

LabMax-Pro SSIM

User Manual



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PREFACE

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.

Anyone setting up or operating the LabMax-Pro SSIM Laser Power Meter must first read and understand how safety information is presented prior to beginning any tasks.



This user information reported in this manual is in compliance with the following standards for Light-Emitting Products EN/IEC 60825-1 “Safety of laser products – Part 1: Equipment classification and requirements” 21 CFR Title 21 Chapter 1, Subchapter J, Part 1040 “Performance standards for light-emitting products”.

Safety Warnings

This section provides information about signal words and safety symbols that you need to know before you begin to use the LabMax-Pro SSIM Laser Power Meter.

Signal Words

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

These signal words designate the degree or level of hazard when there is the risk of injury, as described in Table 1:

Preface Table-1. Signal Words

SIGNAL WORD	DESCRIPTION
DANGER	Indicates a hazardous situation that, if not avoided, WILL result in <i>death or serious injury</i> . This signal word is to be limited to the most extreme situations.
WARNING	Indicates a hazardous situation that, if not avoided, COULD result in <i>death or serious injury</i> .
CAUTION	Indicates a hazardous situation that, if not avoided, could result in <i>minor or moderate injury</i> .
NOTICE	Indicates information considered important, but not hazard-related. The signal word “NOTICE” is used when there is the <i>risk of property damage</i> .

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. The icons are intended to alert the operator as described in Table 2:

Preface Table-2. Safety Symbols

ICON	ALERTS THE OPERATOR TO...
	Important notes or instructions for operation and maintenance.
	Danger of exposure to hazardous visible and invisible laser radiation.
	Dangerous voltages when working with other equipment may be of sufficient magnitude to constitute a risk of electric shock.
	Danger of susceptibility to Electro-Static Discharge (ESD).

Export Control Laws

It is the policy of Coherent to comply strictly with export control laws of the United States of America (USA).

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 (ITAR).

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 laws in the USA, clarification must be obtained from Coherent or an appropriate agency of the U.S. Government.

For 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.

SECTION ONE: PRODUCT DESCRIPTION

This section describes the following topics:

- Introduction (this page)
 - Product features (p. 1-2)
 - Sensor compatibility (p. 1-2)
- Hardware (p. 1-2)
- Specifications (p. 1-4)

Introduction

Coherent has developed the LabMax-Pro SSIM Laser Power Meter to fully capitalize on the capabilities of PowerMax-Pro sensor technology. The meter is also compatible with PowerMax model thermopiles in standard operating mode.

The LabMax-Pro SSIM meter is packaged as a **Smart Sensor Interface Module (SSIM)**, shown in Figure 1-1:



Figure 1-1. LabMax-Pro SSIM

This module interfaces with a host computer through either a USB or RS-232 connection. *LabMax-Pro PC*, a Windows PC application, enables instrument control and displays measurement results—including laser tuning, high-fidelity pulse shape visualization and energy integration—on a host computer.

In addition, a complete set of host commands can be sent through either the USB or RS-232 interface, which is useful for embedded applications.

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. This allows the user to size the information of greatest importance.

Product Features

The features of the LabMax-Pro SSIM Laser Power Meter include:

- USB 2.0 “High-Speed” and RS-232 connectivity.
- Instrumentation platform is compatible with PowerMax model thermopile sensors, PowerMax-Pro sensors, LabMax model position-sensing thermopiles, LM-2 & OP-2 optical sensors, and EnergyMax DB25 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. Software updates are available from within the application or from the Coherent website.
- 32-bit and 64-bit Microsoft Windows v7, v8, and v10 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.

Sensor Compatibility

The LabMax-Pro SSIM Laser Power Meter is compatible with PowerMax-Pro, PowerMax model thermopiles, LabMax model thermopiles, OP-2 & LM-2 optical sensors, and DB-25 EnergyMax sensors. For a current list of all compatible sensors and their specifications, go to www.Coherent.com/LMC.

Hardware Features

This section describes the hardware features of the LabMax-Pro SSIM Laser Power Meter.

The Meter is supplied with an AC power adapter, power cord, USB cable, trigger cable, software and driver, and Certificate of Calibration.

Front Panel

Figure 1-2 shows the front panel on the LabMax-Pro SSIM Laser Power Meter:

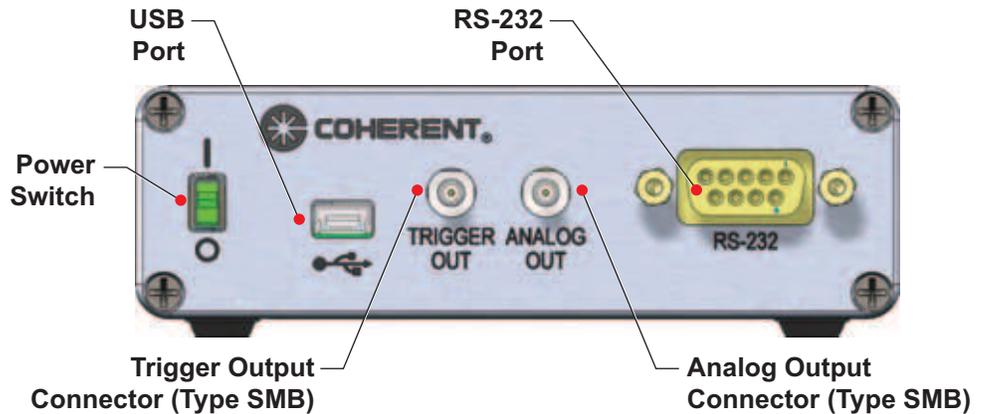


Figure 1-2. LabMax-Pro SSIM Front Panel

USB/RS-232 Ports

LabMax-Pro requires a USB 2.0 High-Speed USB to communicate with the PC. A Type A-to-Type Mini B USB cable (P/N 1108906) is included with the LabMax-Pro SSIM Laser Power Meter.

RS-232 connections are intended for OEM integration and cause reduced data transfer rates.

Power Switch

The Power Switch is a toggle switch that turns power ON or OFF.

Analog or Trigger Output

In addition to interfacing with a PC, LabMax-Pro SSIM also includes an analog output with user-selectable voltages of 0 to 1V, 2V, or 4V. Triggering is done using either an external trigger input or a user-adjustable internal trigger. See “Section Two: Operation” (p. 2-1) for details.

Back Panel

Figure 1-3 shows the back panel on the LabMax-Pro SSIM Laser Power Meter.

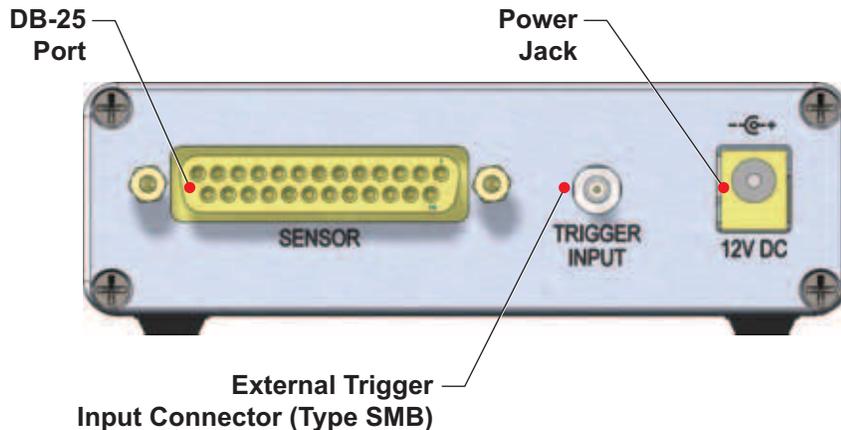


Figure 1-3. LabMax-Pro SSIM Back Panel

DB-25 Port This port provides a DB-25 connection to the LabMax-Pro SSIM Laser Power Meter.

Power Input Power is supplied through an external 12 VDC/15W universal power supply (P/N 1105427). A power cable appropriate for the country to which the meter is shipped is included with the LabMax-Pro SSIM Laser Power Meter.

External Trigger Input Triggering is done using either an external trigger input or a user-adjustable internal trigger. See “Section Two: Operation” (p. 2-1) for details.

Specifications

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

Table 1-1 lists specifications for the operating environment for the LabMax-Pro SSIM.

Table 1-1. Operating Environment Specifications

PARAMETER	DESCRIPTION
Temperature	
Operating Range	5 to 40°C (41 to 104°F)
Storage Range	-20 to 70°C (-68 to 158°F)
Humidity	Non-condensing

Table 1-2 lists the general specifications for the LabMax-Pro SSIM Laser Power Meter (P/N 1268881).

Table 1-2. General Specifications

PARAMETER	DESCRIPTION
Measurement Resolution (%) (full-scale)	
at 10 Hz speed	0.1
at 20 kHz high-speed	0.2
Sensor Compatibility	Power-Max Thermopile, PowerMax-Pro, LabMax Thermopile, OP-2 & LabMax-2 Optical, and DB-25 EnergyMax pyroelectric
Measurement Range	Sensor dependent (see sensor specifications)
Accuracy (%)	
Digital Meter	± 1
System	Meter + sensor
Analog Output	± 1
Calibration Uncertainty (%) (k = 2)	± 1
Measurement Analysis	Trending, tuning, histogram, data logging, statistics (minimum, maximum, mean, range, standard deviation, dose, stability), pulse shape and pulse energy (with PowerMax-Pro in High-Speed and Snapshot Mode), beam position with LabMax Model thermopiles
Pulse Triggering	Internal and External

Table 1-3 lists Power specifications for the LabMax-Pro SSIM Laser Power Meter.

Table 1-3. Power Specifications

PARAMETER	DESCRIPTION
Power Sampling Rate	
Thermopile	10 Hz
PowerMax-Pro — Standard Speed	10 Hz
PowerMax-Pro — High Speed	20 kHz
PowerMax-Pro — Snapshot Mode	625 kHz
Pyroelectric	10000 Hz
LM-2/OP-2 Optical	10 Hz
Analog Output	0 to 1, 2, or 4 VDC (selectable)
Analog Output Resolution	1 mV
Analog Output Update Rate	19 kHz
Instrument Power (external supply)	90 to 260 VAC, 50/60 Hz

Table 1-4 lists physical characteristics and specifications for the LabMax-Pro SSIM Laser Power Meter.

Table 1-4. Physical Specifications

PARAMETER	DESCRIPTION
Dimensions	105 x 105 x 32 mm (4.1 x 4.1 x 1.3 in.)
Weight	0.3 kg (0.6 lb.)
Computer Interface	USB and RS-232
Compliance	CE, RoHS, WEEE
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	DB25 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)

SECTION TWO: OPERATION

This section describes the following topics:

- Operating modes (p. 2-1)
- Input/Output
 - External trigger input (p. 2-3)
 - External trigger output (p. 2-5)
 - Analog output (p. 2-5)
- LabMax-Pro PC software (p. 2-5)

Operating Mode Overview

The LabMax-Pro SSIM Laser Power Meter uses three operating modes. These reflect the sampling rates (how fast the meter is taking a sample).

- Standard-Speed Mode (also referred to as “Slow Mode”)
- The following Modes are available only with PowerMax-Pro sensor:
 - High-Speed Mode
 - Snapshot Mode (also referred to as “Fast Mode”)

These are discussed in the sections that follow. For more details and tutorials about each mode, see the *LabMax-Pro PC Quick Start Guide*. Also see the “Section Three: Host Interface” (p. 3-1) for detailed information about commands and queries used in different operating modes.

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 photo diode, 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.

This feature is available only with PowerMax-Pro sensors.

Figure 2-1 shows data collected using a 20W CO2 laser to show the type of detail available in this mode.

