 1 kHz PRF
- 50% Duty Cycle



Pulse shape visualization obtained with a PowerMax-Pro sensor and LabMax-Pro electronics and software

# LabMax-Pro SSIM

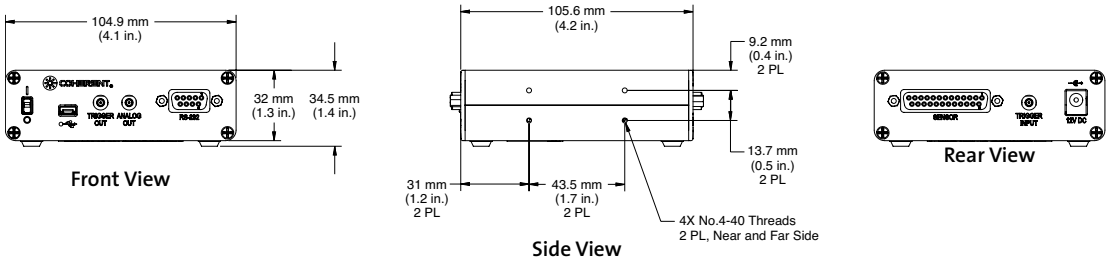
## Laser Power and Energy Meter

**Device Specifications**

| Model | LabMax-Pro SSIM |
|---|---|
| Measurement Resolution (%)(full-scale) | |
| at 10 Hz speed | 0.1 |
| at 20 KHz high speed | 0.2 |
| Sensor Compatibility | PM Model Thermopile; PowerMax-Pro; LM Model Thermopile, OP-2 & LM-2 Optical, DB-25 EnergyMax pyroelectric |
| Measurement Range | Sensor dependent (reference sensor specifications) |
| Accuracy (%) | |
| Digital Meter | ±1 |
| System | Meter + sensor |
| Analog Output | ±1 |
| Calibration Uncertainty (%)(k=2) | ±1 |
| Power Sampling Rate (Hz) | |
| Thermopile | 10 |
| PowerMax-Pro - Low Speed | 10 |
| PowerMax-Pro - High Speed | 20,000 |
| PowerMax-Pro - Snapshot Mode | 625,000 |
| Pyroelectric | 10,000 |
| LM-2/OP-2 Optical | 10 |
| Analog Output (VDC) | 0 to 1, 2, or 4.096 (selectable) |
| Analog Output Resolution (mV) | 1 |
| Analog Output Update Rate (kHz) | 19 |
| Measurement Analysis | Trending, tuning, histogram, data logging, statistics (min., max., mean, range, std. dev., dose, stability), pulse shape (with PowerMax-Pro in High Speed and Snapshot mode), long pulse Joules with thermopiles |
| Computer Interface | USB and RS-232 |
| Pulse Triggering | Internal and External |
| Temperature | |
| Operating Range | 5 to 40°C (41 to 104°F) |
| Storage Range | -20 to 70°C (-68 to 158°F) |
| Instrument Power (external supply) | 90 to 260 VAC, 50/60 Hz |
| Compliance | CE, RoHS, WEEE |
| Dimensions | 105 x 105 x 32 mm (4.1 x 4.1 x 1.3 in.) |
| Weight | 0.3 kg (0.6 lbs.) |
| Front Panel | Power switch<br>USB hi-speed port (mini B connector)<br>Trigger output (SMB connector)<br>Analog output (SMB connector)<br>RS-232 port (DB-9F connector) |
| Rear Panel | DB-25 sensor port<br>External trigger input (SMB connector, 3 to 5 Vin, 2 to 10 mA, 50 ohm AC, 300 ohm DC impedance)<br>Power jack (12VDC - center positive) |
| Part Number[1,2] | 1268881 |

[1] Meter supplied with AC power adapter, power cord, USB cable, trigger cable, software and driver CD, and certificate of calibration.
[2] OEM mounting and stacking hardware kit (Part Number 1268401) is available for purchase as an optional accessory.

