COHERENT

User Manual

LabMax™-Pro SSIM

Laser Power Meter

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LabMax-Pro SIMM
Laser Power Meter

COHERENT
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If you call outside our office hours, your call will be taken by our answering system and will be returned when the office reopens.

If there are technical difficulties with your laser that cannot be resolved by support mechanisms outlined above, e-mail, or telephone Coherent Technical Support with a description of the problem and the corrective steps attempted. When communicating with our Technical Support Department via the web or telephone, the Support Engineer responding to your request will require the model and Laser Head serial number of your laser system.

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If you are located outside the U.S., visit our website for technical assistance or contact our local service representative. Representative phone numbers and addresses can be found on the Coherent website: www.Coherent.com.

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Signal Words and Symbols in this Manual

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and ***NOTICE***.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER!
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING!
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

The signal word "***NOTICE***" is used when there is the risk of property damage:

NOTICE!
Indicates information considered important, but not hazard-related.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the danger of crushing injury.

This symbol is intended to alert the operator to the danger of a lifting hazard.

Preface

This manual has user information for the LabMax-Pro SSIM Laser Power Meter.

RoHS Compliance

This Coherent product is RoHS compliant.

Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification must be obtained from Coherent or an appropriate U.S. Government agency.

Products manufactured in the European Union, Singapore, Malaysia, Thailand: These commodities, technology, or software are subject to local export regulations and local laws. Diversion contrary to local law is prohibited. The use, sale, re-export, or re-transfer directly or indirectly in any prohibited activities are strictly prohibited.

Publication Updates

To view information that has been added or changed since this publication went to print, connect to www.Coherent.com.

Firmware Updates

To get the latest version of LabMax firmware:

1. Download the *LabMax-Pro SSIM Updater* executable file from our website and save it to your computer.
2. Attach the meter to the PC via USB.
3. Make sure the sensor is *disconnected* from the meter.
4. Turn the meter ON.
5. Double-click the *LabMax-Pro SSIM Updater* executable file you downloaded and follow the instructions.

SECTION ONE: SAFETY

Carefully review the following safety information to prevent personal injury and to prevent damage to this meter or any sensor connected to the meter. This equipment has no user-serviceable parts. For service information, refer to “Obtaining Service” (p. 5-3).

WARNING!
The use and measuring of lasers can be dangerous. This instrument operates on wavelengths that include non-visible laser emissions.

Correct laser operating practice according to manufacturer recommendations is vital.

Eyewear and other personal protective equipment must be used according to applicable laws and regulations.

If in doubt as to correct operating procedures, refer to the laser manufacturer and your laser safety officer.

The equipment is not for use in critical medical environments.

WARNING!
Do not operate this instrument if its panels are removed or any of the internal circuits are exposed.

WARNING!
Do not operate this instrument in wet or damp conditions, or in an explosive atmosphere.

NOTICE!
Operate this instrument only within the specified voltage range.

NOTICE!
Do not operate this instrument if there are suspected failures. Refer damaged equipment to qualified Coherent service personnel.

Waste Electrical and Electronic Equipment (WEEE, 2002)

The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) is represented by a crossed-out garbage container label (see Figure 1-1). The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.

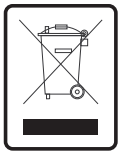


Figure 1-1. Waste Electrical and Electronic Equipment Label

Declaration of Conformity

Declaration of Conformity certificates are available upon request.

SECTION TWO: DESCRIPTION

In this section:

Introduction

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 high-speed sampling modes when used with PowerMax-Pro technology (patent pending). Coherent has developed the LabMax-Pro SSIM laser power meter to fully capitalize on the capabilities of PowerMax-Pro sensors. The meter is also compatible with PM model thermopiles in the standard operating mode.

LabMax-Pro SSIM is packaged as a **S**mart **S**ensor **I**nterface **M**odule (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, high-fidelity pulse shape visualization and energy integration—on a host computer. The software provides a wide range of analytical functions, including live statistics, histograms, trending and data logging. The user interface permits flexible sizing of informational panes within the application, in which contents are auto-sized dynamically as the panes are adjusted, letting the user size the information of greatest importance. Also, a complete set of host commands can be sent through either the USB or RS-232 interface, which is useful for embedded applications.

Besides PC interfacing, LabMax-Pro SSIM also includes an analog output with user-selectable voltages of 0 to 1V, 2V, or 4V. Triggering is done with either an external trigger input or a user-adjustable internal trigger.

Operating Mode Overview

LabMax-Pro SSIM uses three operating modes:

- Standard-Speed
- High-Speed
- Snapshot

These are discussed, next.

Standard-Speed Mode

The Standard-Speed operating mode of the LabMax-Pro SSIM uses a typical 10 Hz sampling rate. At this data rate, PowerMax-Pro sensors supply an almost instantaneous power reading, similar to a photodiode, while also taking advantage of the sensor's ability to directly read very high powers. The standard operating mode is best used to measure the power of CW lasers or the average power of high-repetition rate lasers.

High-Speed Mode

High-speed mode operates at a continuous data sampling rate of 20 kHz, permitting pulse shape analysis of modulated lasers with repetition rates up to 2.5 kHz. These types of pulse trains are common in many laser-based medical treatments and some material processing applications, such as micro welding.

Figure 2-1, below, shows data collected using a 20W CO2 laser to show the type of detail you can get in this mode.

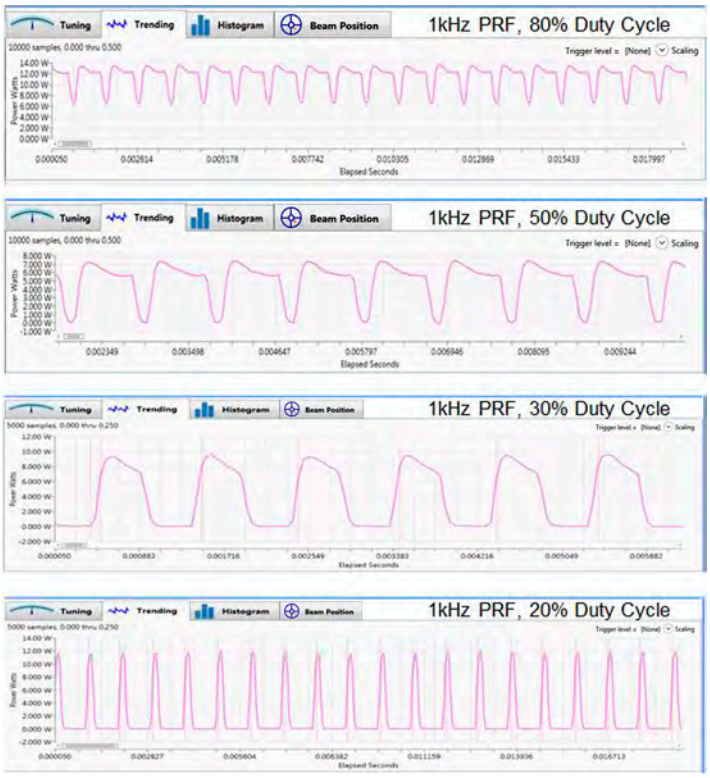


Figure 2-1. Example of Detail Available When Using High-Speed Mode

Snapshot Mode

A faster high-speed sampling mode—"Snapshot Mode"—provides burst sampling at a rate of 625 kHz for a maximum of 384 milliseconds. This mode lets you see the temporal characteristics of modulated pulses used in commercial cutting, engraving and drilling applications, as well as long pulses and pulse trains used in aesthetic medical applications. This temporal detail shows the true performance of the laser—previously masked by slow thermopiles—thereby providing more information to assist setting up process recipes and for monitoring system performance in manufacturing.

Figure 2-2, below, shows the data quality and high pulse shape fidelity that is achievable.

Modulated 10.6 µm CO2 Laser
50 µs PW
8 kHz PRF
40% Duty Cycle

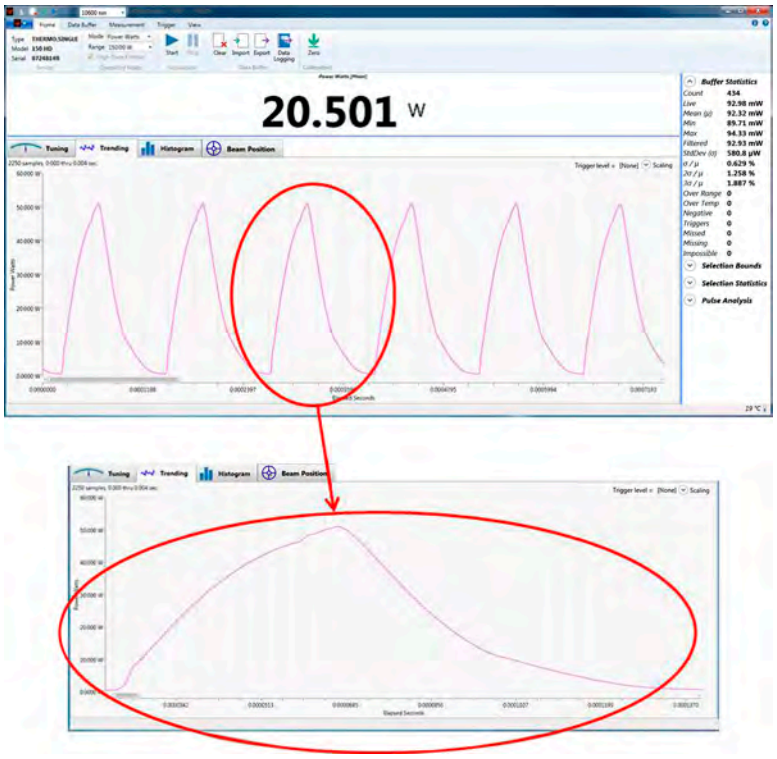
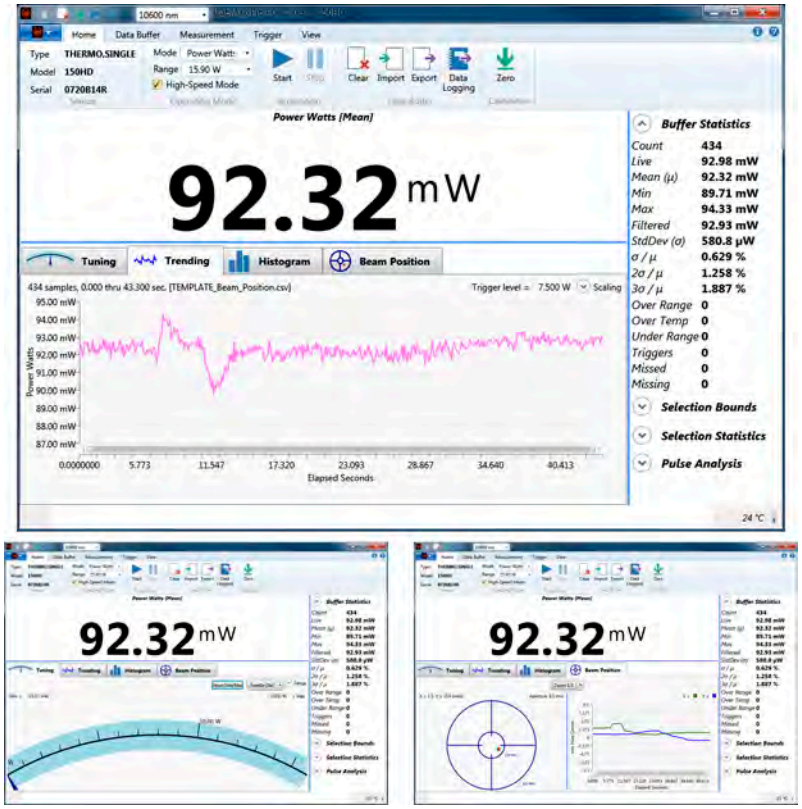