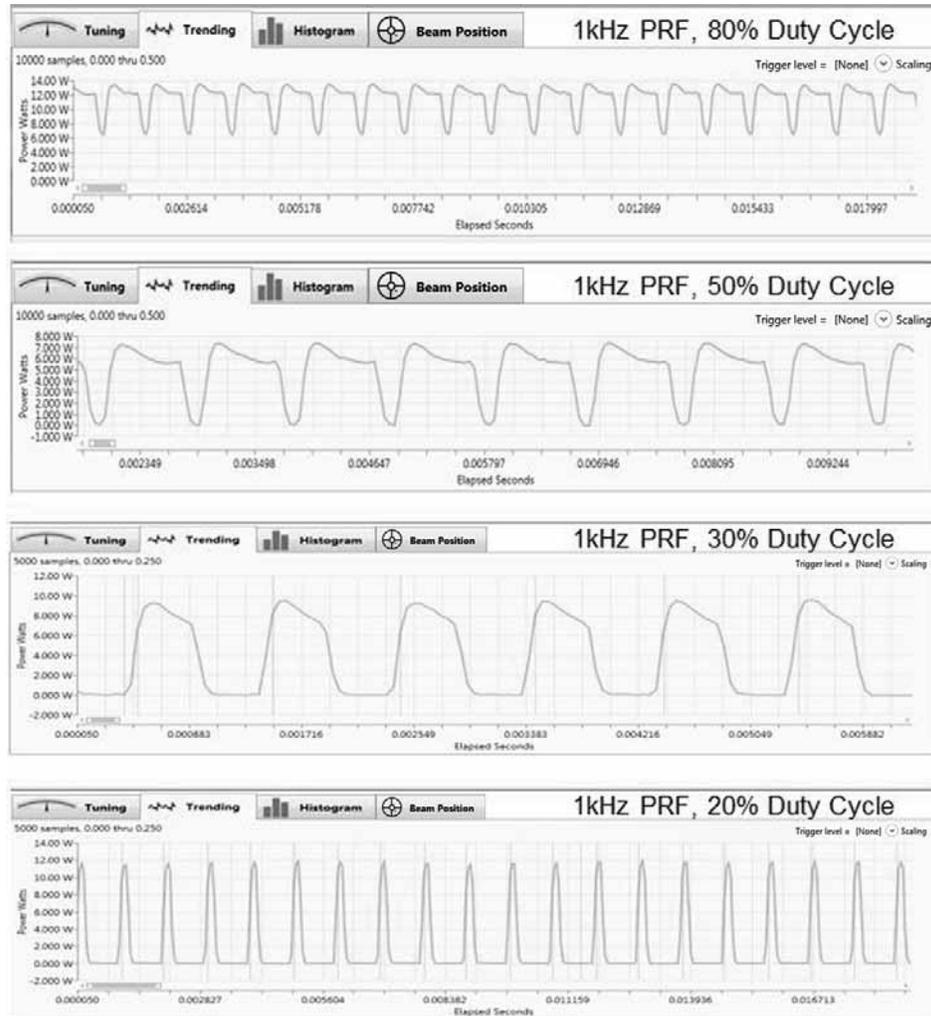


Figure 2-1. Example of Detail — High-Speed Mode

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 feature is available only with PowerMax-Pro sensors.

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

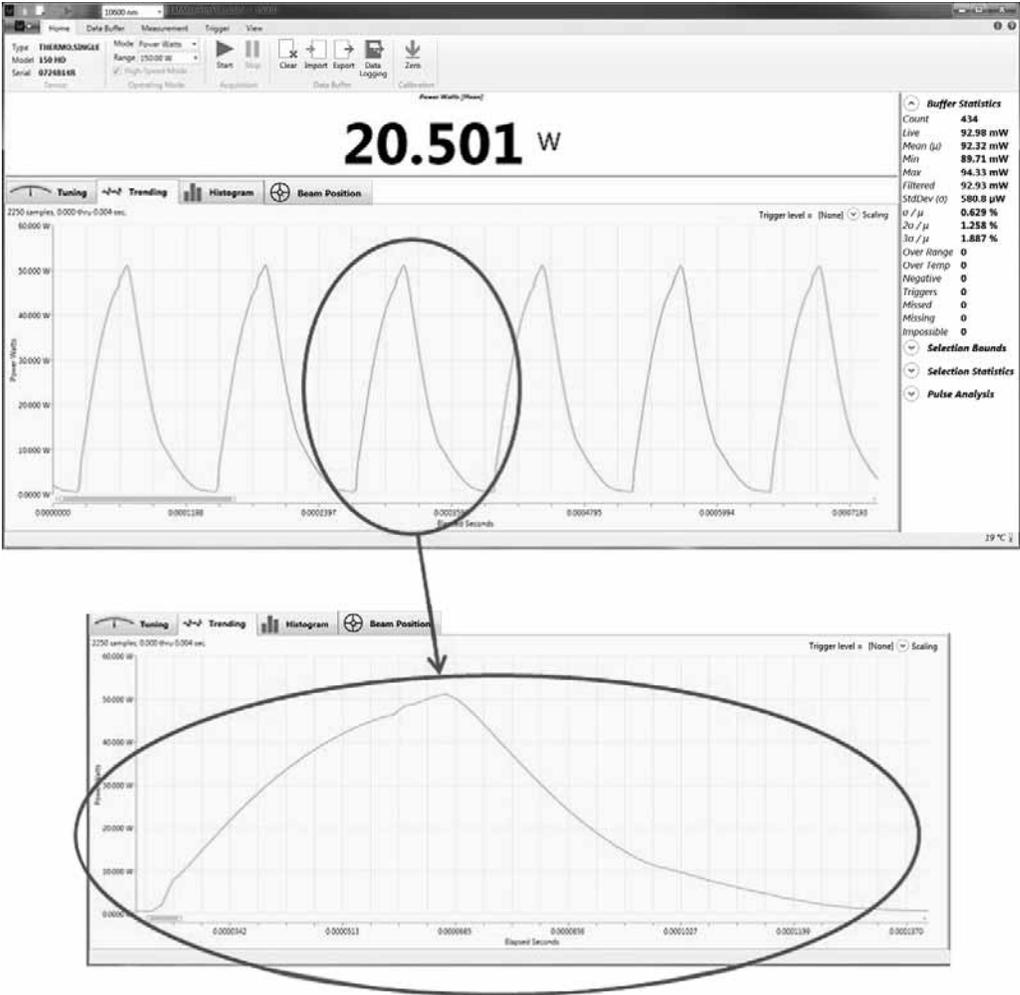


Figure 2-2. Example Detail — Snapshot Mode

Input/Output

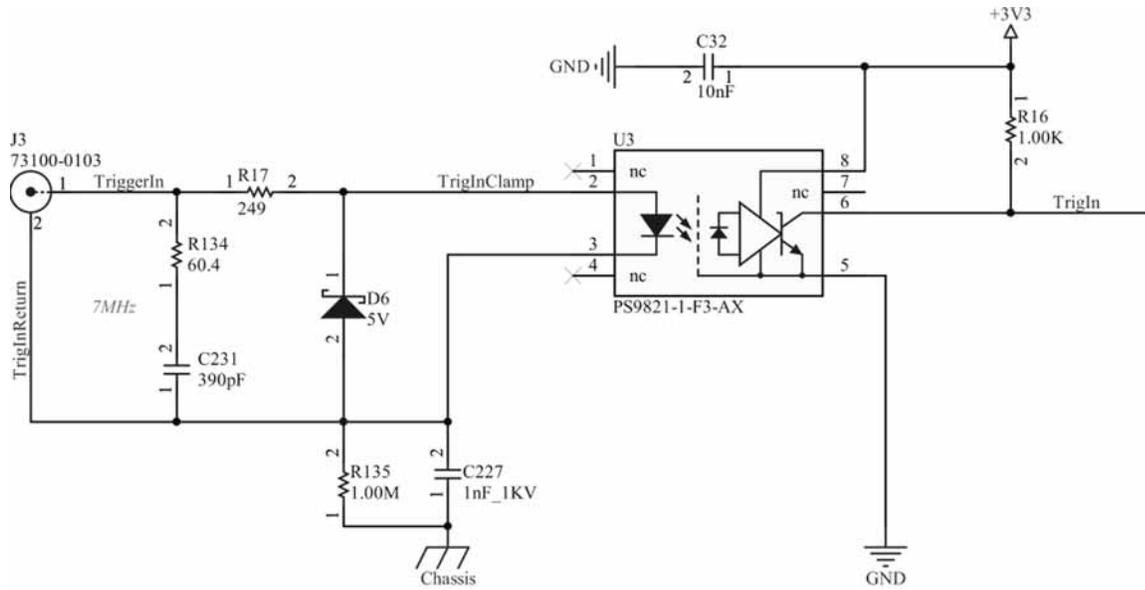
This section describes the following:

- External trigger input
- External trigger output
- Analog output

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.

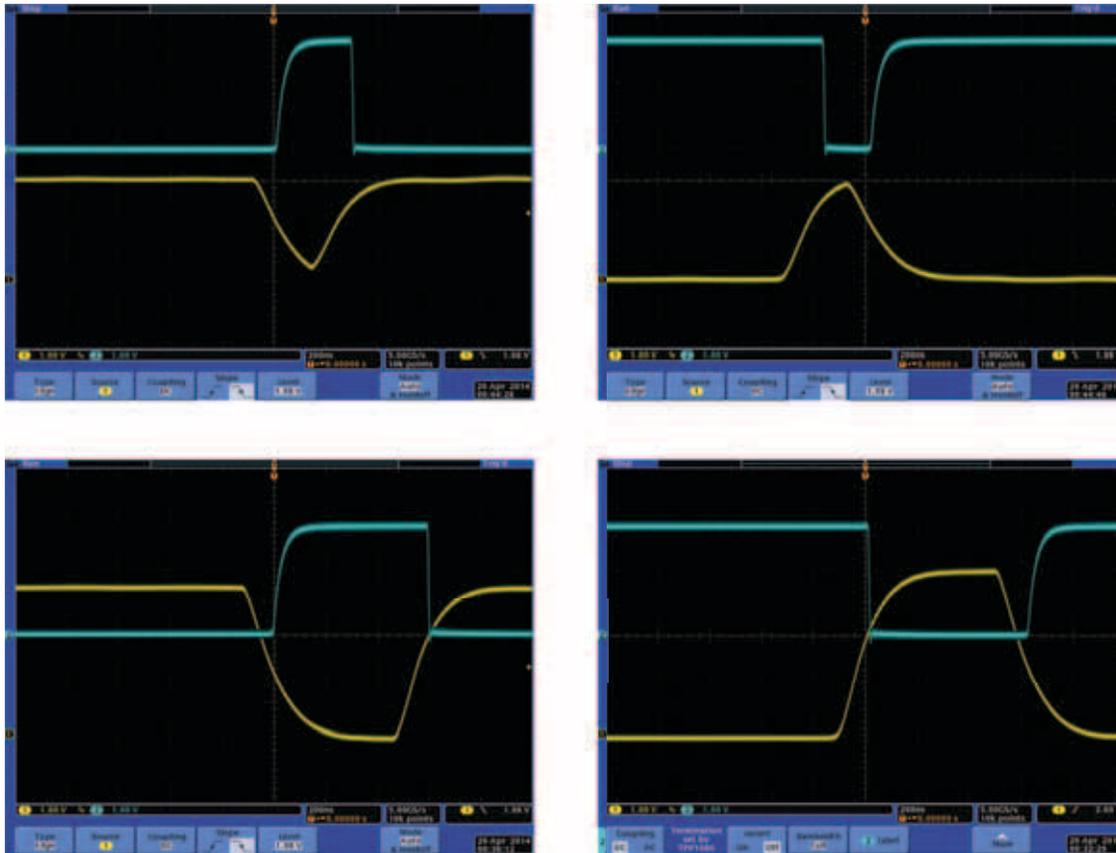
Figure 2-3 shows a simplified schematic of the external trigger input circuitry.