**LabMax-Pro SSIM**



# LabMax Meters

## Laser Power and Energy Meters




LabMax-TOP Power and Energy Meter

### Features

- Measure power and energy
- Ergonomic design enhances user experience
- Directly compatible with PM Model and LM Model thermopiles
- Display beam position with LM Model thermopiles
- Log data to internal memory, directly onto USB flash drive, or to PC
- USB, RS-232, and GPIB PC interfaces
- Software:
  - LabMax PC applications software
  - LabVIEW instrument driver and ActiveX control
  - XP/Vista (32-bit)/Windows 7 (32-bit and 64-bit) compatible

### Models

- LabMax-TOP is compatible with thermopile, optical and pyroelectric (power & energy)
- LabMax-TOP w/GPIB adds IEEE-488 GPIB PC interface (cable included)
- LabMax-TO is compatible with thermopile and optical (power and long-pulse Joules)

LabMax is a versatile meter suitable for anyone who needs to analyze laser output. It analyzes and monitors laser output via onboard data logging. It also supports logging data directly to a USB flash drive, provides enhanced data analysis and statistics, as well as a form factor that allows flexible positioning and viewing angles so it can be used in areas with limited bench space. These meters provide direct compatibility with LM Model and PM Model sensors with no need for adapters.

### Sensor Compatibility

LabMax displays beam position for quick and accurate setup, and is directly compatible with most Coherent thermal, pyroelectric and semiconductor sensors. These sensors offer wavelength coverage from 190 nm to 12 µm, measure from nW to kW, from nJ to J, and from single shot to 10 kHz.

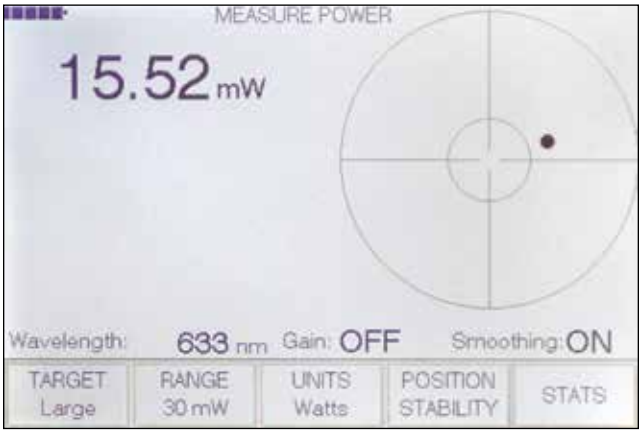
### Beam Positioning

The position of the laser beam on the sensor can be displayed by LabMax when using an LM Model thermopile sensor. This makes it easier to align the laser beam during setup, especially for infrared laser beams. There is also a trending feature to monitor the position of the beam over time, and the position data can be logged to a file.

LM-45 HTD sensor with beam position

### Data Logging

Data logging of unlimited size can be performed directly to a USB flash drive, and additionally over 400,000 points can be retained onboard the meter itself in flash memory. The meter has a file management system that allows naming and renaming files, auto increments file names for repetitive logging events, folder creation and renaming, and transferring files and folders from the meter storage to a USB flash drive. Data can also be logged to a file with the LabMax PC applications software.




LabMax beam position display

# LabMax Meters

## Laser Power and Energy Meters

### Ergonomic Design

LabMax features a large, backlit graphical display with an ergonomic interface with easily accessible buttons for all features and modes. The Measure, Tune, and Trend modes are directly accessible via front panel buttons.


Front panel buttons

### Flexible Positioning

The LabMax display and meter can be positioned at many different angles within the limited bench space typically available in a laser lab, while still making the display easy to view.

### Additional Inputs/Outputs

In addition to PC interfacing, LabMax also includes an analog output with user-selectable voltages of 0 to 1V, 2V, or 4V. Pyroelectric triggering can be achieved with an external trigger input or an internal trigger that is user-adjustable from 2% to 20% percent of full-scale range.

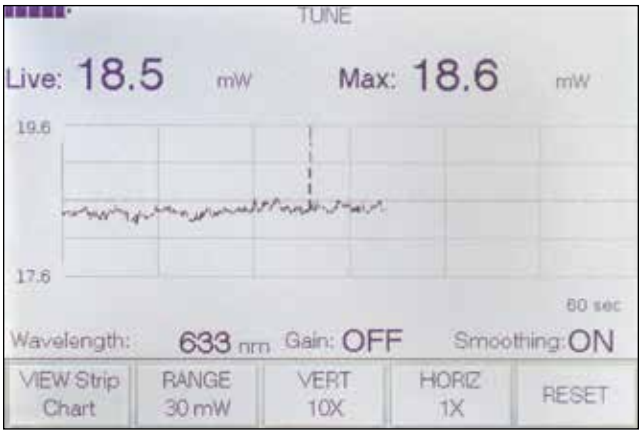
### Measurement Analysis

LabMax meters contain several advanced analysis capabilities, including:

Onboard statistics – mean, minimum, maximum, standard deviation, range, three stability parameters, as well as missed pulses. Users can also select which statistical parameters to display, up to six at a time.