Figure 2-2. Example of Detail Available When Using Snapshot Mode

Product Features

- USB 2.0 “High-Speed” and RS-232 connectivity.
- Instrumentation platform is compatible with PM model thermopile sensors, PowerMax-Pro sensors, LM model position-sensing thermopiles, LM-2 & OP-2 optical sensors, and EnergyMax DB-25 pyroelectric energy sensors.
- High-speed sampling up to 625 kHz for laser temporal pulse analysis when used with PowerMax-Pro sensors.
- Operation up to 10 kHz each pulse with pyroelectric sensors.
- Windows PC application included. Updates are available from within the application or from the Coherent website.
- 32-bit and 64-bit Microsoft™ Windows™ 7 and Windows™ 8 compatibility.
- Direct host command support for OEM integration.
- The meter's internal firmware is field upgradeable, so you can have access to the latest LabMax features.
- High resolution and fast analog-to-digital converter supports up to five digits of resolution and measurement accuracy equivalent to that found in Coherent's other LabMax meters.
- Meter supports spectral compensation for accurate use at wavelengths that are different from the calibration wavelength. Each sensor receives a different spectral compensation curve specific to the responsivity of its specific element, as well as transmission characterization of any associated optics.
- Long-pulse joules capability with thermopile sensors in Standard operating mode
- Trending mode includes adjustable x-y cursors and energy integration of captured pulses using PowerMax-Pro sensors.

LabMax-Pro PC Software Features



Plug-and-play application software is supplied and includes the following features:

- Trending Feature
  - Trend average power stability over time.
  - Visualize and track pulse shape and peak power. High fidelity resolution of temporal pulses greater than 10 microseconds.
- Beam position target and trend chart when used with position-sensing LM model thermopiles.
- Statistics (mean, minimum, maximum, stability and standard deviation)
- Export comma or tab-delimited data for analysis in a spreadsheet—for example, Microsoft™ Excel™—or import directly back into LabMax PC application.
- Tuning (needle dial or bar graph)
- Histogram

- Run multiple instances of software to operate multiple sensors at the same time.

For system integrators and for implementations that include customer-written software, the sensors have a comprehensive command set that is easy to access:

- USB driver is a Virtual COM port and supports simple ASCII host commands for remote interfacing.
- Using customer-written software, the remote interfacing host command set permits sensors to be remotely controlled.
- National Instruments™ LabVIEW™ examples for easy LabVIEW integration.

Thermopile and PowerMax-Pro Sensor Technology

Thermopile Sensors

For many years thermopiles have been the detector of choice for high power lasers. These detectors operate on the thermoelectric principle in which thermal energy is converted into electrical energy. The typical thermopile has a central, light absorbing disk, a series of thermocouples that surround the disk, and an annular heatsink around the ring of thermocouples—refer to the following figure.

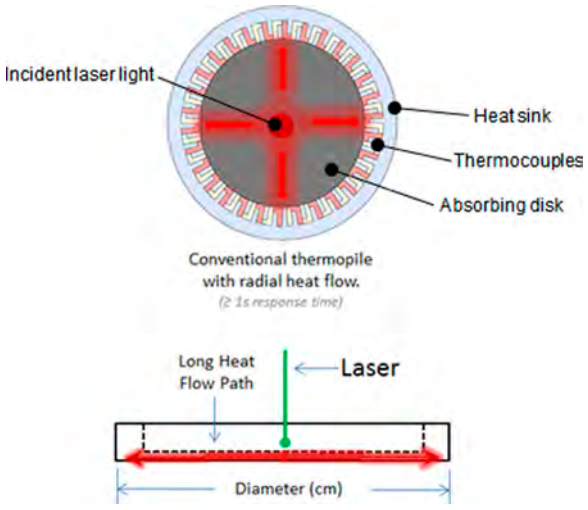


Figure 2-3. Construction of a Traditional Radial Thermopile

In operation, incident laser energy falls on the absorbing disk in the center of the detector and is converted into heat. This disk is typically coated with a material that absorbs light over a very broad wavelength range to increase sensitivity. The heat then flows across the width of the thermopile disk to the heatsink, which is held at a near constant ambient temperature by either air or water cooling. The temperature difference between the absorber and heatsink is converted into an electrical signal by the thermocouples. Calibrated electronics in the meter convert this electrical signal into a laser power reading.

Thermopile sensors have several advantages, including a very broad spectral range, an ability to work over a wide range of input powers, high laser damage resistance and uniform spatial response (meaning insensitivity to changes in beam size, position or uniformity). The limitation of the technology is that the transfer of heat across the width of the thermopile disk makes this technology inherently slow. Specifically, it frequently takes several seconds before the heat flow caused by the laser reaches equilibrium and the power measurement becomes stable on the display. Physically larger sensors take longer to reach this stable state. This slow response time makes thermopiles best suited for measuring CW laser power. For pulsed lasers, the best they can deliver is average power over a finite time interval, or total integrated energy from a long burst of pulses.

PowerMax-Pro Sensors

Coherent developed PowerMax-Pro technology to meet the growing need for a laser power sensor that offers the broad wavelength sensitivity, large dynamic range and high damage resistance of a thermopile, with the fast response speed approaching that of a semiconductor photodiode. The PowerMax-Pro is constructed and configured differently than a thermopile. Specifically, in this device the heat flows vertically through the detector and the electrical field that is generated moves perpendicular to the heat flow—refer to Figure 2-4, below.

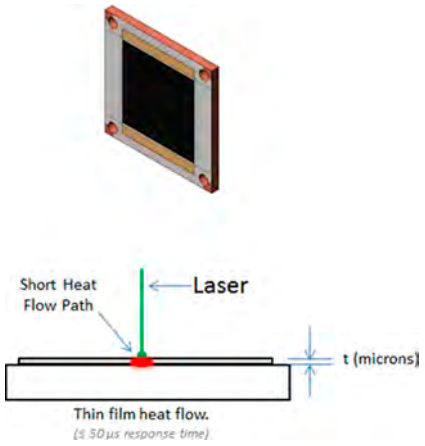


Figure 2-4. Basic Configuration of a PowerMax-Pro Sensor

The materials used in this sensor are a stack of films which have layer thicknesses on the order of microns. Incident laser light is absorbed and generates heat which can flow very quickly through these thin layers to the heatsink below the detector, where it is dissipated. The electrical signal from the thin film layers moves laterally to the edges of the device where it is measured by tapping into the sensor electrodes.

Compared with the traditional radial-flow thermopile—which has a sensing time constant value of several seconds—the time constant for the thin film configuration is in the microsecond range. This enables the sensor to supply an essentially instant power measurement without any overshoot—refer to Figure 2-5, below. The PowerMax-Pro sensor preserves the main benefits of the traditional thermopile architecture, namely large active area (30 mm x 30 mm), wide dynamic range (50 mW to 150W), high damage resistance (14 kW/cm²) and broad wavelength range (300 nm to 11 µm).

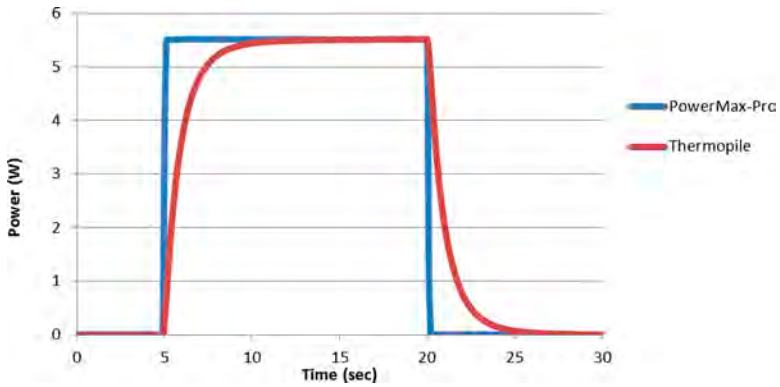


Figure 2-5. The Rise Time of a Typical Mid-power Thermopile (30W) Compared with the PowerMax-Pro

The response speed of PowerMax-Pro sensors lets users move beyond just measuring average power and enables visualization of the temporal pulse shape and peak power of modulated lasers with pulse lengths greater than 10 µs. These pulses can be integrated to calculate individual pulse energy.

Applying Wavelength Compensation Accuracy

Overall measurement accuracy is a combination of the meter and sensor calibration uncertainties. For an up-to-date list of all compatible sensors and their specifications, go to www.Coherent.com/LMC.

Wavelength Compensation Accuracy

The combined accuracy is based upon practices outlined in the *National Institute of Standards Guidelines for Evaluating and Expressing Uncertainty* (NIST Technical Note 1297, 1994 Edition). The combined accuracy of the measurement is calculated by using the law of propagation of uncertainty using the "root-sum-of-square" (square root of the sum of squares), sometimes described as "summing in quadrature" where:

$$\text{Measurement Accuracy} = \sqrt{U^2 = + W^2}$$

where:

U = Percent Calibration Uncertainty
W = Wavelength Accuracy

Coherent uses several coatings to capture the incident radiation on thermal sensors. The specifications list which coating is for each sensor. Typical wavelength ranges and response curves for these coatings are shown below. Each sensor has a spectral curve generated from reflectance measurements taken with spectrometers or direct laser lines. The reflectance data are converted into a wavelength compensation look-up table that is loaded into the sensor. This data is accessed by selecting a wavelength of operation in the software.