Trigger Input

Figure 2-3. External Trigger Input Circuitry

Figure 2-4 shows examples of trigger outputs.



Yellow = external trigger input
 Blue = optocoupler to output logic

Figure 2-4. Example Screens — Trigger Output

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 2-5.

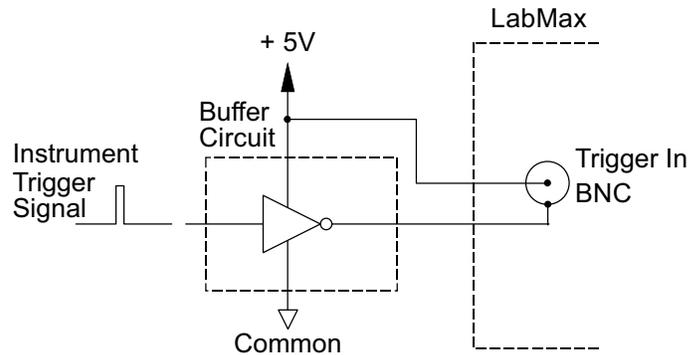


Figure 2-5. Boosting Source Current of Triggering Device

The external trigger signal can be either a rising or a falling edge. Trigger polarity is selected in the SETUP: Trigger menu of the LabMax-Pro PC software.



CAUTION!

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

External Trigger Output

The Trigger Out SMB connector on the front panel of the LabMax-Pro SSIM Laser Power Meter is a 15 nS, 5V pulse from a 50 ohm source. It is designed to cascade into another device's trigger input.

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.

LabMax-Pro PC Software

The LabMax-Pro PC application software offers plug-and-play software with 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 LabMax model thermopiles
- Statistics (mean, minimum, maximum, stability and standard deviation)
- Export comma or tab-delimited data for analysis in a spreadsheet—such as 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

Figure 2-6 illustrates some of the features of the LabMax-Pro PC software.

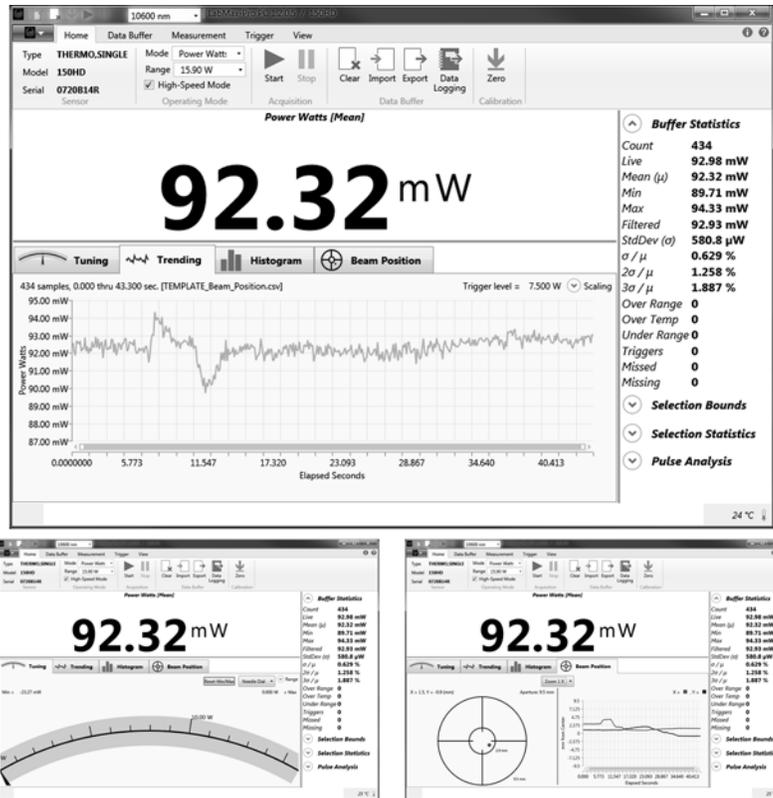


Figure 2-6. LabMax-Pro PC Software Features

Online Help

For more information about *La.bMax-Pro PC*, open the software and launch the HELP file at the top right of the screen.

SECTION THREE: HOST INTERFACE

This section defines high-level commands, responses, and behavior when using a the LabMax-Pro PC software. The low-level interface (which covers RS-232, USB, and other types of communication methods) is beyond the scope of this document except when it directly impacts the high-level interface.

This section includes information about the following topics:

- Message considerations (this page)
- Firmware and Hardware Considerations (p. 3-3)
- Summary of host commands (p. 3-4)
- Commands and Queries
 - Common Commands
 - System Options (p. 3-8)
 - Communications (p. 3-10)
 - Measurement Set-Up and Control (p. 3-12)
 - Statistics Mode Control (p. 3-20)
 - Measurement data Collection (p. 3-21)
 - Meter and Probe Device Information (p. 3-25)
- Error commands/queries and error codes (p. 3-26)
- Glossary of Host Interface terms (p. 3-29)

Message Considerations

This section provides additional information about various messages that may be displayed.

Message Terminators

Messages between the meter and the host computer are comprised entirely of ASCII string characters. The exception is a binary data streaming transmission that sends unsolicited binary encoded data.

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 meter must be terminated by a carriage return (decimal 13).

A line feed (decimal 10) following the carriage return is discarded so message terminator flexibility can be attained. A command or query is considered incomplete without proper termination.

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—with the exception of binary streaming data—are terminated by a carriage return (decimal 13) and line feed (decimal 10) pair.

The maximum length of any message sent by the meter is limited to 200 bytes, including all terminating characters.

Syntax and Notation Conventions

Syntax specified by the SCPI and IEEE 488.2 Standards is followed unless otherwise specified. Refer to the SCPI and IEEE 488.2 Standards for more information.

Notably, the base-10 numeric data format specification is used heavily in this document and covered in the IEEE 488.2 Standard. Unless otherwise specified, numeric data items referred to as NRF (IEEE flexible numeric representation) are interchangeable and may be represented in any of these formats:

- Integer values
- Non-scientific notation floating point values
- Scientific notation floating point values (uppercase E 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.

Devices interpret hexadecimal data using the following rules:

- Uppercase and lowercase are accepted (“FE” = “fe”)
- Leading zeros are required and accepted (“0A” = “A”)
- The data string may optionally be preceded by a “0x” or “0X” C hexadecimal notation idiom (0xD2C4 = D2C4)
- Following the optional “0x” prefix, the acceptable characters are from the list: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f, A, B, C, D, E, and F

Enumerated values must match exactly, using the long form/short form comparison rules defined under the SCPI Standard.

Dates (manufacturing date, calibration date, and so on) use the **YYMMDD** format. Using this format, dates may be stored as ASCII strings or as numeric long integers and converted easily from one format to the other.

Command Set for Remote Interface

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

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

Firmware and Hardware Considerations

This section describes the functional requirements for the firmware working with the hardware, as well as a list of factory-based settings and persistent parameters.

Firmware Requirements

This section describes firmware functional requirements that are related to this host interface specification section. The device firmware shall:

1. Sample sensor output voltage at a fixed rate of 10 Hz for most power probes. PowerMax-Pro power probes sample sensor output at a fixed rate of 20 kHz.
2. Sample the thermistor voltage at a fixed rate of 10 Hz, if the device is a thermopile sensor.
3. Process and calculate pulsed thermopile Joules measurements in the same way as LabMax.
4. Apply temperature compensation (thermopile sensors only), wavelength correction, and power compensation on every measurement sample.
5. Apply speed-up if the feature is enabled and the device is a thermopile sensor.
6. Transmit and receive RS-232 messages at a fixed baud rate of 115200 if the device is configured for RS-232 operation until it is changed using the baud rate host command.

Operating Modes and Commands/Queries

The LabMax-Pro SSIM Laser Power Meter uses three operating modes. These reflect the sampling rates (how fast the meter is taking a sample).

- Standard-Speed Mode (also referred to as “Slow Mode”)
- High-Speed Mode
- Snapshot Mode (also referred to as “Fast Mode”)

This section includes detailed information about commands and queries used in different operating modes.

Factory Settings

When a command is sent to the system, the parameter for the command is stored in internal persistent memory. Internal persistent memory has a logic cell life of one million write cycles. The cell life sets the limits for repetitive commands sent to the system.



NOTE: This applies only to commands and not to queries.

Table 1-1 lists the persistent parameters.

Table 1-1. Persistent Parameters

PARAMETER	DATA ARGUMENT RANGE	FACTORY VALUE
Message Prompt	ON OFF	OFF
Message Handshaking	ON OFF	OFF

Table 1-1. Persistent Parameters (continued)

PARAMETER	DATA ARGUMENT RANGE	FACTORY VALUE
Baud Rate: RS-232	9600,14400,19200,57600,115200	115200
Measurement Mode	DBM Joules Watts	Watts
Statistics Mode	Off (Default power-on state)	Off
Measurement Record Data items	PRI FLAG SEQ	PRI
Record Type Select	ASCii BINary	ASCii
Area Correction State	ON OFF	OFF
Area Correction Aperture	0.01 ... 500.00	1.0
Speed-Up Applied	ON OFF	OFF
Wavelength Correction State	ON OFF	ON
Analog Output Full-Scale Voltage	1 2 4	2
Numeric Smoothing	ON OFF	OFF
Wavelength of operation	1 ... 99999 (listed on the Certificate of Calibration for the sensor)	Calibration Wavelength
Gain Compensation State	ON OFF	OFF
Gain Compensation Factor	0.001 ... 999.000	1.0
Selected Range	The maximum measurement expected	3.0
Auto Ranging State	ON OFF	ON
Statistics Batch Size	Last Setting	10
Statistics Restart mode	Last Setting	Manual
Trigger Source	Internal External	Internal
Trigger Edge	Rising Falling	Rising
Trigger Delay	0 ... 1000	0

Summary of Commands

When using the LabMax-Pro PC software, some settings are automatically configured for the sensor. For example, handshaking may be turned on.



NOTICE!

Verify that all settings are in the state that you want, particularly if switching from using the software GUI to using RS-232 host commands.

The order of the commands listed in Table 1-2 is important. Generally, issue commands or queries as listed from the top to the bottom of the list.