Trend charting – trend chart with statistical display and the ability to log data to a file.

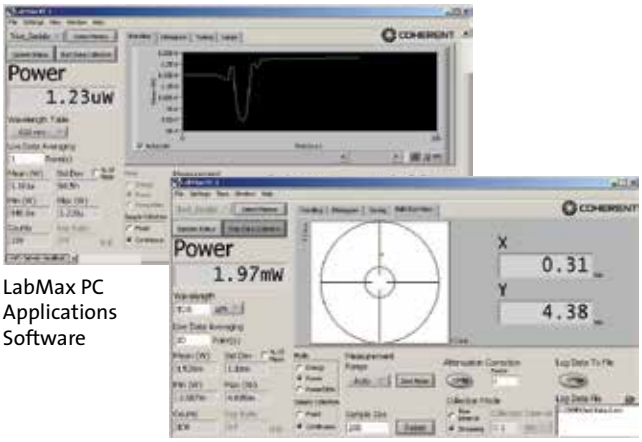
Digital tuning indicators – horizontal bar and trend chart formats with peak indicators.




LabMax Tune Chart

### PC Interfacing and Applications Software

Data can also be analyzed directly on a PC through USB, RS-232, or GPIB connections, or by logging data to a USB flash drive attached directly to the meter. Installable applications software and LabVIEW drivers are provided to support PC interfacing.




LabMax PC Applications Software

# LabMax Meters

## Laser Power and Energy Meters



**Device Specifications**

ISO/IEC 17025:2005

AC-1630

| Model | LabMax-TOP w/GPIB | LabMax-TOP | LabMax-TO |
|---|---|---|---|
| Measurement Resolution | 0.1 % of full-scale | | |
| Displayable Resolution | 3 or 4 digits pyroelectric; 3, 4, or 5 digits thermopile and optical (user-selectable) | | 3, 4, or 5 digits (user-selectable) |
| Measurement Range | Sensor dependent (reference sensor specifications) | | |
| Accuracy | | | |
| Digital Meter | ±1.0% ±2LSD | | |
| System | Meter accuracy + sensor accuracy | | |
| Analog Output (%) | ±1.0 | | |
| Calibration Uncertainty (%)(k=2) | ±1.0 | | |
| Power Sampling Rate (Hz) | 10 | | |
| Maximum Repetition Rate (Hz) | 10,000 sampling (1000 Hz every pulse) | | |
| Minimum Positional Resolution (mm) | 0.1 | | |
| Display | 112 x 78 mm backlight graphic LCD, 480 x 320 pixels. Adjustable contrast and viewing angle | | |
| Measurement Analysis | Min., max., mean, range, std. dev., dose, stability; trending, tuning, beam position | | |
| Computer Interface | GPIB, USB and RS-232 | USB and RS-232 | |
| Pulse Triggering | Internal and external (selectable) | | – |
| Analog Output (VDC) | 0 to 1, 2, or 4 VDC (selectable) | | |
| Analog Output Update Rate | Up to 1000 Hz for pyroelectric; 10 Hz for thermopile and optical | | 10 Hz |
| Temperature | | | |
| Operating Range | 5 to 40°C (41 to 104°F) | | |
| Storage Range | -20 to 70°C (-68 to 158°F) | | |
| Instrument Power | 90 to 260 VAC, 50/60 Hz | | |
| Instrument Batteries | 4400 mAH Rechargeable Li-ion Pack | | |
| Compliance | CE, RoHS, WEEE, ISO 17025 | | |
| Dimensions (H x W x D) | 152 x 229 x 53 mm (6.0 x 9.0 x 2.1 in.) | | |
| Weight | 1.25 kg (2.8 lbs.) | | |
| Front Panel | | | |
| PWR | Turn meter on and off | | |
| ZERO | Reset ambient offset for thermal and optical sensors | | |
| MEASURE | Main measure mode including statistics | | |
| TUNE | View tuning features | | |
| TREND | Display measured values over a period of time and log data to file | | |
| SETUP | Setup meter parameters | | |
| HELP | Onboard context sensitive help - available from any screen | | |
| BACKLIGHT | Toggle backlight on and off | | |
| KNOB | Turn knob to change settings; press the knob to save settings | | |
| Left Side Panel | USB flash drive port<br>USB PC interface port<br>RS-232 PC interface port<br>DB-25 sensor port<br>Power jack | | |
| Rear Panel | Analog output | | |
| | External trigger input (BNC adapter incl.) | | – |
| | GPIB PC interface port | – | |
| Part Number* | 1104620 | 1104622** | 1104619** |

* Meter supplied with 4400 mAH Li-ion battery, AC power adapter, power cord, 1.8-meter USB cable, RS-232 adapter, USB flash drive, RCA-to-BNC adapters, software and driver CD, soft carrying case, and certificate of calibration. LabMax-TOP w/GPIB also includes a GPIB cable.