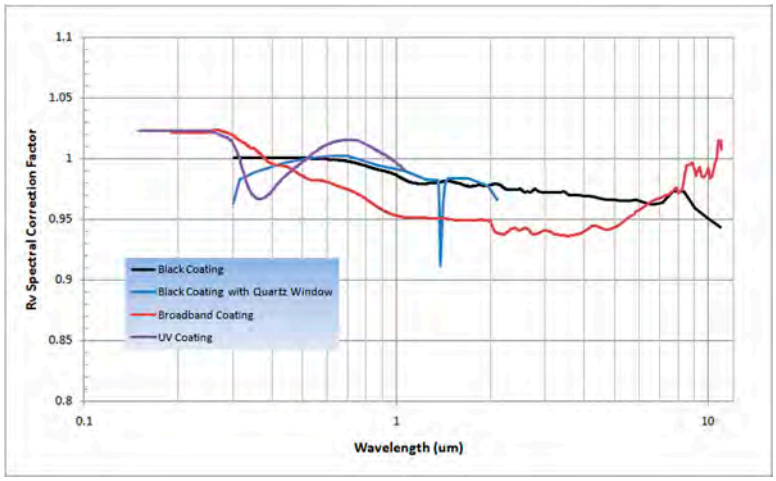


Figure 2-6. RV Spectral Correction for Thermal Sensors (Normalized to Calibration Wavelength)

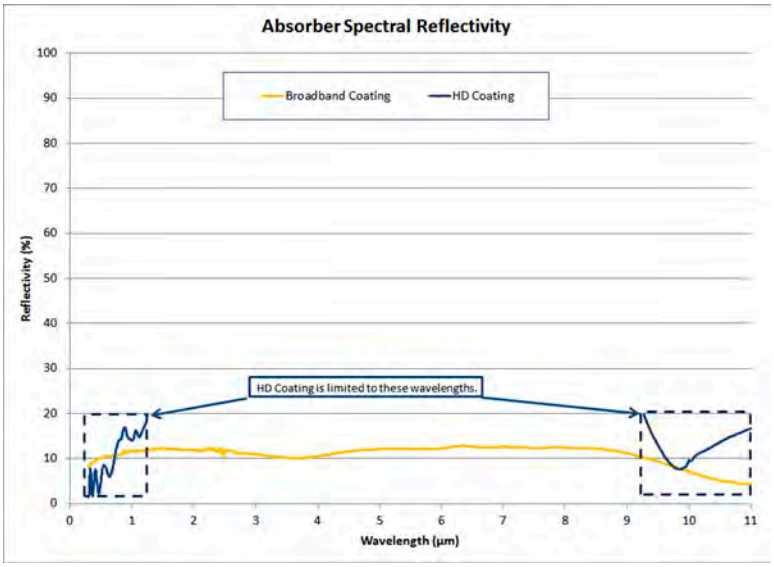


Figure 2-7. RV Spectral Correction for PowerMax-Pro Sensors (Normalized to Calibration Wavelength)

Table 2-1. Wavelength Compensation Accuracy[a]

Sensor	Wavelength Compensation Accuracy	Calibration Wavelength (nm)
All PM model thermopiles	± 1.5%	10600
PowerMax-Pro HD Coating	± 3%	810
PowerMax-Pro BB Coating	± 2%	810

a. Refers to wavelengths different from the calibration wavelength.

SECTION THREE: OPERATION

In this section:

Hardware

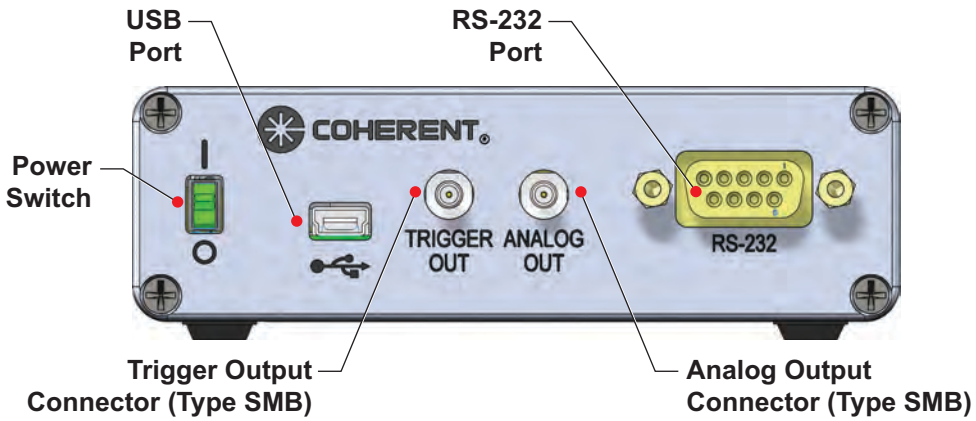


Figure 3-1. Meter Front Panel

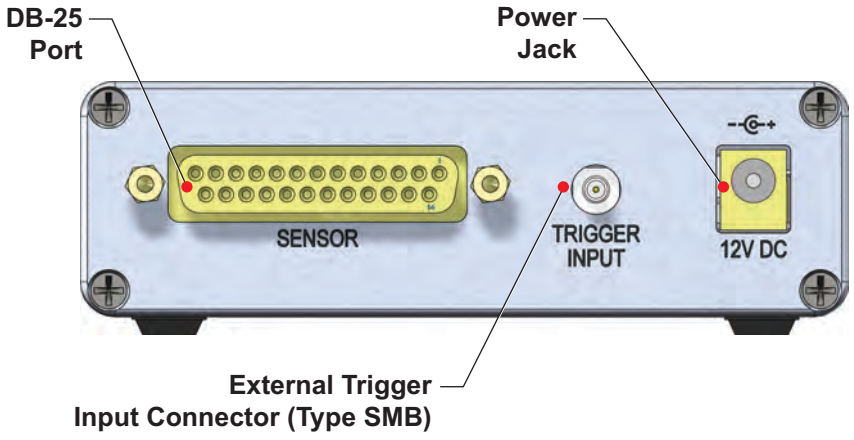


Figure 3-2. Meter Back Panel

Sensor Compatibility

PowerMax-Pro, PM model thermopiles, LM model thermopiles, OP-2 & LM-2 optical sensors, and DB-25 EnergyMax sensors.

USB/RS-232

LabMax-Pro requires a USB 2.0 High-Speed USB to communicate with the PC. (RS-232 connections are intended for OEM integration and will cause reduced data transfer rates.)

Power Supply

Power is supplied through an external 12 VDC/15W power supply (included).

External Trigger Input

To prevent ground loop noise from interfering with accurate measurement, the external SMB trigger input is optically isolated from the LabMax-Pro internal ground by an optoisolator. The following figure shows a simplified schematic of the external trigger input circuitry.

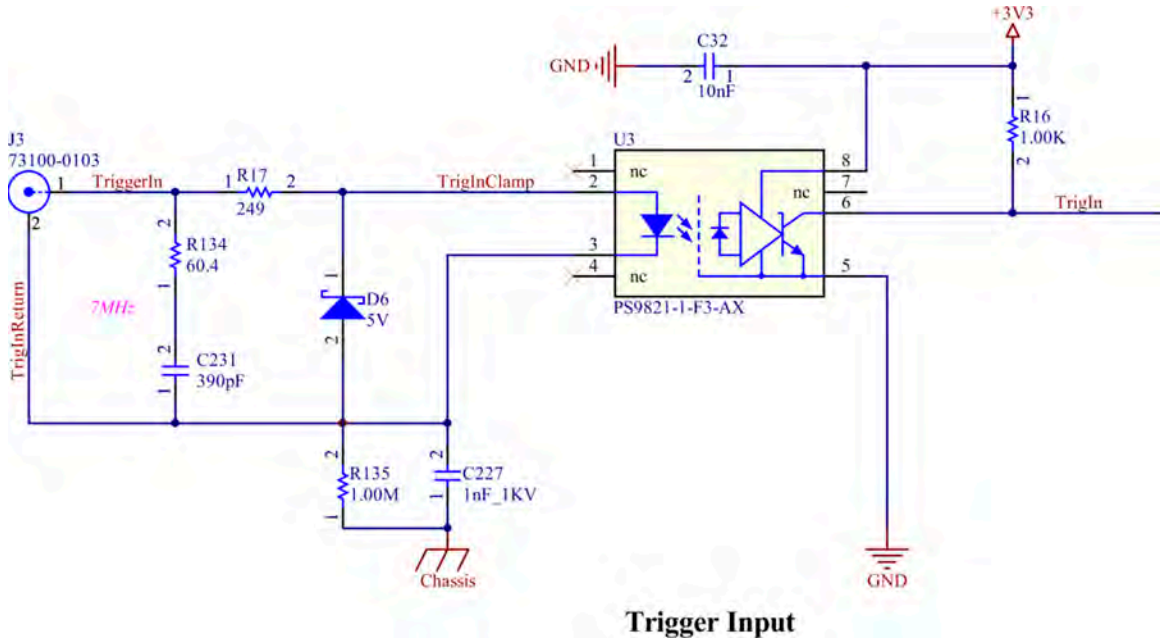
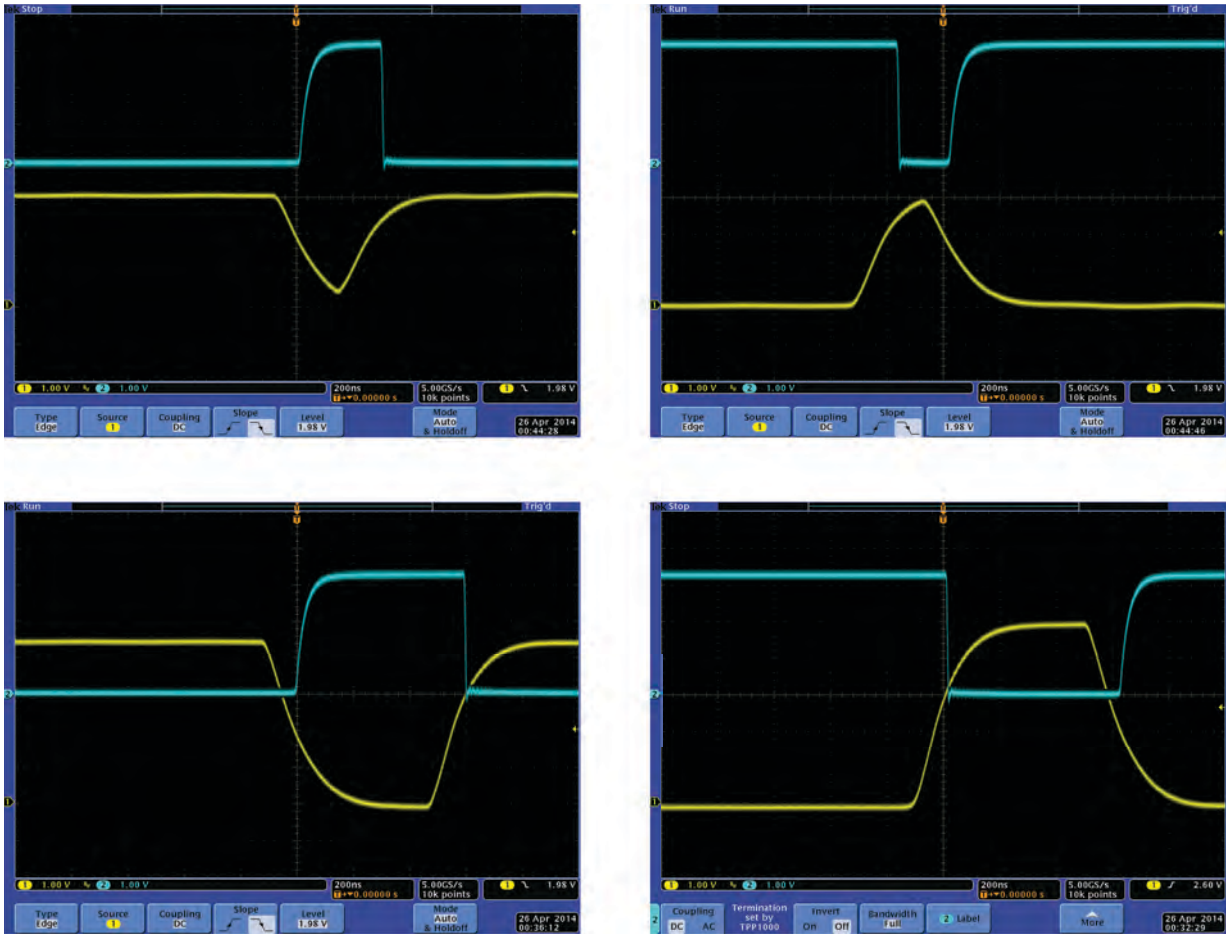


Figure 3-3. External Trigger Input Circuitry

Figure 3-4 shows examples of trigger outputs.