Table 1-2. Summary of Host Interface Commands

COMMAND	DESCRIPTION	PAGE
SPCI Common Commands		
*RST	Resets all operational parameters to their power-on states.	p. 3-8
*IDN?	Gets the meter identification string.	p. 3-8
System Options		
SYSTem:TYPE?	Gets the system type string.	p. 3-8
SYSTem:STATus?	Gets the system status code.	p. 3-8
SYSTem:FAULt?	Gets the system fault code.	p. 3-9
SYSTem:REStore	Restores all user settings to the factory state.	p. 3-10
SYSTem:SYNC SYSTem:SYNC?	Resets or gets the system measurement sync timer.	p. 3-10
Communications		
SYSTem:COMMunicate:HANDshaking SYSTem:COMMunicate:HANDshaking?	Selects or gets the state of SCPI message round trip handshaking.	p. 3-10
SYSTem:COMMunicate:SERial:BAUD SYSTem:COMMunicate:SERial:BAUD?	Sets or gets the transmit and receive baud rates together when the device has an RS-232 serial host port.	p. 3-11
Measurement Set-Up and Control		
CONFigure:MEASure:MODE CONFigure:MEASure:MODE?	Sets or gets the measurement mode of the instrument in a in DBm, Watts, or Joules.	p. 3-12
CONFigure:MEASure:STATistics CONFigure:MEASure:STATistics?	Sets or gets the statistics processing mode to either ON or OFF.	p. 3-12
CONFigure:MEASure:SNAPshot:SElect CONFigure:MEASure:SNAPshot:SElect?	Sets or gets the instrument to acquire data in a burst or Snapshot Mode.	p. 3-12
CONFigure:MEASure:SNAPshot:PREbuffer CONFigure:MEASure:SNAPshot:PREbuffer?	Sets or gets the number of pre-trigger to be displayed on output after a trigger event.	p. 3-13
CONFigure:MEASure:SOURce:SElect CONFigure:MEASure:SOURce:SElect?	Sets the instrument to acquire data from either the slow or fast channel. If fast is selected, other commands are not available (see p. 3-13). Gets the current data channel.	p. 3-13
CONFigure:MEASure:SOURce:LIST?	Returns a list of available source channel selections for the attached probe. Not available in Snapshot Mode.	p. 3-13
CONFigure:SPEedup CONFigure:SPEedup?	Sets or gets the speed-up state. Not available for the PowerMax-Pro.	p. 3-13
CONFigure:AREA:CORRection CONFigure:AREA:CORRection?	Enables/disables or gets the area correction state.	p. 3-14
CONFigure:AREA:APERture CONFigure:AREA:APERture?	Sets or gets the aperture area expressed in square centimeters.	p. 3-14
CONFigure:AOUT:FSCale CONFigure:AOUT:FSCale?	Selects or gets the full-scale output voltage at the analog output connector. Not available in Snapshot Mode.	p. 3-14

Table 1-2. Summary of Host Interface Commands (continued)

	COMMAND	DESCRIPTION	PAGE
	CONFigure:AVERage:TIME CONFigure:AVERage:TIME?	Sets or gets the status of display data smoothing to either ON or OFF. Not available in Snapshot Mode.	p. 3-14
	CONFigure:WAVElength:CORRection CONFigure:WAVElength:CORRection?	Enables/disables or gets the status of wavelength correction.	p. 3-15
	CONFigure:WAVElength:WAVElength CONFigure:WAVElength:WAVElength?	Sets or gets the current, maximum allowed, or minimum allowed wavelengths.	p. 3-15
	CONFigure:WAVElength:LIST?	Gets the wavelength table entries from the probe.	p. 3-15
	CONFigure:GAIN:COMPensation CONFigure:GAIN:COMPensation?	Enables/disables or returns the status of gain compensation.	p. 3-16
	CONFigure:GAIN:FACTor CONFigure:GAIN:FACTor?	Sets or gets the gain compensation factor.	p. 3-16
	CONFigure:ZERO CONFigure:ZERO?	Sets or gets the current measurement as the zero baseline measurement.	p. 3-16
	TRIGger:PTJ:LEVel TRIGger:PTJ:LEVel?	Selects or gets the pulsed thermopile Joules mode trigger sensitivity level. Not available for PowerMax-Pro.	p. 3-16
NOT AVAILABLE IN SLOW MODE.	CONFigure:MEASure:WINDow CONFigure:MEASure:WINDow?	Sets or gets the pulse detection window size. Used only for PowerMax-Pro sensors in Joules mode.	p. 3-16
	CONFigure:DECimation CONFigure:DECimation?	Sets or gets the decimation rate for the first data acquisition channel.	p. 3-17
	CONFigure:RANGe:SElect CONFigure:RANGe:SElect?	Sets or gets the meter measurement range.	p. 3-17
	CONFigure:RANGe:AUTO CONFigure:RANGe:AUTO?	Enables/disables or gets the state of automatic selection of the meter measurement range. Not available in Snapshot mode.	p. 3-18
	CONFigure:RANGe:LIST CONFigure:RANGe:LIST?	Sets or gets the range table entries from the probe.	p. 3-18
NOT AVAILABLE IN SLOW MODE.	TRIGger:SOURce TRIGger:SOURce?	Sets or gets the trigger source for pyroelectric probes.	p. 3-18
	TRIGger:LEVel TRIGger:LEVel?	Sets or gets the trigger level.	p. 3-18
	TRIGger:PERcent:LEVel TRIGger:PERcent:LEVel?	Sets or gets the trigger level for a pyroelectric probe.	p. 3-19
	TRIGger:SLOPe TRIGger:SLOPe?	Selects or gets the external trigger edge.	p. 3-19
	TRIGger:DELay TRIGger:DELay?	Selects or gets the external trigger delay time.	p. 3-19
	TRIGger:SEquence	Sets the sequence ID (used for data synchronization of multiple meters sharing the same trigger signal).	p. 3-20

Table 1-2. Summary of Host Interface Commands (continued)

COMMAND	DESCRIPTION	PAGE
Statistics Mode Control		
CONFigure:STATistics:BSIZE	Sets or gets the statistics batch size.	p. 3-20
CONFigure:STATistics:RMOde	Selects or gets the action to be taken at the end of a statistical batch	p. 3-20
CONFigure:STATistics:STARt	Terminates the current statistical batch and starts a new one.	p. 3-20
CONFigure:STATistics:STOP	Terminates the current statistical batch if a batch is in progress.	p. 3-20
Measurement Data Collection		
CONFigure:ITEMselect CONFigure:ITEMselect?	Selects or gets data items in the Statistics Mode OFF transmit that appear in a measurement record.	p. 3-23
CONFigure:STATistics:ITEMselect CONFigure:STATistics:ITEMselect?	Sets or gets the Statistics Mode ON transmit data items.	p. 3-23
READ?	Gets the last recorded measurement at the time of the query.	p. 3-24
STARt (or INIT)	Enables data streaming for a continuous or fixed transmission.	p. 3-24
STOP (or ABORT)	Disables data streaming interface transmission.	p. 3-25
FORCe	Forces a data transmission in Snapshot Mode.	p. 3-25
Meter Device Information		
SYSTem:INFormaTion:INSTrument:SNUMber?	Gets the serial number of the meter.	p. 3-25
SYSTem:INFormaTion:INSTrument:PNUMber?	Gets the part number of the meter.	p. 3-25
SYSTem:INFormaTion:INSTrument:MODEl?	Gets the model name of the meter.	p. 3-25
SYSTem:INFormaTion:FPGA:HVER?	Returns the hardware version of the FPGA in the meter.	p. 3-25
SYSTem:INFormaTion:PGA:FVER?	Returns the firmware version of the FPGA in the meter.	p. 3-25
Probe Device Information		
SYSTem:INFormaTion:PROBe:TYPE?	Gets the currently connected probe type.	p. 3-26
SYSTem:INFormaTion:PROBe:MODEl?	Gets the model for the currently connected probe.	p. 3-26
SYSTem:INFormaTion:PROBe:SNUMber?	Gets the serial number, responsivity, and calibration date for the probe.	p. 3-26
Error Reporting		
SYSTem:ERRor:COUNT?	Gets the number of error records in the error queue.	p. 3-27
SYSTem:ERRor:NEXT?	Gets the next error record(s) in the error queue.	p. 3-27
SYSTem:ERRor:ALL?	Gets all error records in the error queue at the time of the query.	p. 3-27
SYSTem:ERRor:CLEar	Clears all error records in the error queue.	p. 3-27

Common Commands

The SCPI Standard specifies a mandatory set of IEEE-488.2 common commands. All of these commands and queries start with an asterisk. Refer to the IEEE-488.2 specification for more detailed information about these commands.

This section lists common host commands and queries, and provides a brief description of each.

**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

**Identification
Query: *IDN?**

Returns the meter's identification string such as model name, firmware version, and firmware release date.

Gets the laser's identification string, such as model name, firmware version, and firmware date.

QUERY	*IDN?
REPLY	"Coherent, Inc" + "-" + <model name> + "-" + <firmware version> + "-" + <firmware date>

Returns device identification string that includes information about manufacturer name, product name, nominal wavelength, power rating, firmware version, and firmware release date.

For example, a typical identification string might look like this:

Coherent, Inc - OBIS 405nm 50mW C - V1.0.1 - Dec 14 2010

The dash sign separates all fields within the reply string. The reply string is not quoted.

- The first field is always "Coherent, Inc".
- The second field is the product name, which is "LabMax-Pro SSIM".
- The third field is the firmware 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>".

System Options

The system commands and queries access functionality that is exclusive of a sensor's 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.

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.

QUERY	SYSTem: STATus?
REPLY	<status word>

Table 1-3 describes status condition bit mapping. The “Laser” column specifies the bit meaning when the status word is read from LabMax-Pro SSIM. The status word MSB is always unset.

Table 1-3. Status Code Bit Definitions

BIT	MASK	BIT LABEL	LASER
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

Unspecified bits are reserved and are zero. As an example, if a probe has been 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 fault indicator.

QUERY	SYSTem: FAULt?
REPLY	<fault word>

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

00000003 (**Battery is low, probe damage temperature exceeded**)

The Most Significant Bit (MSB) of the code is always unset, as described in Table 1-4 (fault code bit mapping).

Table 1-4. Fault Code Bit Definitions

BIT	MASK	BIT LABEL	LASER
0	00000001	No Sensor	No sensor is attached to the SSIM
1	00000002	Sensor over-temperature	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

Table 1-4. Fault Code Bit Definitions (continued)

BIT	MASK	BIT LABEL	LASER
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

System Restore

This command restores all user settings to the factory state.

COMMAND	SYSTem:RESTore
---------	-----------------------

System Sync

This command resets the system measurement sync timer, and gets the system measurement sync timer value.

COMMAND	SYSTem:SYNC
QUERY	SYSTem:SYNC?
REPLY	<Current 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, the system sync command should be sent at intervals not to exceed 10 minutes.

When in FAST mode, the sync timer internally switches to a different timer source, but that source is not used in the **SYST:SYNC?** query. The query sees only the SLOW channel source.

Communications

This section describes commands and queries related to communications:

- Message handshaking
- USB Interface
- RS-232 Interface

Message Handshaking

Standard Commands for Programmable Instrument (SCPI) message round-trip handshaking is implemented on every message sent by the firmware.

The handshaking command toggles the SCPI system handshaking control on and off. The factory default is ON.

COMMAND	SYSTem:COMMunicate:HANDshaking {ON OFF}
REPLY	OK if ON is selected; otherwise, no reply is sent.

The handshake is a short message string that is sent as the last action performed when handling a received message. The handshake string represents either an OK response or an error response. A received message raises an error condition.

NOTE: Quotation marks shown in the following examples are not included in the handshake string.

The OK response is formatted as “**OK\r\n**”.

- Error responses are formatted as “**ERR<n>\r\n**” where **<n>** represents the error code number. Negative numbers are permitted in the error string.

- Unrecognized commands or queries reply with “ERR100\r\n”
- Error queuing occurs as explicitly defined in “Error Reporting” (p. 3-26)

This setting is stored in persistent memory so that it remains unchanged after a power ON/OFF cycle.

Note that the handshaking reply is not transmitted in response to a command that has been broadcast to all devices, except by a Remote device.

QUERY	SYSTem:COMMunicate:HAndshaking?
REPLY	ON OFF

If handshaking is ON:

- Empty commands (that is, commands with only white space characters) reply with “OK\r\n”
- Valid commands with valid data will reply with “OK\r\n”
- Valid queries with valid data will reply as explicitly defined elsewhere in this document followed by “OK\r\n”
- Valid commands or queries which result in an error replies with “ERR<n>\r\n” where <n> is the error code number (see Table 1-13)

If handshaking is OFF, all command and query response behavior is as explicitly defined elsewhere in this document.