** C24 Quick Ship program: eligible for next business day shipment.

# FieldMaxII Meters

## Laser Power and Energy Meters

FieldMaxII-TOP Power and Energy Meter

FieldMaxII-TO Power Meter

**Features**

- Measure energy of pulsed lasers up to 300 pps
- Large, backlight LCD display
- Compatible with thermopile, optical, and pyroelectric sensors
- Simulated analog-like movement for laser tuning
- USB interface with FieldMaxII PC applications software, LabVIEW instrument driver and ActiveX control
- XP/Vista (32-bit)/Windows 7 (32-bit and 64-bit) compatible
- Area function for density measurements (J/cm² or W/cm²)

**Models**

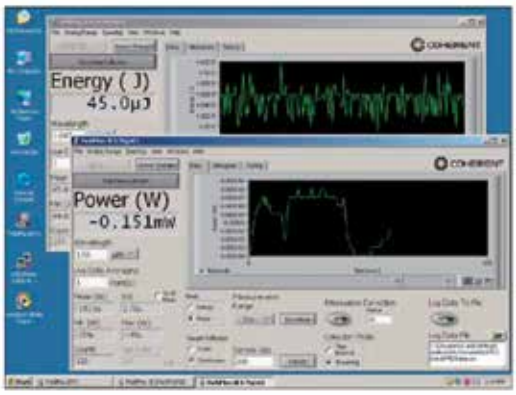
- FieldMaxII-TOP is compatible with thermopile, optical and pyroelectric sensors (power & energy)
- FieldMaxII-TO is compatible with thermopile and optical (power only)
- FieldMaxII-P is compatible with pyroelectric (energy only)

FieldMaxII is an affordable, versatile, easy-to-use digital power and energy meter platform designed for a variety of applications ranging from field service to production test applications.

FieldMaxII features a large, easy-to-read backlit LCD and an intuitive user interface offering button-driven control for simple operation. The meter supports onboard analysis of mean, min., max., and standard deviation statistics. It can measure power from nW to kW, and pulse energy from nJ to J at up to 300 pps. In addition, long-pulse Joules energy measurements can be made on the FieldMaxII-TOP model when using thermopiles.

The meter includes a USB PC interface as well as an analog output. The FieldMaxII PC applications software supports trend charting, tuning, statistics, and logging data to a file. A LabVIEW instrument driver with ActiveX control is provided to support custom software developments.

## FieldMaxII PC Application




**Features**

- USB PC Interface
- FieldMaxII PC is completely open-source so that you can use it to help develop your own customized applications
- Multiple meters can be run on a single PC – useful for final test and burn-in applications
- Meters can be operated remotely via host interface and included drivers
- Software features:
  - Measure, Tune, Trend displays
  - Statistics
- LabVIEW instrument driver and ActiveX DLL server included