Yellow = external trigger input
Blue = optocoupler to output logic

Figure 3-4. Example Trigger Output Screens

Trigger input pulse must be 3 to 6V, 500 nS pulse from a 50 ohm source. If a current source is used, the minimum trigger current is 5 mA. One possible buffer circuit is shown in Figure 3-5.

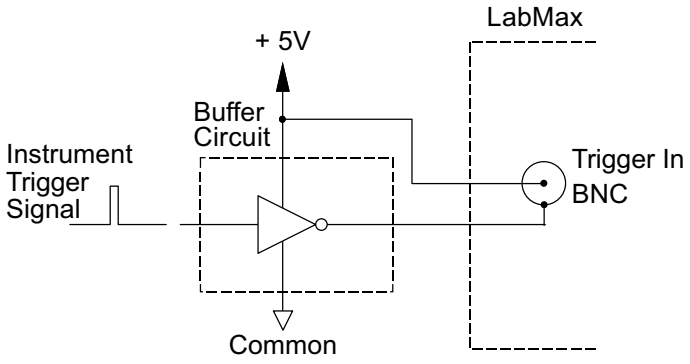


Figure 3-5. Boosting Source Current of Triggering Device

The external trigger signal can be either a rising or a falling edge. Trigger polarity is selected in the SETUP: Trigger menu.

NOTICE!
Trigger signals greater than 7 VDC can damage the optoisolator and should be avoided.

External Trigger Output

The Trigger Out SMB connector is a 15 nS, 5V pulse from a 50 ohm source. It is designed to cascade into another device's trigger input.

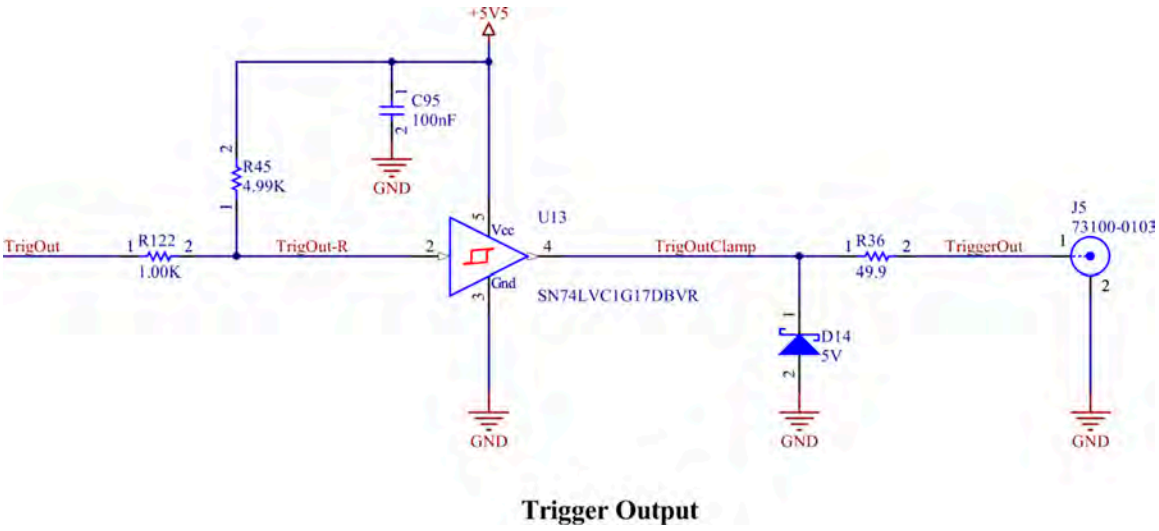


Figure 3-6. External Trigger Output Circuitry

Analog Output

When power is on, the Analog Out SMB connector outputs a voltage in proportion to the current laser measurement. The output voltage is zero (0) volts when the measured energy or power is zero (0) or less. The output voltage is the full-scale output voltage when the measured energy or power is full-scale or over-ranged. The full-scale output voltage (1, 2, or 4V from a 50 ohm source) is selected via the meter or the host interface. Factory default full-scale output voltage is 2V.

PC Application

For detailed information about *LabMax-Pro PC*, open the software and launch the Help file by clicking the Help button at the top right of the screen.

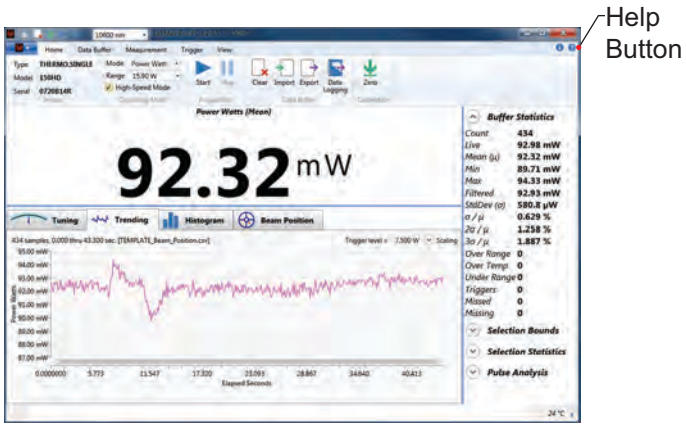


Figure 3-7. Location of PC Application Help Button

SECTION FOUR: HOST INTERFACE

In this section:

Special Considerations

Message Terminators

Messages between the meter and the host computer are comprised entirely of ASCII string characters. All ASCII message strings passing through the host interface are terminated to signal the end of a message string.

Messages Received by the Meter

Messages received by the sensor must be terminated by a carriage return (decimal 13). Line feed characters (decimal 10) are discarded so message terminator flexibility can be attained. A command or query is considered incomplete without the terminator. The maximum length of any message received by the meter is limited to 200 bytes.

Messages Sent by the Meter

All messages sent by the meter are terminated by a carriage return (decimal 13) and line feed (decimal 10) pair.

Using the RS-232 Interface

Data Flow Control

No software or hardware flow control methods for serial communication is used.

Baud Rate and Other Communication Settings

The host must use a fixed baud rate setting of 115200, 8-bit, 1-stop bit, no-parity. Refer to the following table:

Table 4-1. RS-232 Communication Settings

Baud	115200
Parity	None
Data bits	8
Stop bits	1
Flow control	None

Using the USB Interface

When the meter is connected to a host via USB, it is viewed as a virtual serial communications port.

Syntax and Notation Conventions

Syntax and notation conventions specified by the SCPI Standard are followed for all SCPI commands and queries unless otherwise specified. Refer to the SCPI Standard for more information.

The base-10 numeric data format specification is used heavily in this section. Unless otherwise specified, numeric data items are represented as:

- Integer values
- Non-scientific notation floating point values
- Scientific notation floating point values (uppercase or lowercase E)

For example, the following data values are functionally equivalent:

- 31256
- 31256.0
- 3.1256e4
- 31.256e3
- +3.1256e+4

Unless otherwise specified, non-numeric data items (typically referred to as *strings*) are not quoted.

Host Command Quick Reference

The following table gives a brief description of all LabMax-Pro host commands. For detailed information about a specific command, go to the page referenced in the right-hand column.

Table 4-2. Host Command Quick Reference (Sheet 1 of 3)

Command	Description	Page #
SCPI Common Commands		
*RST	Resets all operational parameters to their power-on states.	4-6
*IDN?	Gets the meter identification string.	4-6
System Options		
SYSTem:TYPE?	Returns the system type string.	4-7
SYSTem:STATus?	Gets the system status code.	4-7
SYSTem:FAULt?	Gets the system fault code.	4-8
SYSTem:RESTore	Restores all user settings to the factory state.	4-8
SYSTem:SYNC	Resets the system measurement sync timer.	4-8
SYSTem:SYNC?	Gets the system measurement sync timer.	4-8
Communications		
SYSTem:COMMunicate:HANDshaking	Selects the state of SCPI message round trip hand-shaking.	4-9
SYSTem:COMMunicate:HANDshaking?	Sets the state of SCPI message round trip handshaking.	4-9
Error Record Reporting and Collection		
SYSTem:ERRor:COUNt?	Gets the number of error records in the error queue at the time of the query.	4-11
SYSTem:ERRor:NEXT?	Gets the next error record(s) in the error queue.	4-11
SYSTem:ERRor:ALL?	Gets all error records in the error queue at the time of the query.	4-11
SYSTem:ERRor:CLEar	Clears all error records in the error queue.	4-11
Measurement Setup and Control		
CONFigure:MEASure:MODe	Sets the instrument to a measurement mode of dBm, Watts or Joules.	4-12
CONFigure:MEASure:MODe?	Gets the measurement mode of the instrument.	4-12
CONFigure:MEASure:SNAPshot:SELect	Sets the instrument to acquire data in a burst or snap-shot fashion.	4-12
CONFigure:MEASure:SNAPshot:SEL?	Gets status of instrument to acquire data in a burst or snapshot fashion.	4-12
CONFigure:MEASure:SNAPshot:PREbuffer	Sets the pre-trigger buffer size in samples.	4-12
CONFigure:MEASure:SNAPshot:PREbuffer?	Gets the pre-trigger buffer size in samples.	4-12
CONFigure:MEASure:SOURce:SELect	Sets the instrument to acquire data from either the slow or fast channel.	4-13
CONFigure:MEASure:SOURce:SEL?	Gets the current data channel.	4-13
CONFigure:MEASure:SOURce:LIST?	Returns a list of available source channel selections for the attached probe.	4-13

Table 4-2. Host Command Quick Reference (Sheet 2 of 3)

Command	Description	Page #
CONFigure:SPEedup	Sets the speedup state.	4-13
CONFigure:SPEedup?	Gets the speedup state.	4-13
CONFigure:AREA:CORRection	Enables/disables area correction.	4-13
CONFigure:AREA:CORRection?	Gets the area correction state.	4-13
CONFigure:AREA:APERture	Sets the aperture area.	4-13
CONFigure:AREA:APERture?	Gets the size of the aperture area.	4-14
CONFigure:AOUT:FSCale	Selects the full scale output voltage at the analog output connector.	4-14
CONFigure:AOUT:FSCale?	Gets the full scale output voltage at the analog output connector.	4-14
CONFigure:AVERage:TIME	Sets the display data smoothing to either ON or OFF.	4-14
CONFigure:AVERage:TIME?	Gets the current state of display data smoothing.	4-14
CONFigure:WAVElength:CORRection	Enables/disables wavelength correction.	4-14
CONFigure:WAVElength:CORRection?	Gets the current state of wavelength correction.	4-14
CONFigure:WAVElength:WAVElength	Sets the current wavelength.	4-15
CONFigure:WAVElength:WAVElength?	Gets the current, maximum allowed, or minimum allowed wavelengths	4-15
CONFigure:WAVElength:LIST?	Gets the wavelength table entries from the probe	4-15
CONFigure:GAIN:COMPensation	Enables/disables gain compensation.	4-15
CONFigure:GAIN:COMPensation?	Gets the current state of gain compensation.	4-15
CONFigure:GAIN:FACTor	Sets the gain compensation factor.	4-16
CONFigure:GAIN:FACTor?	Gets the current gain compensation factor.	4-16
CONFigure:ZERO	Sets the current measurement as the zero baseline measurement.	4-16
TRIGger:PTJ:LEVel	Selects the Pulsed Thermopile Joules mode trigger sensitivity level.	4-16
TRIGger:PTJ:LEVel?	Gets the sensitivity level of the Pulsed Thermopile Joules mode trigger.	4-16
CONFigure:MEASure:WINdow	Selects the Pulsed Thermopile Joules mode trigger sensitivity level.	4-16
CONFigure:MEASure:WINdow?	Gets the Pulsed Thermopile Joules mode trigger sensitivity level.	4-16
CONFigure:DECimation	Sets the decimation rate for the fast data acquisition channel.	4-17
CONFigure:DECimation?	Gets the decimation rate for the fast data acquisition channel.	4-17
CONFigure:RANGe:SELect	Selects the meter measurement range.	4-17
CONFigure:RANGe:SELect?	Gets the granted full scale measurement range.	4-17
CONFigure:RANGe:AUTO	Enables/disables automatic selection of the meter measurement range.	4-18
CONFigure:RANGe:AUTO?	Gets the current state of automatic selection of the meter measurement range.	4-18