Using the USB Interface

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

Using the RS-232 Interface

Data Flow Control

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

Baud Rate

This command selects the transmit and receive baud rates together when the device has an RS-232 serial host port. There is no default setting.

COMMAND	SYSTem:COMMunicate:SERial:BAUD {DEFault 9600 14400 19200 38400 57600 115200}
QUERY	SYSTem:COMMunicate:SERial:BAUD?
REPLY	9600 14400 19200 38400 57600 115200

- When using the LabMax-Pro PC software, the host requires a baud rate of 115200.
- When using RS-232 commands, use the settings shown in Table 1-5:

Table 1-5. RS-232 Communication Settings

PARAMETER	SETTING
Baud	115200
Parity	None
Data Bit	8
Stop Bit	1
Flow Control	None

The query **SYSTem:COMMunicate:SERial:BAUD?** returns the currently selected baud rate.

CAUTION:

If you change the baud rate while communications are in process, any further communication is stopped. You must reconnect to the sensor using the new baud rate to again establish communications.

Measurement Set-Up and Control

This section describes the commands and queries for measurement set-up and control.

Measurement Mode Select

This command sets the instrument to a measurement mode in DBm, Watts, or Joules (which refer to a normal sampling mode):

- 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

If a probe is unattached and then re-attached, this command returns to the default setting of Watts, or J (Joules) for pyroelectric probes.

COMMAND	CONFigure:MEASure:MODE {DBM J W}
QUERY	CONFigure:MEASure:MODE?
REPLY	DBM J W

Statistics Mode Select

This command sets the statistics processing mode to either ON or OFF. The default setting is OFF.

COMMAND	CONFigure:MEASure:STATistics {ON OFF}
QUERY	CONFigure:MEASure:STATistics?
REPLY	ON OFF

Measurement Data Snapshot Mode Select

This command sets the meter to acquire data for 1.6 μ s sampling in Snapshot Mode. This command/ query applies only to PowerMax-Pro probes.

COMMAND	CONFigure:MEASure:SNAPshot:SElect {ON OFF}
QUERY	CONFigure:MEASure:SNAPshot:SEL?
REPLY	ON OFF

The default setting is OFF. If no probe is attached, a value of OFF is returned.

- Error 100 is raised if fast channel is not selected.
- Error 200 is raised if CONFigure:MEASure:SOURce:SEL SLOW is selected.

Snapshot Pre-Trigger Buffer Size Select

This command /query applies only to PowerMax-Pro probes.

- This command sets the pre-trigger buffer size in samples.
- This query returns the number of pre-trigger to be displayed on output after a trigger event.

The default setting is 0. The minimum is 0 and the maximum is 240,000 samples.

For an easy-to-view profile, set the pre-trigger buffer size to approximately 25% of the total buffer size. To set the Buffer Size, see “Data Start Command” (p. 3-24).

COMMAND	CONFigure:MEASure:SNAPshot:PREbuffer <iSize>
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. PowerMax-Pro probes may use both channels, but not simultaneously.

- Pyroelectric probes only use the FAST channel setting.
- Thermopile and optical probes use only the SLOW channel setting.

If no probe is attached, a value of SLOW is returned. The default setting is SLOW.

COMMAND	CONFigure:MEASure:SOURce:SElect {SLOW FAST}
QUERY	CONFigure:MEASure:SOURce:SEL?
REPLY	SLOW FAST

If FAST is selected, the following commands are available. These commands are not available for a SLOW channel setting.

- Configuration:
 - CONFigure:MEASure:WINDow (available only for High-Speed/FAST mode for Joules)
 - CONFigure:DECimation
 - CONFigure:RANGe:SElect
 - CONFigure:RANGe:AUTO
 - CONFigure:RANGe:LIST
- Triggering:
 - TRIGger:SOURce
 - TRIGger:LEVel
 - TRIGger:PERcent:LEVel
 - TRIGger:SLOPe
 - TRIGger:DELay

**Measurement
Data
Acquisition
Source List
Query**

This query returns a list of available source channel selections for the attached probe. SLOW is not available in Snapshot Mode. If no probe is attached, a value of SLOW is returned.

QUERY	CONFigure:MEASure:SOURce:LIST?
REPLY	SLOW, FAST

Speed-Up

The command sets the speed-up state. The query gets the speed-up state. The default setting is OFF. Not used for the PowerMax-Pro or Pyroelectric probes.

COMMAND	CONFigure:SPEedup {ON OFF}
QUERY	CONFigure:SPEedup?
REPLY	ON OFF

Error 100 is raised if the sensor is an optical or fast power sensor.

Area Correction Enable/Disable

This command enables or disables area correction. The default setting is OFF.

COMMAND	CONFigure:AREA:CORRection {ON OFF}
QUERY	CONFigure:AREA:CORRection?
REPLY	ON OFF

Aperture Area

This command sets the aperture area expressed in square centimeters (cm²). The default setting is 1.0.

COMMAND	CONFigure:AREA:APERTure {0.01...500.00}
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. The default setting is 2. This command is not available in Snapshot Mode.

COMMAND	CONFigure:AOUT:FSCale {1 2 4}
QUERY	CONFigure:AOUT:FSCale?
REPLY	1 2 4

Data Smoothing

Use this command to 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 may 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.

This command sets the display data smoothing to either ON or OFF. The default setting is OFF.

COMMAND	CONFigure:AVERAge:TIME {ON OFF}
QUERY	CONFigure:AVERAge:TIME?
REPLY	ON OFF

This command is not available in Snapshot Mode.

Wavelength Correction

The following commands are used for Wavelength Correction:

- Enable/disable wavelength correction
- Set the wavelength
- Get the wavelength table entries from the probe



IMPORTANT!
Setting the operational wavelength does NOT enable Wavelength Correction. You must use this CONF:WAVE:CORR ON command. The default is set to OFF.

Enable/ Disable Wavelength

This command enables or disables wavelength correction.

COMMAND	CONFigure:WAVElength:CORREction {ON OFF}
QUERY	CONFigure:WAVElength:CORREction?
REPLY	ON OFF

Operational Wavelength

Setting the wavelength for the sensor simply tells the sensor which wavelength compensation to use *IF* the wavelength is turned on.

The setting is not applied until the wavelength is set and the wavelength correction is turned on (using the CONF:WAVE:CORR ON command).

COMMAND	CONFigure:WAVElength:WAVElength {MINimum MAXimum <requested wavelength in nm>}	
QUERY	CONFigure:WAVElength:WAVElength? [MINimum MAXimum]	
REPLY	• If [MINimum MAXimum] is <i>not</i> specified, returns:	<granted wavelength in nm>
	• If MAXimum is specified, returns:	<allowed maximum wavelength in nm>
	• If MINimum is specified, returns:	<allowed minimum wavelength in nm>

The 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 is set to the upper wavelength limit.
- **Less than** the lower wavelength limit, the current wavelength is set to the lower wavelength limit.

The minimum and maximum allowed wavelength may also be named as data arguments. The query gets the current, maximum allowed, or minimum allowed wavelengths—depending on the optional query data argument.

Query Probe Wavelength Table

This query gets the wavelength table entries from the probe.

QUERY	CONFigure:WAVElength:LIST?
REPLY	<comma separated list of wavelengths>

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.
- Error 241 is raised if no probe is attached.

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.

Gain Compensation

The following commands are used for Gain Compensation:

- Enable/disable gain compensation
- Set the gain compensation factor

Enable/ Disable Gain Compensate

This command enables or disables gain compensation, which is committed to persistent storage when it is changed. The default setting is OFF.

COMMAND	CONFigure:GAIN:COMPensation {ON OFF}
QUERY	CONFigure:GAIN:COMPensation?
REPLY	ON OFF

Gain Compensate 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. The default setting is 1.0. 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>
QUERY	CONFigure:GAIN:FACTor?
REPLY	<gain compensation factor>

Probe Zero

This command sets the current measurement as the zero baseline measurement.

The query gets the mathematical offset (in Watts) for the current range.

COMMAND	CONFigure:ZERO
QUERY	CONFigure:ZERO?
REPLY	[Value in Watts]

If the meter is in Snapshot Mode, it cannot zero baseline the measurement.

Error 200 is raised if the meter is in Snapshot Mode. To correct, first exit Snapshot Mode, zero, and then re-enter Snapshot Mode.

Pulsed Thermopile Joules Trigger Level

This command applies only to thermopile or optical probes. This command is not available for PowerMax-Pro.

This command selects the pulsed thermopile Joules mode trigger sensitivity level. The default setting is LOW.

COMMAND	TRIGger:PTJ:LEVel {LOW MEDIum HIGH}
QUERY	TRIGger:PTJ:LEVel?
REPLY	LOW MEDIUM HIGH

Pulse Detection Measurement Window

This command selects the pulse detection window size for sampling Joules using a High-Speed or FAST measurement channel. This command applies only to thermopile probes (such as PowerMax-Pro sensors) when working with Joules. Optical probes do not support energy measurements.

- The input value is expressed in microseconds.
- The value range is 10, 100...1000000. The default setting is 10.

This command is not used for a SLOW channel setting.

COMMAND	CONFigure:MEASure:WINDow <10,100...1000000>
QUERY	CONFigure:MEASure:WINDow?
REPLY	The pulse detection window size in microseconds.

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. This command is not used in SLOW mode.

COMMAND	CONFigure:DECimation {1...99999}
QUERY	CONFigure:DECimation?
REPLY	1...99999

Measurement data is selected for processing ranging from as frequent as 1 sample processed per 1 measured to as infrequently as 1 sample processed per 99999 samples measured. The default setting is 1.

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

Range Select

The following commands support range select:

- Select the meter measurement range
- Enable/disable automatic selection of the range
- Get the range table entries from the probe
-

Range Value Select

This command selects the meter measurement range expressed in the units defined under the current measurement mode (Joules or Watts). This command is not used in SLOW mode.

COMMAND	CONFigure:RANGe:SElect {<maximum expected measurement> MAXimum MIDdle MINimum}
QUERY	CONFigure:RANGe:SElect? [MAXimum MIDdle MINimum]
REPLY	<granted full scale range>

The measurement range is selected by expressing the maximum expected measurement, which must be greater than 0.0.

- Using the optional MAX and MIN parameters on the command results 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.

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 3mW and 30mW and the maximum expected measurement is 10mW, the granted range is 30mW.

The **<granted full scale range>** is the top range available if the **<maximum expected measurement>** exceeds the top range value.

Auto Range Enable/ Disable State

This command enables or disables automatic selection of the meter measurement range. The default setting is OFF. This command is not used in SLOW mode, and is not available in Snapshot mode.

COMMAND	CONFigure:RANGe:AUTO {ON OFF}
QUERY	CONFigure:RANGe:AUTO?
REPLY	ON OFF

The meter hunts for the best measurement range for the current probe and laser conditions when auto ranging is active. The hunt procedure may require several samples to arrive at the best range. Auto ranging applies only when a thermopile or optical probe is attached.

Error 241 is raised if the sensor is pyroelectric or no probe.

Query Probe Range List

This command gets the range table entries from the probe. This command is not used in SLOW mode.

QUERY	CONFigure:RANGe:LIST?
REPLY	<comma separated list of available ranges>

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 always includes the calibration wavelength of the current probe.

Error 241 is raised if no probe is attached.

Trigger Parameters

These commands and queries select the trigger source and set or query the internal and external trigger levels:

- Select the trigger source
- Set the trigger level expressed as an absolute power or energy value
- Set the trigger level expressed as a percentage of full-scale capability in the selected range

Trigger Source

This command selects the trigger source. This command applies only to pyroelectric probes. The default setting is INTernal. The trigger source setting has no effect on devices positioned as slaves in trigger bussed configurations. All slaves receive their triggers from the trigger bus. This command is not available in SLOW mode.