# FieldMaxII Meters

## Laser Power and Energy Meters



**Device Specifications**

ISO/IEC 17025:2005

AC-1630

| Model | FieldMaxII-TOP | FieldMaxII-TO | FieldMaxII-P |
|---|---|---|---|
| Function | Power and energy | Power | Energy |
| Measurement Resolution | 0.1% of full-scale | | |
| Measurement Range | Sensor dependent - reference sensor specifications | | |
| Accuracy | | | |
| System | Meter accuracy + sensor accuracy | | |
| Analog Output (%) | ±1.0 | | |
| Calibration Uncertainty (%)(k=2) | ±1.0 | | |
| Power Sampling Rate (Hz) | 10 | 10 | – |
| Maximum Pulse Rep. Rate (Hz) | 300 | – | 300 |
| Display | 58 x 73 mm , fixed-segment LCD with backlight | | |
| Digital Tuning Indicator | 100 msec time constant | | |
| Statistics | Mean, max., min., standard deviation | | |
| PC Interface | USB 1.1 | | |
| Analog Output | 0 to 1, 2, or 5 VDC (selectable) | | |
| Internal Trigger | 2 to 20% of full-scale, selectable | – | 2% to 20% of full-scale, selectable |
| Temperature | | | |
| Operating Range | 5 to 40°C (41 to 104°F) | | |
| Storage Range | -20 to 70°C (-68 to 158°F) | | |
| Instrument Power | 100 to 240 VAC, 50/60 Hz | | |
| Instrument Batteries | Rechargeable NiMH battery pack | | |
| Compliance | CE, RoHS, WEEE, ISO 17025 | | |
| Dimensions (H x W x D) | 200 x 100 x 40 mm, (7.87 x 3.94 x 1.57 in.) | | |
| Weight | 1.0 kg (2.2 lbs.) | | |
| Front Panel | | | |
| PWR | Toggle power switch and backlight | | |
| HZ | Display rep. rate | – | Display rep. rate |
| J/W | Select Joules or Watts mode | – | – |
| ZERO | Reset ambient offset for thermal and optical sensors | | Zero stats |
| AUTO | Engage auto-ranging with power sensors | | – |
| STAT | Display statistics: mean, max., min., standard deviation | | |
| AVG | Engage display averaging | | |
| λ | Enter wavelength and engage wavelength compensation | | |
| ATTEN | Enter attenuation factor and engage attenuation | | |
| AREA | J/cm² (fluence) W/cm² (power density) | W/cm² (power density) | J/cm² (fluence) |
| HOLD | – | Holds displayed values on screen | – |
| TRIG | Select trigger level with energy sensors | – | Select trigger level with energy sensors |
| SETUP / LOCAL | Set and enter button/Takes local control of meter back from PC | | |
| ARROW KEYS | Manually control range; Select Stats parameter; Select and change numerical values | | |
| Left Side Panels | Power jack<br>USB PC interface port<br>Analog output | | |
| Right Side Panels | DB-25 sensor port | | |
| Part Number* | 1098580** | 1098579** | 1098581 |

* Meter supplied with NiMH rechargeable battery pack, power cord, AC adapter, USB cable (1.8m), RCA-to-BNC analog output adapter, installation CD with FieldMaxII PC and drivers, soft carrying case, and certificate of calibration.

** C24 Quick Ship program: eligible for next business day shipment.

# FieldMate

## Laser Power Meter

FieldMate Power Meter

**Features**

- **Analog needle for tuning**
- **Large digital LCD display**
- **Compatible with thermopile and optical sensors**
- **Wavelength compensation**
- **Analog output**
- **Compact and portable**
- **AC and battery power**
- **Auto ranging**

FieldMate combines a digital display and analog meter with sophisticated digital processing to enable rapid, sensitive laser adjustment. This meter also offers an economical way of measuring laser power when advanced data analysis is not necessary.

**Device Specifications**

ISO/IEC 17025:2005

AC-1630

| Model | FieldMate |
|---|---|
| Power Resolution | 0.1% of full-scale for all ranges in the 10s scale<br>0.3% of full-scale for all ranges in the 3s scale |
| Measurement Range | Sensor dependent (reference sensor specifications) |
| Accuracy | |
| System | Meter accuracy + sensor accuracy |
| Analog Meter (%) | ±3.0 |
| Analog Output (%) | ±1.0 |
| Calibration Uncertainty (%)(k=2) | ±1.0 |
| Power Sampling Rate | 20 Hz (thermopile and optical) |
| Display | 26 x 89 mm, custom fixed-segment LCD |
| Analog Needle | |
| Scale | 0 to 10 (100 divisions), 0 to 3 (60 divisions) |
| Response | 80 ms time constant |
| Analog Output | |
| Voltage | 0 to 2 VDC |
| Update Rate | 20 times/sec. |
| Temperature | |
| Operating Range | 5 to 40°C (41 to 104°F) |
| Storage Range | -20 to 70°C (-68 to 158°F) |
| Instrument Power | 100 to 240 VAC, 50/60 Hz |
| Instrument Batteries | Two 9V alkaline batteries |
| Compliance | CE, RoHS, WEEE, ISO 17025 |
| Dimensions (H x W x D) | 193 x 117 x 46 mm, (7.6 x 4.6 x 1.8 in.) |
| Weight | 0.8 kg (1.8 lbs.) |
| Front Panel | |
| PWR | Toggle power |
| ZERO | Ambient offset |
| AUTO | Engage auto-ranging |
| λ | Enter wavelength compensation |
| ARROW KEYS | Manually control range; select and change numerical values |
| Left Side Panel | Power jack<br>Analog output<br>DB-25 sensor port |
| Part Number* | 1098297** |

* Meter supplied with two alkaline 9V batteries, power cord, AC power adapter, RCA-to-BNC analog output adapter, and certificate of calibration.
** C24 Quick Ship program: eligible for next business day shipment.