Table 4-2. Host Command Quick Reference (Sheet 3 of 3)

Command	Description	Page #
CONFigure:RANGe:LIST?	Gets the range table entries from the probe.	4-18
CONFigure:ITEMselect	Selects data items that appear in a measurement record.	4-18
CONFigure:ITEMselect?	Gets the data items that appear in a measurement record.	4-18
TRIGger:SOURce	Selects the trigger source.	4-20
TRIGger:SOURce?	Gets the current trigger source.	4-20
TRIGger:LEVel	Sets the trigger level	4-20
TRIGger:LEVel?	Gets the current trigger level.	4-20
TRIGger:PERcent:LEVel	Sets the trigger level	4-21
TRIGger:PERcent:LEVel?	Gets the trigger level	4-21
TRIGger:SLOPe	Selects the external trigger edge.	4-21
TRIGger:SLOPe?	Gets the current external trigger edge.	4-21
TRIGger:DELay	Selects the external trigger delay time.	4-22
TRIGger:DELay?	Gets the external trigger delay time.	4-22
TRIGger:SEQuence	Sets the sequence ID.	4-22
Measurement Data Collection		
READ?	Gets the last recorded measurement at the time of the query.	4-22
STARt	Enables data streaming for a continuous or fixed transmission.	4-23
STOP	Disables data streaming interface transmission.	4-23
FORCe	Forces a data transmission when in Snapshot mode.	4-23
Meter and Probe Device Information		
SYSTem:INFormation:INSTrument:SNUMber?	Gets the meter serial number.	4-23
SYSTem:INFormation: INSTrument:PNUMber?	Gets the meter part number.	4-24
SYSTem:INFormation: INSTrument:MODel?	Gets the model name.	4-24
SYSTem:INFormation:INSTrument:CDATe?	Gets the calibration date.	4-24
SYSTem:INFormation: INSTrument:MDATe?	Gets the manufacturing date.	4-24
SYSTem:INFormation:INSTrument:TYPE?	Gets the meter type.	4-24
SYSTem:INFormation: INSTrument:FVER?	Returns the firmware version of the meter.	4-25
SYSTem:INFormation:FPGA:HVER?	Returns the hardware version of the FPGA in the meter.	4-25
SYSTem:INFormation: FPGA:FVER?	Returns the firmware version of the FPGA in the meter.	4-25
SYSTem:INFormation:PROBe:TYPE?	Gets the currently-connected probe type.	4-25
SYSTem:INFormation:PROBe:MODel?	Gets the currently-connected probe model.	4-26
SYSTem:INFormation:PROBe:SNUMber?	Gets the serial number of the probe.	4-26
SYSTem:INFormation:PROBe:RESPonsivity?	Gets the currently-connected probe calibration responsivity.	4-26
SYSTem:INFormation:PROBe:CDATe?	Gets the calibration date of the probe.	4-27
SYSTem:INFormation:PROBe:TEMPerature?	Gets the head temperature of the probe.	4-27
SYSTem:INFormation:PROBe:DIAMeter?	Gets the probe diameter.	4-27

Commands and Queries

SCPI Common Commands

The SCPI Standard specifies a standard set of common commands. All common commands and queries start with an asterisk.

Reset Command - *RST

This command resets all operational parameters to their power-on states. Reset does not affect calibration settings or user persistent settings.

Command: *RST

Query: none

Identification Query - *IDN?

This query gets the meter identification string, such as model name, firmware version, and firmware date.

Command: none

Query: *IDN?

Reply: “Coherent, Inc - LabMax-Pro SSIM” + <type> + “ - ” + <version> + “ - ” + <firmware date>

The dash sign separates all fields within the reply string. The first field is always “Coherent, Inc”. The second field is the product name, “LabMax-Pro SSIM”. The third field is the version number, having the format “V<major>.<minor><optional qualifier characters>”. The fourth field is the firmware date, having the form “<3 character month name> <day of the month> <year>”. The reply string is not quoted.

For example, a typical identification string looks like:

“Coherent, Inc - LabMax-Pro SSIM - V1.0 - Jun 11 2013”
Note: The quotes are not transmitted.

System Options

The system commands and queries access functionality that is exclusive of the sensor measurement functions. These commands can be sent at any time without affecting a measurement in progress.

System Type

This query returns the system type string. For example, a typical type string looks like:

"SSIM" *Note: The quotes are not transmitted*

Command: none

Query: SYSTem:TYPE?
Reply: SSIM

System Status

This query gets the system status code. The status code is returned in a string expressed in uppercase hexadecimal integer form. The 32-bit word represents a bit-mapped status indicator. Table 4-3 describes the status condition bit mapping.

Table 4-3. Status Code Bit Definitions

Bit	Mask	Bit Label	Status Description
2	00000004	Probe Attached	A valid probe is attached
3	00000008	Identifying Probe	Identifying probe is in progress
18	00040000	Zeroing	Zeroing is in progress
19	00080000	Ready / Calculating	Applies to Joules mode only when a power probe is attached; Ready = 0, Calculating = 1
20	00100000	FPGA updating	FPGA firmware update in progress
31	80000000	System Fault	A system fault occurred, check SYSTem:FAULt

Command: none

Query: SYSTem:STATus?
Reply: <status>
System

As an example, if a probe is found, but there is a general fault, the system status query returns:

00040004 (*Probe attached and ready to use, meter zeroing in progress*)

System Fault

This query gets the system fault code. The fault code is returned in a string expressed in uppercase hexadecimal integer form. The 32-bit word represents a bit-mapped status indicator. Table 4-4 describes the fault condition bit mapping.

Table 4-4. Fault Code Bit Definitions

Bit	Mask	Bit Label	Description
0	00000001	No Sensor	No sensor is attached to the SSIM
1	00000002	Sensor overtemp	Sensor damage temperature is exceeded
2	00000004	Sensor communication	Sensor EEPROM communication failure
3	00000008	Sensor Checksum	Sensor checksum invalid
4	00000010	Sensor firmware	Sensor firmware version invalid
5	00000020	Sensor EEPROM corrupt	Sensor table value corrupt or out of order
6	00000040	Sensor unrecognized	Unsupported sensor or bad configuration
7	00000080	Bad Initialization	Meter failed to initialize or properly configure
8	00000100	Bad Zero	Meter failed to properly zero
9	00000200	IPC failure	Interprocessor communication failure

Command: none

Query: SYSTem:FAULt?
Reply: <fault>
System

As an example, if a probe is found but there is a general fault, the system fault query returns:

00000102 (*Bad zero, probe damage temperature exceeded*)

System Restore

This command restores all user settings to the factory state.

Command: SYSTem:RESTore

Query: none

System Sync

This command resets the system measurement sync timer. This query gets the system measurement sync timer value. The system measurement sync timer is a free-running timer that increments by ten for every 10 microseconds of elapsed time. This timer is used as the source for the time stamp value for all power-related measurements. To counteract clock creep, send the system sync command at intervals not to exceed 10 minutes.

Command: SYSTem:SYNC

Query: SYSTem:SYNC?
Reply: <current timer value>

Communications

Message Handshaking

This command selects the state of SCPI message round trip handshaking.

Command: SYSTem:COMMunicate:HANDshaking {ON|OFF}
Reply: OK if ON is selected; otherwise no reply is sent

Query: SYSTem:COMMunicate:HANDshaking?
Reply: ON|OFF

If handshaking is ON:

- Empty commands (that is, commands with only whitespace characters) reply with “OK\r\n”
- Valid commands with valid data reply with “OK\r\n”
- Valid queries with valid data reply as explicitly defined elsewhere in this section, followed by “OK\r\n”
- Valid commands or queries which result in an error reply with “ERR<n>\r\n” where <n> is the error code number (see “Error Record Reporting and Collection,” below)
- Unrecognized commands or queries reply with “ERR100\r\n”
- Error queuing occurs as explicitly defined elsewhere in this section

If handshaking is OFF:

- All command and query response behavior is explicitly defined elsewhere in this section

Error Record Reporting and Collection

Programming and system errors occasionally occur while testing or debugging remote programs and also during measurement. Error strings follow the SCPI Standard for error record definition:

<error code>,<quoted error string>

The host queries for errors in two steps:

1. The host queries for the number of error records available (N).
2. The host queries N times for the error records.

Errors are stacked up to 20 deep. In the case of error overflow, the last error in the error list is an indication of error overflow.

The possible error strings are shown in Table 4-5 (p. 4-10).

Table 4-5. Error Codes and Description Strings

Error Code Number	Quoted Error String	Error Description
-350	“Queue overflow”	Error queue is full
-310	“System error”	Unexpected/unrecoverable hardware or software fault
0	“No error”	No error
100	“Unrecognized command/query”	The command or query is not recognized
101	“Invalid parameter”	The command or query parameter is invalid
102	“Data error”	A data error was encountered
200	“Execution Order”	Command issued out of order
203	“Command Protected”	Command is password protected
220	“Parameter Problem”	Invalid parameter to otherwise valid command
241	“Device Unavailable”	Cannot process command—probe is not present

Error -350 is raised when the error queue becomes full. Non-“Queue overflow” errors are replaced by “Queue overflow” errors when there is exactly one available storage location available in the error queue. No additional errors are added to the error queue if the error queue is full.

Error -310 is raised when the meter firmware detects an unexpected or unrecoverable error. This error condition includes unrecoverable hardware faults.

Error 100 is raised when the meter receives an unrecognized command or query.

Error 101 is raised when the meter receives a command or query with one or more invalid data parameters.

Error 102 is raised when the device receives a command or query for which no valid data exists.

Error 200 is raised when the device receives a command or query that is out of expected order of execution.

Error 203 is raised when the device receives a command or query that is password protected.

Error 220 is raised when the device receives a command or query that contains invalid parameters, but the command is valid.

Error 241 is raised when the device receives a command or query that requires a probe to be present.

Error Count Query

This query gets the number of error records in the error queue at the time of the query.