COMMAND	TRIGger:SOURce {INTernal EXTernal}
QUERY	TRIGger:SOURce?
REPLY	INT EXT

Internal Trigger Level

This command sets the trigger level expressed as an absolute power or energy value, depending on which measurement mode is selected. The default setting is 1 Watt.

This command applies only to pyroelectric and fast power probes.

COMMAND	TRIGger:LEVel {MINimum MAXimum 0.1 ... maximum Range Value}
QUERY	TRIGger:LEVel? {MINimum MAXimum}
REPLY	0.1...maxValue

- If a pyroelectric probe (such as PowerMax-Pro) is attached, the minimum trigger level is 0.1 percent of full scale for the currently selected range. Also, the maximum trigger level is 30 percent of full scale for the currently selected range.
- All other probe types have a minimum trigger level of 0 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.

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

This command is not available in SLOW mode.

Internal Trigger Percent Level

When a pyroelectric probe is attached, this command sets the trigger level expressed as a percentage of full-scale capability in the selected range.

Using this command for any other probe type sets the trigger level expressed as a percentage of the maximum power rating for the probe. The default setting is 5.

COMMAND	TRIGger:PERcent:LEVel {DEFault MINimum MAXimum: 0.1 ... 100.0}
QUERY	TRIGger:PERcent:LEVel? {DEFault MINimum MAXimum}
REPLY	0.1 ... 100.0

This command is not available in SLOW mode.

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. These commands applies only to pyroelectric and fast power probes.

External Trigger Edge Select

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

COMMAND	TRIGger:SLOPe {POSitive NEGative}
QUERY	TRIGger:SLOPe?
REPLY	POS NEG

This command is not available in SLOW mode.

External Trigger Delay

This command selects the external trigger delay time.

COMMAND	TRIGger:DELaY {0...1000}
QUERY	TRIGger:DELaY?
REPLY	0...1000

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 is in microseconds. The default setting is 0.

This command is not available in SLOW mode.

Set Sequence ID

This command sets the sequence ID, which must be an integer value. The sequence ID is used for data synchronization of multiple meters sharing the same trigger signal. The default setting is 0.

COMMAND	TRIGger:SEquence {0...16777215}
---------	---------------------------------

Statistics Mode Control

These commands set statistics calculation parameters to be used in the Statistics operating mode.

Batch Size

This command sets the statistics batch size, which takes effect at the end of the current statistical batch. The batch size units are pulses rounded to the nearest integer. The default setting is 10.

COMMAND	CONFigure:STATistics:BSIZE {DEFault 2...99999}
QUERY	CONFigure:STATistics:BSIZE?
REPLY	2...99999

Restart Mode

This command selects the action to be taken at the end of a statistical batch. The default setting is **MANual**.

COMMAND	CONFigure:STATistics:RMode {DEFault MANual AUTomatic}
QUERY	CONFigure:STATistics:RMode?
REPLY	MAN AUT

- Selecting **AUTomatic** begins a new batch at the next measured pulse when statistics mode is on.
- Selecting **MANual** requires the Start command to begin a new batch when statistics mode is on (see following information for **CONFigure:STATistics:START**).

Batch Initiation and Termination

Start a New Batch

This command terminates the current statistical batch and starts a new one. The command is ignored if Statistics Mode is OFF.

COMMAND	CONFigure:STATistics:START
---------	----------------------------

Stop a Batch

This command terminates the current statistical batch if a batch is in progress. The command will be ignored if statistics mode is OFF or a batch is not in progress.

COMMAND	CONFigure:STATistics:STOP
---------	---------------------------

Measurement Data Collection

Before you begin measurement data collection, first:

- Understanding Measurement formats
- Select data items

Measurement data can be collected in these ways:

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

The host has control over when measurement data is transmitted.

- Transmission is enabled after an **START** command. All measurement data records are transmitted immediately as they are generated while transmission is enabled.
- Transmission is disabled after an **STOP** command.

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. Watts or Joules are expressed as units per square centimeter if area correction is active.

- The user receives energy readings from the host interface if the measurement mode is Joules (J).
- The user receives power readings from the host interface if the measurement mode is Watts (W).

The information shown in Table 1-6 is available with each data record:

Table 1-6. Data Records

DATA	DESCRIPTION
PRI	Measurement value: “%.3E” format when a modular power probe is connected
FLAG	Flags — see Table 1-9 for Flag Bit Definitions
SEQ	Sequence number and formatted as a decimal integer
PER	Period value expressed in decimal integer as microseconds

NOTES:

- %.3E format applies to Fast Mode in general.
- %.5E format still works for PowerMax-Pro probes in slow mode.

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 and a thermopile or optical probe is attached and if Watts mode is selected

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

The presentation of the data items in a data record will be in PRI, FLAG, SEQ, PER order depending on which tokens were specified, listed in Table 1-7.

Table 1-7. Measurement Data Record Format

MEASUREMENT MODE	RECORD FORMAT
Watts or long pulse Joules	<PRI>,<FLAG>,<SEQ>
Watts or long pulse Joules (quad LabMax sensors)	<PRI>,<FLAG>,<SEQ>
Joules	<PRI>,<FLAG>,<SEQ>,<PER>

Table 1-8 lists the measurement modes and formats when the Statistics Mode is ON.

Table 1-8. Measurement Data Record Format

MEASUREMENT MODE	RECORD FORMAT
Watts or long pulse Joules	<MEAN>,<MIN>,<MAX>,<STDV>,<DOSE>,<FLAG>,<SEQ>
Watts or long pulse Joules (quad LabMax sensors)	<MEAN>,<MIN>,<MAX>,<STDV>,<DOSE>,<FLAG>,<SEQ>
Joules	<MEAN>,<MIN>,<MAX>,<STDV>,<DOSE>,<FLAG>,<SEQ>

The FLAG data item may 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 upper case hexadecimal number. Each bit has a qualification meaning, described in Table 1-9.

Table 1-9. FLAG Bit Definition

BIT POSITION	HEX BIT MASK	QUALIFICATION MEANING
0	01	Trigger Event, or, bad batch (statistics mode on only)
1	02	Baseline CLIP
2	04	Calculating (PTJ mode only)
3	08	Final energy record (PTJ mode only)
4	10	Over-range
5	20	Negative Power
6	40	Measurement is sped up
7	80	Over-temperature error
8	100	Missed measurement
9	200	Missed Pulse
xxx	000	No qualification exists

Binary Data Record Format

Binary representation of data is in variable-length packets based on user token selection. A packet consists of at least 1 byte. The presentation of the binary data items in a data record will be in the same order as the ASCII format. The size of the record is dependent on user selection of specified tokens.

Binary Data Record Format is not available for statistics mode.

An example of selecting the binary format PRI, FLAG, SEQ, and PER tokens is shown in Table 1-10:

Table 1-10. Binary Data Packet Example

FLOAT 4 BYTES	INTEGER 2 BYTES	INTEGER 4 BYTES	INTEGER 4 BYTES
<PRI>	<FLAG>	<SEQ>	<PER>

Table 1-11 describes the relationship of tokens to byte size in Measurement Mode.

Table 1-11. Binary Representation Size of Tokens

TOKEN	SIZE	DESCRIPTION
PRI	4 bytes	4 bytes of data, single precision IEEE754 floating point format
FLAG	2 bytes	2 bytes of data
SEQ	4 bytes	4 bytes of data, 32-bit unsigned integer form
PER	4 bytes	4 bytes of data, 32-bit unsigned integer form

Data Item Select

Data items that appear in a measurement data record are selectable. Selections differ based on measurement and statistics modes.

Data Item: Statistics Mode is Off

This command selects the Statistics Mode OFF transmit data items, which takes effect immediately if statistics mode is OFF. The default setting is PRI.

COMMAND	CONFigure:ITEMselect {PRI, FLAG, SEQ, PER}
QUERY	CONFigure:ITEMselect?
REPLY	One or more of PRI FLAG SEQ PER

The data argument is a comma-separated list of one or more tokens (see Table 1-12). The tokens may be specified in any order; at least one token must be specified.

Table 1-12. Data Item Selections for Measurement Data Record

TOKEN	DATA DESCRIPTION	RESULT EXPRESSION
PRI	Primary data value (includes Watts or Joules)	Scientific notation (for example, "2.88E-3")
FLAG	Flags	16-bit hexadecimal integer form
SEQ	Sequence ID	32-bit unsigned integer form
PER	Pulse Period (expressed in μ sec, Joules mode)	32-bit unsigned integer form

Data Item: Statistics Mode is On

This command selects the Statistics Mode ON transmit data items, which takes effect at the end of the current statistical batch if statistics mode is on.

COMMAND	CONFigure:STATistics:ITEMselect {MEAN, MIN, MAX, STDV, DOSE, FLAG, SEQ}
QUERY	CONFigure:STATistics:ITEMselect?
REPLY	One or more of MEAN, MIN, MAX, STDV, DOSE, FLAG, SEQ

The data argument is a comma-separated list of one or more tokens shown in the command. At least one token must be specified. The tokens may be specified in any order.

Statistics data items use the same units as the power or energy measurements from which they were calculated. The MEAN, MIN, MAX, STDV, and DOSE data items are zero if any constituent pulse measurement in the batch is not measurable due to an error (such as peak or baseline clipping).

The FLAG data item, which communicates qualification information, may optionally be reported with each data message.

- A zero value indicates the batch is valid.
- A value of one '1' indicates a bad statistical batch.

Last Data Record Query

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

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.

The data items (including a Flags item) presented may vary. This depends on the Measurement and Statistics Modes and the data items selected, as shown earlier in Table 1-7 (p. 3-22).

Data Gating

The following commands are used for Data Gating:

- Enable data streaming
- Disable data streaming
- Force a data transmission when in Snapshot Mode

Data Start Command

This command enables data streaming for a continuous or fixed transmission. Either a **START** or **INIT** command may be used.

- An optional number of samples between 0 and 60,000 may be selected.
- In Snapshot Mode, up to 240,000 samples may be selected.
- A value of zero is equivalent to infinity.

COMMAND	START (or INIT) <optional number of requested samples>
----------------	---

When in Snapshot acquisition mode, the **<optional number of requested samples>** equals the total Snapshot buffer sample size, as shown in this example:

Total Snapshot buffer sample size (such as 20000)	
Pre-buffer size (such as 1000)	Remainder = 19000 samples

If the number of requested samples is smaller than the pre-Snapshot buffer size (see **CONFigure:MEASure:SNAPshot:PREbuffer**), ERR-101 is raised.

This command is ignored if data streaming transmission has already started.

Data Stop Command

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

COMMAND	STOP (or ABORT)
---------	-----------------

Force Data Transmission Command

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

COMMAND	FORCE
---------	-------

An Error 200 is raised if the command is sent outside of Snapshot Mode and no **START** command has been issued.

Meter Device Information

The sensor can be queried for information for the purposes of unit identification and quality control. The following queries apply to the meter.

Meter Serial Number

The query gets the meter serial number. The query is always available. The serial number string is restricted to no more than 20 characters and white space is not allowed.

QUERY	SYSTem:INFormation:INSTrument:SNUMber?
REPLY	<quoted meter serial number>

Meter Part Number

The query gets the part number. The query is always available. The part number string should be restricted to no more than 20 characters.

QUERY	SYSTem:INFormation:INSTrument:PNUMber?
REPLY	<quoted part number>

Meter Model Name

The query gets the model name. The query is always available. The model name string should be restricted to no more than 20 characters.