Command: none

Query: SYSTem:ERRor:COUNt?
Reply: <count of error records stored in integer format>

Error Query

This query gets the next error record(s) in the error queue. More than one error record can be queried using the optional <error record count> parameter, which must be an integer value. A single error record is returned if <error record count> is not specified. No reply is transmitted if there are no error records available.

As the meter transmits each error record:

- The error record is permanently removed from the error queue
- The queued error record count decrements by one

Command: none

Query: SYSTem:ERRor:NEXT? [<error record count>]
Default is not applicable.
Reply: <next available error record(s)>

All Error Query

This query gets all error records in the error queue at the time of the query. No reply is transmitted if there are no error records available.

After the completion of the reply transmission:

- The error queue is empty
- The queued error record count is zero

Command: none

Query: SYSTem:ERRor:ALL?
Reply: <all available error record(s)>

All Error Clear

This command clears all error records in the error queue.

Command: SYSTem:ERRor:CLEar

Query: none

Measurement Setup and Control

Measurement Mode Select

This command sets the instrument to a measurement mode of dBm, Watts, or Joules. dBm, Watts, and Joules modes refer to a normal sampling mode. Scope mode only applies to PM-Pro power probes.

dBm—ratio of power to 1 milliwatt

Watts—derived unit of power defined as joules per second.

Joules—derived unit of energy defined as the amount of work required to produce one watt of power for one second.

Command: CONFigure:MEASure:MODe {DBM|J|W}
Default is W (Watts) - J (Joules) for pyroelectric probes.

Query: CONFigure:MEASure:MODe?
Reply: DBM|J|W

Note: If a probe is unattached/re-attached, this command returns to the default setting of Watts.

Measurement Data Snapshot Mode Select

This command sets the instrument to acquire data in a burst or snapshot fashion. This command/query only applies to PowerMax-Pro probes.

Command: CONFigure:MEASure:SNAPshot:SELect {ON|OFF}
Default is OFF.

Query: CONFigure:MEASure:SNAPshot:SEL?
Reply: ON|OFF

Note: If no probe is attached, a value of OFF is returned. Err 100 is raised if fast channel is not selected. Err 200 is raised if CONFigure:MEASure:SOURce:SEL SLOW is selected.

Snapshot Pre-Trigger Buffer Size Select

This command sets the pre-trigger buffer size in samples. This specifies the number of pre-triggers to be displayed on output after a trigger event. This command/query only applies to PowerMax-Pro probes.

Command: CONFigure:MEASure:SNAPshot:PREbuffer <iSize>
Default is 0.

Query: CONFigure:MEASure:SNAPshot:PREbuffer?
Reply: <iSize >

Measurement Data Acquisition Source Select

This command sets the instrument to acquire data from either the slow or fast channel. Pyroelectric probes only use the FAST channel, whereas thermopile and optical probes only use the SLOW channel setting. PowerMax-Pro probes can use both channels, but not simultaneously.

Command: CONFigure:MEASure:SOURce:SELect {SLOW|FAST}
Default is SLOW.

Query: CONFigure:MEASure:SOURce:SEL?
Reply: SLOW|FAST

Note: A value of SLOW is returned if a probe is not attached.

Measurement Data Acquisition Source List Query

This query returns a list of available source channel selections for the attached probe.

Command: none

Query: CONFigure:MEASure:SOURce:LIST?
Reply: SLOW, FAST

Note: A value of SLOW is returned if a probe is not attached.

Speedup

This command sets the speedup state. The query gets the speedup state.

Command: CONFigure:SPEedup {ON|OFF}
Default is OFF

Query: CONFigure:SPEedup?
Reply: {ON|OFF}

Error 100 is raised if the sensor is an optical, or if fast channel is selected.

Area Correction

Enable/Disable State

This command enables/disables area correction.

Command: CONFigure:AREA:CORRection {ON|OFF}
Default is OFF

Query: CONFigure:AREA:CORRection?
Reply: ON|OFF

Aperture Area

This command sets the aperture area, expressed in square centimeters (cm^2).

Command: CONFigure:AREA:APERture {0.01..500.00}
Default is 1.0

Query: CONFigure:AREA:APERture?
Reply: 0.01..500.00

Analog Output Full Scale Voltage

This command selects the full scale output voltage at the analog output connector.

Command: CONFigure:AOUT:FSCale {1|2|4}
Default is 2

Query: CONFigure:AOUT:FSCale?
Reply: 1|2|4

Data Smoothing

Enable smoothing to suppress large and rapid variations in the output reading. Smoothing is implemented as a decimating average of 32:1 for thermopile, optical, and Pyroelectric probes.

The smoothing function can be used under the following conditions:

- A Pyroelectric probe is attached and Joules mode is selected
- A thermopile probe is attached and Watts mode is selected
- An optical probe is attached and Watts mode is selected

Time

This command sets the display data smoothing to either ON or OFF.

Command: CONFigure:AVERage:TIME {OFF|ON}
Default is OFF

Query: CONFigure:AVERage:TIME?
Reply: OFF|ON

Wavelength Correction

Enable/Disable State

This command enables/disables wavelength correction.

Command: CONFigure:WAVElength:CORRection {OFF|ON}
Default is OFF

Query: CONFigure:WAVElength:CORRection?
Reply: OFF|ON

Operational Wavelength

This command sets the current wavelength, which is committed to persistent storage when it is changed. If the requested wavelength is greater than the upper wavelength limit, the current wavelength will be set to the upper wavelength limit. Likewise, if the requested wavelength is less than the lower wavelength limit, the current wavelength will be set to the lower wavelength limit. The minimum and maximum allowed wavelength can also be named as data arguments. The query gets the current, maximum allowed, or minimum allowed wavelengths, depending on the optional query data argument.

Command:
CONFigure:WAVElength:WAVElength {MINimum|MAXimum|
<requested wavelength in nm>}

Query:
CONFigure:WAVElength:WAVElength? [MINimum|MAXimum]
Reply:
<granted wavelength in nm> *if [MINimum|MAXimum] is not specified*
Reply:
<allowed maximum wavelength in nm> *if MAXimum is specified*
Reply:
<allowed minimum wavelength in nm> *if MINimum is specified*

Query Probe Wavelength Table

This query gets the wavelength table entries from the probe. Each wavelength is expressed in units of nm, rounded to the nearest integer. Each wavelength ranges from 1 to 99999. Error 101 is raised if the list length exceeds 100 entries. Note that the list returned by the query always includes the calibration wavelength of the current probe. The list does not include the selected operational wavelength.

Command: none

Query: CONFigure:WAVElength:LIST?
Reply: <comma separated list of wavelengths>

Error 241 is raised if no probe is attached.

Gain Compensation

Enable/Disable State

This command enables/disables gain compensation, which is committed to persistent storage when it is changed.

Command: CONFigure:GAIN:COMPensation {OFF|ON}
Default is OFF

Query: CONFigure:GAIN:COMPensation?
Reply: OFF|ON

Factor

This command sets the gain compensation factor, which is committed to persistent storage when it is changed. The gain compensation factor has no units. Error 101 is raised if the gain compensation factor is less than 0.001 or greater than 100,000.0.

Command: CONFigure:GAIN:FACTor <0.001..100000.0>
Default is 1.0

Query: CONFigure:GAIN:FACTor?
Reply: <gain compensation factor>

Probe Zero

This command sets the current measurement as the zero baseline measurement. The meter cannot zero baseline the measurement when in Snapshot mode.

Command: CONFigure:ZERO

Query: none

Err 200 is raised if the meter is in Snapshot mode. To correct: exit Snapshot mode, zero, and then re-enter Snapshot mode.

Pulsed Thermopile Joules Trigger Level

This command selects the Pulsed Thermopile Joules mode trigger sensitivity level.

Command: TRIGger:PTJ:LEVel {LOW|MEDium|HIGH}
Default is LOW

Query: TRIGger:PTJ:LEVel?
Reply: LOW|MEDIUM|HIGH

Note: This command only applies to thermopile or optical probes.

Pulse Detection Measurement Window

This command selects the pulse detection window size for Sampling Joules using the fast measurement channel. The input value is expressed in microseconds. Value range is 25..10000000.

Command: CONFigure:MEASure:WINdow <25..10000000>
Default is 100

Query: CONFigure:MEASure:WINdow?
Reply: Pulse detection window size in microseconds

Note: This command only applies to PowerMax-Pro sensors.

Sample Variable Decimation

This command sets the decimation rate for the fast data acquisition channel, which takes effect at the end of the current decimation cycle. The decimation rate units are expressed samples rounded to the nearest integer.

Measurement data is selected for processing, ranging as frequently as 1 sample processed per 1 measured to as infrequently as 1 sample processed per 99999 samples measured.

Command: CONFigure:DECimation {1..99999}
Default is 1

Query: CONFigure:DECimation?
Reply: 1..99999

Error 241 is raised if the sensor is not a pyroelectric or fast power sensor.

Range Select

Range Value Select

This command selects the meter measurement range, expressed in the units defined under the current measurement mode (Joules or Watts). The measurement range is selected by expressing the maximum expected measurement, which must be greater than 0.0. The <granted full scale range> value is the lowest available full scale range that can measure the <maximum expected measurement>. For example, if the list of available ranges is 3 mW to 30 mW and the maximum expected measurement is 10 mW, the granted range will be 30 mW. The <granted full scale range> is the top range available if the <maximum expected measurement> exceeds the top range value.

Command: CONFigure:RANGe:SELect {<maximum expected measurement>|MAXimum|MINimum}
Default is not applicable

Query: CONFigure:RANGe:SELect? [MAXimum||MINimum]
Reply: <granted full scale range>

Using the optional MAX and MIN parameters on the command result in selecting the maximum or minimum available ranges, respectively. Using the optional MAX and MIN parameters on the query results in obtaining the maximum or minimum range full scale readings, respectively. The MIDdle range option only applies to pyroelectric probes.

Auto Range Enable/Disable State

This command enables/disables automatic selection of the meter measurement range. The meter hunts for the best measurement range for the current probe and laser conditions when auto ranging is active. The hunt procedure can require several samples to arrive at the best range. Auto ranging applies only when a thermopyle or optical probe is attached.

Command: CONFigure:RANGe:AUTO {ON|OFF}
Default is OFF

Query: CONFigure:RANGe:AUTO?
Reply: ON|OFF

Note: Error 241 is raised if the sensor is pyroelectric or there is no probe attached.

Query Probe Range List

This query gets the range table entries from the probe. Each range is expressed in units of nm, rounded to the nearest integer. Each wavelength ranges from 1 to 99999. Note that the list returned by the query will always include the calibration wavelength of the current probe.

Command: none

Query: CONFigure:RANGe:LIST?
Reply: <comma separated list of available ranges>

Error 241 is raised if no probe is attached.

Data Item Select

Data items that appear in a measurement data record are selectable.

The data argument is a comma-separated list that consists of one or more tokens shown in Table 4-6, below. At least one token must be specified. The tokens can be specified in any order.