QUERY	SYSTem:INFormation:INSTrument:MODEl?
REPLY	<quoted model name>

Meter FPGA Hardware Version

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

QUERY	SYSTem:INFormation:FPGA:HVER?
REPLY	<hardware version>

Meter FPGA Firmware Version

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

QUERY	SYSTem:INFormation:FPGA:FVER?
REPLY	<hardware version>

Probe Device Information

The following commands apply to the probe that is currently connected. An empty string is returned if a valid probe is not attached.

Probe Type

This query returns the type of the probe currently connected.

QUERY	SYSTem:INFormation:PROBe:TYPE?
REPLY	See below.

The **<type>** is one of **NONE**, **THERMO**, **PYRO**, or **OPT**.

The **<qualifier>** is one of **NONE**, **SINGLE**, **QUAD**, or **NOSPEC**.

- NONE,NONE is returned when no valid probe is 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.

Probe Model

This query gets the model for the currently connected probe.

QUERY	SYSTem:INFormation:PROBe:MODe1?
REPLY	<probe model string>

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

The following naming conventions apply, in this order:

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 LabMax style probe is attached and a probe model string does not exist.
4. "PM" if a valid PowerMax style probe is attached and a probe model string does not exist.
5. "Unknown" in all other cases.

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

Probe Serial Number

This query gets the serial number for the probe that is currently connected. An empty string is returned if a valid probe is not attached.

QUERY	SYSTem:INFormation:PROBe:SNUMber?
REPLY	<probe serial number>

Error Reporting

This section describes error record reporting and collection:

- Get the number of error records
- Get the next error record(s)
- Get all error records
- Clear all error records

Error Count Query

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

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 may be queried using the optional **<error record count>** parameter which must be an integer value. A default is not applicable.

QUERY	SYSTem:ERRor:NEXT? [<error record count>]
REPLY	<next available error record(s)>

A single error record is returned if **<error record count>** is not specified. No reply is transmitted if no error records are 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.

All Error Query

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

QUERY	SYSTem:ERRor:ALL?
REPLY	<all available error record(s)>

No reply is transmitted if no error records are available. After completion of the reply transmission:

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

All Error Clear

This command clears all error records in the error queue.

COMMAND	SYSTem:ERRor:CLEar
----------------	---------------------------

SCPI Error Codes

Programming and system errors occasionally occur while testing or debugging remote programs and 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:

- First, the host queries for the number of error records available (N).
- Second, 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.

Table 1-13 lists the SCPI Error Codes and provides information about the condition under which each error code is issued:

Table 1-13. SCPI Error Codes

CODE	ERROR	ISSUED WHEN ...
-350	SCPI_ERROR_QUEUE_OVERFLOW	Error queue is 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.
-310	SCPI_ERROR_SYSTEM_ERROR	Occurs when the device firmware detects an unexpected or unrecoverable error. This error condition includes unrecoverable software or hardware faults.
0	SCPI_ERROR_NONE	No error.
100	SCPI_ERROR_UNRECOGNIZED	Occurs when the device receives an unrecognized command or query. This is a generic syntax error for devices that cannot detect more specific errors.
101	SCPI_ERROR_INVALID_PARAM	Occurs when the device receives a command or query with one or more invalid data parameters.
102	SCPI_ERROR_DATA_ERROR	Occurs when the device receives a command or query for which no valid data exists.
200	“Execution Order”	Occurs when the device receives a command or query that is out of expected order of execution.
203	“Command Protected”	Occurs when the device receives a command or query that is password protected.
220	“Parameter Problem”	Occurs when the device receives a command or query that contains invalid parameters, but the command is valid.
241	“Device Unavailable”	Cannot process command; probe is not present. Occurs when the device receives a command or query that requires a probe to be present.

Glossary for Host Interface Terms

This section briefly describes some terms used in this Addendum:

Message

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

Reset cycle

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

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.

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 had never been sent.

Factory settings

Persistent settings that are set by the manufacturer, with parameters restricted by password. Factory settings do not include operational parameters.

SECTION FOUR: ERROR MESSAGES

This section provides a list of error messages that may be displayed when using meters and sensors. Table 1-1 lists messages (in alphabetical order) that can be used to assist in troubleshooting.

Table 1-1. Meter and Sensor Errors

DISPLAYED MESSAGE		CAUSE/CORRECTIVE ACTION
Announce Faults Window		
	Cause	One or more system faults have been reported.
	Corrective Action	Reference the specific corrective action shown next to the error in the error message.
Confirm Buffer Clear		
	Cause	Trying to change the buffer size when the buffer contains unsaved data.
	Corrective Action	<ul style="list-style-type: none"> • Click <u>O</u>K to discard the data. • Click <u>C</u>ancel to preserve the data.
Hardware Incompatibility Error		
	Cause	Software is connected to a meter that has obsolete firmware or hardware.
	Corrective Action	Install newer firmware or software, or install older software that is compatible.
Standard Mode vs. Snapshot Mode Conflict		
	Cause	High-Speed mode in the Home tab was de-selected while Snapshot mode is enabled in the Data Buffer tab.
	Corrective Action	<ul style="list-style-type: none"> • Press <u>Y</u>es to disable Snapshot mode and change to Standard mode. • Press <u>N</u>o to remain in High-Speed and Snapshot mode.
Meter Reports Missing Data		
	Cause	Data samples from the meter were marked with the Missing Data flag.
	Corrective Action	None. Missing data cannot be recovered.
Meter's User Settings Restored to Default		
	Cause	Factory defaults are being overwritten with non-factory default user settings.
	Corrective Action	Unplug the meter from the computer before restoring the factory defaults.
Meter was disconnected		
	Cause	The meter is not connected.
	Corrective Action	Connect the meter to the sensor and the PC.
No COM Port Selected		
	Cause	A communications (COM) port is not selected.
	Corrective Action	Select a COM port.
Snapshot Mode Setting Conflict		

Table 1-1. Meter and Sensor Errors (continued)

DISPLAYED MESSAGE		CAUSE/CORRECTIVE ACTION
	Cause	Not all requirements have been met for entering Snapshot mode.
	Corrective Action	<ul style="list-style-type: none"> • Click <u>Confirm Changes</u> to make necessary setting adjustment and enable Snapshot mode. • Click <u>Cancel Request</u> to leave all settings unchanged.
Unable to launch Updater Program		
	Cause	Software is unable to find the updater application when you press the <u>Check for Updates</u> button.
	Corrective Action	Reinstall the software.
Unable to Open Meter on COM1		
	Cause	The port is not connected to a meter or another application is using the port.
	Corrective Action	Select an available COM port.
Unexpected Error Encounter		
	Cause	Unexpected error condition.
	Corrective Action	Reference the specific corrective action shown next to the error in the error message. Unrecoverable errors require that you exit the application.

APPENDIX A: SAFETY AND COMPLIANCE

This section describes requirements for safety for persons setting up or operating the LabMax-Pro SSIM Laser Power Meter with lasers, and includes:

- Laser Safety Hazards (page A-1)
 - Optical Safety (page A-2)
 - Laser Back Reflection (page A-3)
 - Recommended Precautions (page A-3)
- Electrical safety (page A-4)

You must review these laser safety sections thoroughly BEFORE operating the LabMax-Pro SSIM. Carefully follow all safety instructions presented throughout this manual.

- Compliance with standards and regulations (page A-6)
 - Laser compliance (page A-6)
 - Environmental compliance (page A-7)



WARNING!

Use of controls or adjustments or performance of procedures other than those specified in this manual may result in exposure to hazardous radiation.

Laser Safety Hazards

Hazards associated with using lasers generally fall into the following categories:

- Biological hazards from exposure to laser radiation that may damage the eyes or skin
- Electrical hazards generated in the laser power supply or associated circuits
- Chemical hazards resulting from contact of the laser beam with volatile or flammable substances, or released as a result of laser material processing

The above list is not intended to be exhaustive. Anyone operating a laser must consider the interaction with its specific working environment to identify potential hazards.

When using the LabMax-Pro SSIM Laser Power Meter, hazards vary with the input angle and the laser beam.



WARNING—LASER RADIATION!

Always avoid eye or skin exposure to both DIRECT and SCATTERED radiation.

Optical Safety

Laser light, because of its optical qualities, poses safety hazards not associated with light from conventional light sources. The safe use of lasers requires all operators, and everyone near a laser, to be aware of the dangers involved. Users must be familiar with the instrument and the properties of coherent, intense beams of light.

The safety precautions listed below are to be read and observed by anyone working with or near the laser. At all times, ensure that all personnel who operate, maintain or service the laser are protected from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits defined in the laser safety standards.



WARNING!

Direct eye contact with the output beam from the laser may cause serious eye injury and possible blindness.

The greatest concern when using a laser is eye safety. In addition to the main beam, there are often many smaller beams present at various angles near a laser. These beams are formed by specular reflections of the main beam at polished surfaces such as lenses or beamsplitters. While weaker than the main beam, such beams may still be sufficiently intense to cause eye damage.

Laser beams are powerful enough to burn skin, clothing, or combustible materials, even at some distance. They can ignite volatile substances such as alcohol, gasoline, ether, and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers, and photodiodes. Follow the control measures listed in “Recommended Precautions for Laser Safety” (p. A-3).

Laser Safety Eyewear

Always wear appropriate laser safety eyewear for protection against the specific wavelengths and laser energy being generated.

The appropriate eye protection can be calculated as defined in the “EN 207 Personal eye protection equipment—Filters and eye-protectors against laser radiation (laser eye-protectors)”, in other national or international standards (such as ANSI, ACGIH, or OSHA) or as defined in national safety requirements.



CAUTION!

Laser safety eyewear protects the user from accidental exposure to laser radiation by blocking light at the laser wavelengths.

However, laser safety eyewear may also prevent the operator from seeing the beam or the beam spot. Exercise extreme caution even while wearing safety glasses.

Viewing Distance

A laser produces optical power levels that are dangerous to the eyes and skin if exposed directly or indirectly. This product must be operated only with proper eye and skin protection at all times. Never view directly emitted or scattered radiation with unprotected eyes.

When viewing the laser during operation, the operator must maintain the Nominal Ocular Hazard Distance (NOHD) between the laser or scatter radiation and the operator's eyes. Check the Operator's Manual for the laser you are using.

Maximum Accessible Radiation Level

A laser produces visible radiation over the various wavelengths. See the Product Label on your laser for details about maximum emission levels.

Laser Back Reflection

Back reflection (also referred to as retroreflection) occurs when a part of the laser beam is sent back into the laser's exit aperture.

Back reflection can be caused by any object in front of the laser and can result in instability, noise, or damage to the laser. Damage from back reflection can be immediate, or it can be subtle and slowly decrease the service life of a laser. A laser that shows symptoms—such as low output power, no output power, over-current, or high noise—indicates a possibility of back reflection to the laser.

The low back-reflection design and coatings on the LabMax-Pro SSIM Laser Power Meter reduce reflectivity and make set-up quicker and easier.

Recommended Precautions for Laser Safety

The following recommended precautions and guidelines to prevent damage to persons or property should always be observed. Laser beams can easily cause flesh burns or ignite clothing. These precautions also help to increase the operating life of the laser.

- Read and follow all safety precautions in the associated product manuals (whether Installation, Set-Up, Quick Start, Operator's or User Manuals).
- Set up the laser so that the beam height is either well below or well above eye level.
- Never look directly into the laser light source or at scattered laser light from any reflective surface, even when wearing laser safety eyewear. Never sight down the beam.
- Always wear appropriate eyewear for protection against the specific wavelengths and laser energy being generated. See "Laser Safety Eyewear" (p. A-2) for more information.
- Watch where the reflections from objects are returning to make sure the reflections are not at or near the laser exit aperture. Change the objects to add an angle so the object is less reflective whenever possible. Add an optical isolator to those applications with laser exit aperture back reflections that cannot be corrected by angling the optics.
- Review any objects in front of the laser and make a note of which surfaces are a possible hazard for back reflections. Keep precautions in mind when moving objects that can create a back reflection in front of the laser.