Command:
CONFigure:ITEMselect {PRI|QUAD|FLAG|SEQ|PER}
Default is PRI

Query: CONFigure:ITEMselect?
Reply: one or more of PRI|QUAD|FLAG|SEQ|PER

Table 4-6. Data Item Selections for Measurement Data Record

Tokens	Data Description	Result Expression in Data Record
PRI	Primary data value (includes Watts or Joules)	Scientific notation (for example, “2.88E-3”)
QUAD	X, Y coordinate values for quad LM probes	Scientific notation
FLAG	Flags	16-bit hexadecimal integer form
SEQ	Sequence ID	32-bit unsigned integer form
PER	Pulse period (expressed in µSec, Joules mode)	32-bit unsigned integer form

Measurement Data Format

ASCII Data Record Format

By default, data records are sent to the host in ASCII text. A data record is a set of one or more comma-delimited data values generated at the same instant, ending in "<CR><LF>".

The selected meter measurement mode controls the type of measurement data that is sent over the host interface. The user receives energy readings from the host interface if the measurement mode is "J". The user receives power readings from the host interface if the measurement mode is "W". Watts or Joules are expressed as units per square centimeter if area correction is active.

The following information is available with each data record:

- PRI (Measurement value in "%.3E" format when fast channel is used and "%.5E" format for any other power probe type)
- QUAD (Measurement values in "%.2E, %.2E" format for the X,Y coordinates when a quad LM sensor is connected.
- FLAG (Flags)—refer to Table 4-8 (p. 4-20)
- SEQ (Sequence number, formatted as a decimal integer)
- PER (Period value, expressed in decimal integer as microseconds)

The meter internally generates a data record according to the following rules:

- With every pulse when a thermopile probe is attached and if Joules mode is selected
- When a measurement sample is taken, a thermopile or optical probe is attached, and Watts mode is selected

Since thermopile and optical power measurements are continuous in nature (not event-based as with pyroelectric probes), the delivery of this data can be configured as a stream of sampled points or simply the last point recorded.

The presentation of the data items in a data record are in PRI, QUAD- X, QUAD-Y, FLAG, SEQ, or PER order, depending on which tokens are specified (see the following table).

Table 4-7. Measurement Data Record Format, ASCII

Measurement Mode	Measurement Record Format
Watts or long pulse Joules	<PRI>,<FLAG>,<SEQ>
Watts or long pulse Joules (quad LM sensors)	<PRI>,<QUAD-X>,<QUAD-Y>,<FLAG>,<SEQ>
Joules	<PRI>,<FLAG>,<SEQ>,<PER>

The FLAG data item can be used so that accompanying qualification information is reported with each data record. Qualification information includes various error conditions. The flag word is reported in the ASCII form of an 8-bit uppercase hexadecimal number. Each bit has a qualification meaning, as described in the following table.

Table 4-8. FLAG Bit Definitions

Bit Position	Hex Bit Mask	Qualification Meaning
0	01	Trigger event
1	02	Baseline CLIP
2	04	Calculating (PTJ mode only)
3	08	Final energy record (PTJ mode only)
4	10	Over-range
5	20	Under-range
6	40	Measurement is sped up
7	80	Over-temperature error
8	100	Missed measurement
9	200	Missed pulse
xxx	000	No qualification exists

Trigger Parameters

Trigger Source

This command selects the trigger source. Trigger Source only applies to pyroelectric probes.

Command: TRIGger:SOURce {INTernal|EXTernal}
Default is INTernal

Query: TRIGger:SOURce?
Reply: INT|EXT

The trigger source setting have no effect on devices positioned as slaves in trigger bussed configurations. All slaves receive their triggers from the trigger bus.

Internal Trigger

Level

This command sets the trigger level expressed as an absolute power or energy value, depending on which measurement mode is selected. This command only applies to pyroelectric and fast power probes.

If a pyroelectric probe is attached, the minimum trigger level is 0.0001 percent of the maximum Joules rating of the probe and the maximum trigger level is 30 percent of maximum Joules rating of the probe.

If a PM-Pro probe is attached and Joules mode is selected, the minimum trigger level is 0.0001 percent of the maximum Power rating of the probe and the maximum trigger level is 100 percent of maximum Power rating of the probe. All other modes have a minimum trigger level of 0 (zero) and a maximum trigger level that is the maximum power rating of the probe.

To determine the minimum and maximum values of the probe, use the query TRIGger:LEVel? MIN and TRIGger:LEVel? MAX, respectively.

Command:
TRIGger:LEVel {MINimum|MAXimum|<probe dependent>}
Default is probe dependent

Query: TRIGger:LEVel? {MINimum|MAXimum}
Reply: probe dependent

Percent Level

Using this command for any probe type sets the trigger level expressed as a percentage of the maximum power or Joules rating of the probe.

Command:
TRIGger:PERcent:LEVel {DEFault| MINimum|MAXimum: 0.0001..100.0}
Default is 5

Query: TRIGger:PERcent:LEVel? {DEFault|MINimum|MAXimum}
Reply: 0.0001..100.0

The trigger level setting has no effect when external triggering is selected.

External Trigger

The external trigger settings have no effect when internal triggering is selected or on devices that are positioned as slaves in trigger bussed configurations. This command only applies to pyroelectric and fast power probes.

Edge Select

This command selects the external trigger edge. The selected trigger edge is the external trigger event.

Command: TRIGger:SLOPe {POSitive|NEGative}
Default is POSitive

Query: TRIGger:SLOPe?
Reply: POS|NEG

Delay

This command selects the external trigger delay time. The internal trigger happens at the time marked by the external trigger delay time after the selected external trigger edge. The trigger delay time units are microseconds.

Command: TRIGger:DELay {0..1000}
Default is 0

Query: TRIGger:DELay?
Reply: 0..1000

Set Sequence ID

This command sets the sequence ID. It must be an integer value.

The sequence ID is used for data synchronization of multiple meters sharing the same trigger signal.

Command: TRIGger:SEQuence {0..16777215}
Default is 0

Query: none

Measurement Data Collection

Measurement data can be collected in two ways:

1. Receiving measurement data records from a continuous data stream.
2. Querying the last data record generated

The host has control over when measurement data is transmitted. Transmission is enabled after a STARt command. Transmission is disabled after a STOP command. All measurement data records are transmitted immediately as they are generated while transmission is enabled.

Last Data Record Query

This query gets the last recorded measurement at the time of the query. There is no reply transmitted if no measurement has been recorded.

Command: none

Query: READ?
Reply: <last measurement record>

The last measurement record is composed of comma-delimited data items generated at the same instant if in ASCII mode, or a packet of binary data of a fixed length. Data items presented, including a flags item, will vary depending on the measurement and statistics modes and the data items selected. Refer to Table 4-7 (p. 4-19).

Data Gating

Start Command

This command enables data streaming for a continuous or fixed length transmission. An optional number of samples between 0 and 2^32 -1 can be selected. In Snapshot mode, the maximum number of requested samples can be 240,000. A value of zero is equivalent to infinity. This command is ignored if data streaming transmission has already started.

Command: STARt <optional number of requested samples>

Query: none

Stop Command

This command disables data streaming interface transmission and is ignored if data streaming interface transmission is already disabled.

Command: STOP

Query: none

Force Trigger Command

This command forces a data transmission when in Snapshot mode. This command does not respond with an 'OK' if handshaking is enabled but will, instead, transmit data.

Command: FORCe

Query: none

Note: An ERR-200 is raised if the command is sent outside of Snapshot mode and no STARt command has been issued.

Meter and Probe Device Information

The sensor can be queried for unit identification and quality control information.

Meter

Serial Number

This query gets the meter serial number. The query is always available. Restrict the serial number string to no more than 20 characters (white space is not allowed).

Command: none

Query: SYSTem:INFormation:INSTrument:SNUMber?
Reply: <quoted meter serial number>

Part Number

This query gets the part number and is always available. Restrict the part number string to no more than 20 characters.

Command: none

Query: SYSTem:INFormation:INSTrument:PNUMber?
Reply: <quoted part number>

Model Name

This query gets the model name and is always available. Restrict the model name to no more than 20 characters.

Command: none

Query: SYSTem:INFormation:INSTrument:MODel?
Reply: <quoted model name>

Calibration Date

This query gets the calibration date and is always available. Restrict the date string to no more than 20 characters.

Command: none

Query: SYSTem:INFormation:INSTrument:CDATe?
Reply: <quoted calibration date>

Manufacturing Date

This query gets the manufacturing date and is always available. Restrict the date string to no more than 20 characters.

Command: none

Query: SYSTem:INFormation:INSTrument:MDATe?
Reply: <quoted calibration date>

Meter Type

This query returns the meter type as TOP or TO. *TOP* means the meter supports Thermopile, Optical, and Pyroelectric detectors (probes). *TO* meters only support Thermopile and Optical detectors (probes).

Command: none

Query: SYSTem:INFormation:INSTrument:TYPE?
Reply: TOP|TO

Firmware Version

This query returns the firmware version of the meter.

Command: none

Query: SYSTem:INFormation:INSTrument:FVER?
Reply: <firmware version>

FPGA Hardware Version

This query returns the hardware version of the FPGA in the meter.

Command: none

Query: SYSTem:INFormation:FPGA:HVER?
Reply: <hardware version>

FPGA Firmware Version

This query returns the firmware version of the FPGA in the meter.

Command: none

Query: SYSTem:INFormation:FPGA:FVER?
Reply: <hardware version>

Probe

Type

This query gets the currently-connected probe type.

Command: none

Query: SYSTem:INFormation:PROBe:TYPE?
Reply: <type>,<qualifier>

<type> = NONE, THERMO, PYRO, or OPT

<qualifier> = NONE, SINGLE, QUAD, or NOSPEC

NONE,NONE is returned when there is no valid probe attached. THERMO,QUAD or THERMO,SINGLE is returned when a valid thermopile probe is attached. PYRO,NOSPEC is returned when a valid pyroelectric probe is attached. OPT,NOSPEC is returned when a valid optical probe is attached.

Model

This query gets the currently-connected probe model.

Command: none

Query: SYSTem:INFormation:PROBe:MODel?
Reply: <probe model string>

The probe model string is the name string of the attached probe and is the generic name of the attached probe if the string does not exist. The reply string is not quoted.

The following naming rules apply (in the order listed):

1. An empty string, if a valid probe is not attached
2. The probe model string stored within the probe EEPROM, if a probe model string exists
3. “LM” if a valid LM style probe is attached and a probe model string does not exist
4. “PM” if a valid PM style probe is attached and a probe model string does not exist
5. “Unknown” in all other cases

Serial Number

This query gets the serial number of the probe.

Command: none

Query: SYSTem:INFormation:PROBe:SNUMber?
Reply: <probe serial number>

An empty string is returned if a valid probe is not attached.

Responsivity

This query gets the currently-connected probe calibration responsivity. Responsivity units depend on the probe type.

Command: none

Query: SYSTem:INFormation:PROBe:RESPonsivity?
Reply: <responsivity>

0.0 is returned if a valid probe is not attached.

Calibration Date

This query gets the calibration date of the probe.

Command: none

Query: SYSTem:INFormation:PROBe:CDATe?
Reply: <probe calibration date>

The date is expressed using the ASCII string format of "<3 character month name> <day of the month> <year>". An empty string is returned if a valid probe is not attached.

Head Temperature

This query gets the head temperature of the probe.

Command: none

Query: SYSTem:INFormation:PROBe:TEMPerature?
Reply:
<probe head temperature in degrees Celsius in integer format>

The literal string "NA" (quotes not included) is returned if a valid probe is not attached or the attached probe does not have a temperature measurement device.

Diameter

This query gets the probe diameter.

Command: none

Query: SYSTem:INFormation:PROBe:DIAMeter?
Reply: <probe diameter in mm>

The literal string "NA" (quotes not included) is returned if a valid probe is not attached or the attached probe diameter value is not known.

Persistent Parameters

Table 4-9. Persistent Parameters[a]

Parameter Description	Data Argument Range	Factory Value
Message Prompt	ON|OFF	OFF
Message Handshaking	ON|OFF	OFF
Measurement Mode	DBM|Joules|Watts	Watts
Measurement Record Data Items	PRI|FLAG|SEQ	PRI
Area Correction State	ON|OFF	OFF
Area Correction Aperture	0.01..500.00	1.0
Speedup Applied	OFF|ON	OFF
Wavelength Correction State	OFF|ON	ON
Analog Output Full Scale Voltage	1|2|4	2
Numeric Smoothing	OFF|ON	OFF
Wavelength of Operation	1..99999	193
Gain Compensation State	OFF|ON	OFF
Gain Compensation Factor	0.001..999.000	1.0
Selected Range	The maximum measurement expected	3.0
Auto Ranging State	ON|OFF	ON
Trigger Source	Internal|External	Internal
Trigger Edge	Rising|Falling	Rising
Trigger Delay	0..1000	0

a. PC host software settings will overwrite persistent parameters.

Host Interface Glossary

Factory settings - Persistent settings typically set by the manufacturer. These settings are parameters whose access is restricted by password. Factory settings do not include operational parameters.

Ignored command /query - A defined response for commands or queries in which no internal or external action is taken and the command or query is dropped. The meter responds to ignored commands/queries as if the command/query was never sent.

Message - The transmission of a properly-terminated string from host to sensor or from sensor to host.

Over-range error - A measurement error condition in which the measurement exceeds the measurement capability of the device.

Over-temperature error - A measurement error condition in which the temperature of the sensor exceeds the over-temperature setting.

Reset cycle - The reception of a reset command or the action of disconnecting power and then reconnecting power to the sensor. Either event sets all non-persistent operational parameters to their default settings.

SECTION FIVE: CALIBRATION AND WARRANTY

In this section:

Calibration

Coherent laser power and energy meters are precision instruments, capable of delivering very accurate measurements, as well as providing many years of useful service. To maintain this high level of performance, it is important to have your measurement system serviced and recalibrated once a year.

Coherent Calibration Facilities and Capabilities

As the largest laser manufacturer in the world, Coherent has been able to build state-of-the-art calibration facilities containing the widest possible range of laser types and technologies. This enables us to perform instrument and sensor calibration under virtually any combination of wavelength, power, and operating characteristics. Sensors are calibrated against NIST-traceable working standard sensors which are, in turn, calibrated against NIST-calibrated golden standard sensors. These working and golden standards are maintained with the utmost care, recalibrated annually, and verified even more regularly. We maintain multiple NIST-calibrated standards at many laser wavelengths to support the growing calibration needs of our customers. Optical calibration is a core competency at Coherent and we strive to continually improve our methods, precision, and repeatability. Additionally, most of the calibrations are performed with highly automated systems, thus reducing the possibility of human error to nearly zero. Strict quality inspections during many stages of calibration and testing assure a precise and accurate instrument that is NIST traceable and CE marked. The benefit to our customers is that instruments calibrated by Coherent will consis-

tently perform as expected under their actual use conditions. We are a registered ISO 9001:2000 company, our products are NIST traceable, and our calibration labs are fully ANSI Z540 compliant.

In addition to the technological advantage, we also strive to deliver the best service in the industry, with a knowledgeable and responsive staff, and rapid turnaround.

Limited Warranty

Coherent, Inc. (the "Company") warrants its laser power and energy meters and sensors products ("Products") to the original purchaser (the "Customer") that the product is free from defects in materials and workmanship and complies with all specifications, active at the time of purchase, for a period of twelve (12) months.

Coherent, Inc. will, at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferable.

Extended Warranty

Coherent, Inc. (the "Company") offers original purchasers (the "Customer") purchasing laser power and energy meters and sensors products ("Products") an extended twelve (12) month warranty program, which includes all parts and labor. In order to qualify for this warranty, a Customer must return the Product to the Company for recalibration and recertification. The Company will re-certify the Product, provide software upgrades, and perform any needed repairs, and recalibrate the Product, for a fixed service fee (as established by the Company from time to time and in effect at the time of service). If the product cannot be re-certified due to damage beyond repair, parts obsolescence, or other reasons, the Customer may be informed that an Extended Warranty program is not available for the Product.

If the Product fails and is returned to the Company within one year following the date of recalibration and recertification service, the Company will, at its option, repair or replace the Product or any component found to be defective. If the Product must be replaced and the Product is no longer available for sale, Coherent reserves the right to replace with an equivalent or better Product. This warranty applies only to the original purchaser and is not transferable.

Warranty Limitations

The foregoing warranties shall not apply, and Coherent reserves the right to refuse warranty service, should malfunction or failure result from:

- Damage caused by improper installation, handling or use.
- Laser damage (including sensor elements damaged beyond repair).
- Failure to follow recommended maintenance procedures.
- Unauthorized product modification or repair.
- Operation outside the environmental specifications of the product.

Coherent assumes no liability for Customer-supplied material returned with Products for warranty service or recalibration.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL, OR IMPLIED. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR ANY INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS PRODUCTS.

Obtaining Service

In order to obtain service under this warranty, Customer must notify the Company of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Company shall, in its sole discretion, determine whether to perform warranty service at the Customer's facility, at the Company's facility or at an authorized repair station.

If Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall package the product (to protect from damage during shipping) and ship it to the address specified by the Company, shipping prepaid. The customer shall pay the cost of shipping the Product back to the Customer in conjunction with recalibration and recertification; the Company shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve months of time of sale or during an extended twelve month warranty period.

A Returned Material Authorization number (RMA) assigned by the Company must be included on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender.

For the latest Customer Service information, refer to our website: www.Coherent.com.

Detailed instructions on how to prepare a product for shipping are given under Product Shipping Instructions, below.

Table 5-1. Coherent Service Centers

Location	Phone	Fax	E-mail
USA	1.800.343.4912	503.454.5777	info_service@Coherent.com
Europe	+49-6071-968-0	+49-6071-968-499	info_service@Coherent.com
International	503.454.5700	503.454.5777	info_service@Coherent.com

Product Shipping Instructions

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service (refer to Table 5-1, above) for a Return Material Authorization number.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Coherent Customer Service.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. If the original packing material and carton are not available, obtain a corrugated cardboard shipping carton with inside dimensions that are at least 6 in. (15 cm) taller, wider, and deeper than the product. The shipping carton must be constructed of cardboard with a minimum of 375 lb. (170 kg) test strength. Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the product. Allow 3 in. (7.5 cm) on all sides, top, and bottom.
5. Seat the shipping carton with shipping tape or an industrial stapler.
6. Ship the product to:

   Coherent, Inc.
   27650 SW 95th Ave.
   Wilsonville, OR 97070
   Attn: RMA # (*add the RMA number you received from Coherent Customer Service*)

APPENDIX A: SPECIFICATIONS

Meter Specifications

This appendix lists specifications for the LabMax-Pro SSIM Laser Power Meter.

Table A-1. Specifications (Sheet 1 of 2)

Parameter	Description
Measurement Resolution (%) (full-scale) at 10 Hz speed at 20 kHz high-speed	 0.1 0.2
Sensor Compatibility	PM Model Thermopile, PowerMax-Pro, LM Model Thermopile, OP-2 & LM-2 Optical, and DB25 EnergyMax pyroelectric
Measurement Range	Sensor dependent (reference sensor specifications)
Accuracy (%) Digital Meter System Analog Output	 ± 1 Meter + sensor ± 1
Calibration Uncertainty (%) (k = 2)	± 1
Power Sampling Rate Thermopile (Hz) PowerMax-Pro - Standard-Speed (Hz) PowerMax-Pro - High-Speed (Hz) PowerMax-Pro - Snapshot Mode (kHz) Pyroelectric (Hz) LM-2/OP-2 Optical (Hz)	 10 10 20 kHz 625 10000 10
Analog Output (VDC)	0 to 1, 2, or 4V (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 and pulse energy (with PowerMax-Pro in High-Speed and Snapshot mode), beam position with LM Model thermopiles
Computer Interface	USB and RS-232
Pulse Triggering	Internal and External
Temperature Operating Range Storage Range	 5 to 40°C (41 to 104°F) -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 lb.)

Table A-1. Specifications (Sheet 2 of 2)

Parameter	Description
Front Panel	Power switch USB high-speed port (mini-B connector) Trigger output (SMB connector) Analog output (SMB connector) RS-232 port (DB-9F connector)
Rear Panel	DB-25 sensor port External trigger input (SMB connector, 3 to 5 Vin, 2 to 10 mA, 50 ohm AC, 300 ohm DC impedance) Power jack (12 VDC - center positive)
Part Number[a]	1268881

a. Meter supplied with AC power adapter, power cord, USB cable, trigger cable, software and driver CD, and certificate of calibration.

Persistent Parameters

Refer to “Persistent Parameters” (p. 4-28).

APPENDIX B: ERRORS

Meter and Sensor Errors

Table B-1. Meter and Sensor Errors

Displayed Message	Cause	Corrective Action
AnnounceFaultsWindow	One or more system faults have been reported	Reference the specific corrective action shown next to the error in the error message
Confirm Buffer Clear	Trying to change the buffer size when the buffer contains unsaved data	Click OK to discard the data or Cancel to preserve the data
Hardware Incompatibility Error	Software is connected to a meter that has obsolete firmware or hardware	Install newer firmware or software, or install older software that is compatible
Standard Mode vs. Snapshot Mode Conflict	De-selecting High-Speed mode in the Home tab while Snapshot mode is enabled in the Data Buffer tab.	Press Yes to disable Snapshot mode and change to Standard mode, or press No to remain in High-Speed and Snapshot mode
Meter Reports Missing Data	Data samples from the meter were marked with the Missing Data flag	None—missing data is not recoverable
Meter's User Settings Restored to Default	Factory defaults are being overwritten with non-factory default user settings.	Unplug the meter from the computer before restoring the factory defaults.
Meter was disconnected	Meter is not connected	Connect the meter to the sensor and the PC
No Com Port Selected	Com port not selected	Select Com port
Snapshot Mode Setting Conflict	Not all requirements have been met for entering Snapshot mode	Click Confirm Changes to make necessary setting adjustment and enable Snapshot mode, or click Cancel Request to leave all settings unchanged
Unable to launch Updater Program	Software is unable to find the updater application when you press the Check for Updates button	Reinstall the software.
Unable to Open Meter on COM1	Port not connected to a meter or another application is using the port	Select an available Com port
Unexpected Error Encounter	Unexpected error condition	Reference the specific corrective action shown next to the error in the error message—unrecoverable errors require you to exit the application

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LabMax™-Pro SSIM User Manual
©Coherent, Inc., 5/2015 (RoHS), printed in the USA
Part No. 1269224 Rev. AC