- Avoid wearing watches, jewelry, or other objects that may reflect or scatter the laser beam.
- Block the beam before applying tools such as Allen wrenches or ball drivers to external optics.
- Provide enclosures for beam paths whenever possible.
- Stay aware of the laser beam path, particularly when external optics are used to steer the beam.
- Use appropriate energy-absorbing targets for beam blocking.
- Terminate the laser beam with a light-absorbing material. Laser light can remain collimated over long distances and therefore presents a potential hazard if not confined. It is good practice to operate the laser in an enclosed room.
- Decrease the power from any possible back reflections by starting the laser at lower output power—for example, 10% output power—before opening the laser shutter.
- Exercise extreme caution when using solvents in an area with any laser.
- Post laser warning signs in the area of the laser beam to alert those present.
- Limit access to the laser to trained and qualified users who are familiar with laser safety practices. When not in use, lasers should be shut down completely and made off-limits to unauthorized personnel.
- Advise all those working with or near the laser of these precautions.

Electrical Safety

The LabMax-Pro SSIM Laser Power Meter does not have dangerous voltages.



IMPORTANT!

The LabMax-Pro SSIM Laser Power Meter is designed to be operated as assembled; there are no user-serviceable components in the device. DO NOT disassemble the enclosure. *The Warranty is void if the enclosure is disassembled!*

The most common ESD damage occurs when handling a device during installation or use. Take the necessary measures to protect the system from ESD.

Dry air and carpet also create a higher potential for ESD. Remember to take precautions or shielding not only for operations, but for demonstrations or trade show exhibitions.



CAUTION!

Electrostatic charges as high as 4000 volts easily collect on the human body and equipment and can discharge without detection.

Although the electronics features have input protection, permanent damage can occur on devices subjected to high-energy electrostatic discharges. You must take correct ESD precautions to prevent damage or performance degradation.

Electrical Safety Precautions

Everyone must observe the following precautions when working with potentially hazardous electrical circuitry:



WARNING!

When working with electrical power systems, the rules for electrical safety must be strictly followed. Failure to do so could result in the exposure to damaging levels of electricity.

1. Disconnect main power lines before working on any electrical equipment when it is not necessary for the equipment to be operating.
2. Do not short or ground the power supply output. Protection against possible hazards requires proper connection of the ground terminal on the power cable, and an adequate external ground. Check these connections at the time of installation, and periodically thereafter.



WARNING!

Normal operation of the sensor should not require access to the power supply circuitry. Removing the power supply cover exposes the user to potential electrical hazards. Contact an authorized service representative before attempting to correct any problem with the power supply.

3. Never work on electrical equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment, and who is competent to administer first aid.
4. When possible, keep one hand away from the equipment to reduce the danger of current flowing through the body if a live circuit is touched accidentally.
5. Always use approved, insulated tools.

ESD Protection

The most common ESD damage occurs when handling the device during installation or use.



WARNING!

Damage can occur to the electronics features of the LabMax-Pro SSIM Laser Power Meter from Electrostatic Discharge (ESD).

Electrostatic charges easily collect on the human body, equipment, and facilities, and can discharge without detection. Dry air and carpet create a higher potential for Electrostatic Discharge (ESD).

Take necessary precautions or shielding to protect the system from ESD to prevent performance degradation or damage to the system.

When mobile equipment (a cart or table) is used as an ESD-protected workstation, connect it to ESD ground that meets ANSI/ESD S4.2 required limits for an ESD-protected workstation ($<1 \times 10^9$ ohms).

Compliance

This section describes compliance with various government requirements for safety, environmental regulations, and control law.

Laser Safety Standards

Following are sources for information about laser safety standards, as well as safety equipment and training.

Within the United States:

The applicable United States Government laser safety requirements are contained in 21 CFR Title 21 Chapter 1, Subchapter J, Part 1040 (“*Performance standards for light-emitting products*”). The text of this federal standard is available from:

U.S. Food and Drug Administration
Center for Devices and Radiological Health (CDRH)
Document Mail Center – WO66-G609
Sliver Spring, MD 20993-0002
Website: www.fda.gov

Outside of the United States:

For jurisdictions outside of the United States:

Safety of laser products - Part 1: Equipment classification and requirements
IEC 60825-1 / EN 60825-1

Safety of laser products - Part 14: A user’s guide
IEC 60825-1 / EN 60825-1

Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use
IEC 61010-1 / EN 61010-1

Publications and Guidelines

International Electrotechnical Commission (IEC)
www.iec.ch

Safety of laser products - Part 1: Equipment classification and requirements
BS EN 60825-1

British Standard Institute
www.bsigroup.com

American National Standard for Safe Use of Lasers
ANSI Z136 Series
American National Standards Institute (ANSI)
www.ansi.org

A Guide for Control of Laser Hazards
American Conference of Governmental
and Industrial Hygienists (ACGIH)
www.acgih.org

Laser Safety Guide
Laser Institute of America
www.lia.org

CE Marking

The European Community requirements for product safety are specified in the Low-Voltage Directive (LVD) (published in 2014/35/EU).

This Directive requires that lasers comply with the standard EN 61010-1/IEC 61010-1 “Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use” and EN 60825-1/IEC 60825-1 “Safety of Laser Products”. Compliance with the European requirements is certified by CE Marking.

Electromagnetic Compatibility

The primary issue for electromagnetic compatibility is to design covers, shielding, grounding, routing of electrical cable assemblies, and control elements with the proper safety features for a complete system.

The LabMax-Pro SSIM Laser Power Meter has been tested and shown to be compliant with the relevant requirements of the following directives for Electromagnetic Compatibility EN 61326-1_Ed2:2013 (IEC 61326-1_Ed2:2012) and EN 61000-3-2:2006.

Environmental Compliance

This section describes compliance with various environmental regulatory directives to identify hazardous substances.

EU REACH

Coherent products are classified as “articles” according to v REACH definition, as follows:

Article means an object which, during production, is given a special shape, surface or design that determines its function to a greater degree than its chemical composition. (REACH, Article 3(3))

Articles as defined by REACH regulations are exempt from registration as long as they are not intended to release a chemical substance.

To the best of our knowledge, all Coherent product meet the definition of “article” according to REACH.

In addition, to the best of our knowledge, Coherent products do not contain any Substances of Very High Concern (SVHC) above the legally mandated thresholds included in the REACH SVHC list, which is updated every six months. The current SVHC list is available on-line at <https://echa.europa.eu/candidate-list-table>.

RoHS Compliance

The European Union RoHS Directive EN 50581:2012 restricts the use of certain hazardous substances in electrical and electronic equipment. Coherent is in compliance with this Directive and can provide RoHS certification upon request. Compliance of this laser with the EMC requirements is certified by the CE Mark.

Waste Electrical and Electronic Equipment (WEEE, 2002)

The European Union Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU) is represented by a crossed-out garbage container label. The WEEE Directive applies to your product and any peripherals marked with this symbol.

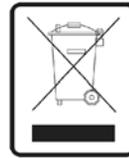


Figure A-1. WEEE Label

The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.



Do not dispose of these products as unsorted municipal waste. Contract your local distributor for procedures for recycling this equipment.

Battery Directive

There is no battery in the LabMax-Pro SSIM Laser Power Meter.

China RoHS Compliance

This section details compliance with the China RoHS (Restriction of Hazardous Substances) Regulation SJ/T 11364-2014.

This Regulation restricts the use of certain hazardous substances in electrical and electronic equipment. The China RoHS Regulation applies to the production, sale, and import of products into the Peoples Republic of China.

The China RoHS compliance label is included on the Certificate of Calibration for each LabMax-Pro SSIM Laser Power Meter, as shown the example in Figure A-2.

部件名称 Part Name	产品中有害物质的名称及含量 有害物质 Hazardous Substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷电路板组装 Printed Circuit Board Assembly	X	○	○	○	○	○

本表格依据 SJ/T 11364 的规定编制
 ○: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。
 X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

Figure A-2. China RoHS Label

The table shows that Lead (Pb) may be found in components of the LabMax-Pro SSIM Laser Power Meter. The environmental-friendly use period is 20 years, indicated by the number 20 inside the circle.

The China RoHS Regulation also requires that the date of manufacture be identified. This is also provided on the *Certificate of Calibration* shipped with each product, shown in Figure A-4.

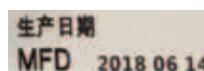


Figure A-3. Example of Label for Date of Manufacture

An example of the product label is shown in Figure A-4.



Figure A-4. Example of Product Label

APPENDIX B: CALIBRATION, SERVICE, SUPPORT

This section provides information about:

- Calibration services (this page)
- How to obtain service (page B-2)
- Product shipping instructions (page B-2)
- How to contact Product Support (page B-3)

Calibration Services and Capabilities

A Certificate of Calibration is enclosed with each individual LabMax-Pro SSIM Laser Power Meter. The serial number on the label for each meter matches the serial number listed on the Certificate of Calibration.

Coherent laser power and energy meters are precision instruments, capable of delivering very accurate measurements and 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.

Facilities

As the largest laser manufacturer in the world, Coherent has built state-of-the-art calibration facilities containing the widest possible range of laser types and technologies. By doing so, we perform instrument and sensor calibration for virtually any combination of wavelength, power, and operating characteristics.

Calibrated Standards

Sensors are calibrated against traceable working standard sensors from the National Metrology Institute (NMI). These are, in turn, calibrated against NMI-calibrated golden standard sensors. These working and golden standards are maintained with the utmost care, recalibrated annually, and verified even more often. We maintain multiple NMI-calibrated standards at many laser wavelengths to support the growing calibration needs of our customers.

Strict quality inspections during many stages of calibration and testing assure a precise and accurate instrument that is NMI-traceable and CE-marked. The benefit to our customers is that instruments calibrated by Coherent will consistently perform as expected under their actual use conditions. We are a registered ISO 9001:2000 company, our products are NMI traceable, and our calibration labs are fully compliant with ANSI Z540.

Competencies

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.

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.

Obtaining Service

Customers may request service either when sending the meter for a service evaluation or for service under the Warranty.



Request for Service Under Warranty

To obtain service under 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.

- Package the product (to protect from damage during shipping) as instructed in the next section, Product Shipping Instructions.
- 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 (12) months of time of sale or during an extended 12-month or 24-month Warranty period.

You must include a Returned Material Authorization number (RMA) assigned by the Company on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender. Detailed instructions to prepare a product for shipping are provided in the next section.

Product Shipping Instructions

If Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall:

1. Contact Coherent Customer Service (see Contact Product Support in the next section) to obtain 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. This tag should be packed inside the box.
3. Wrap the product with polyethylene sheeting or equivalent material.



IMPORTANT!

Remember to package any non-standard hardware and return it with the product, so the meter can be appropriately evaluated.

4. Using the original shipping and packaging materials, pack the product.
5. Seal the shipping carton securely with shipping tape or an industrial stapler.

6. Add the RMA number you received from Coherent Customer Service to the shipping label for the box.
7. Ship the product to the following address:

Coherent, Inc.
Laser Measurement and Control Service
Attn: RMA #
27650 SW 95th Ave.
Wilsonville, OR 97070
USA

Contact Product Support

Coherent provides telephone and web-based technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services.

Under no circumstances do these support services affect the terms of any Warranty agreement between Coherent and the buyer. Operation of any Coherent laser with any of its interlocks (or safety features) defeated is always at the operator's own risk.

Please be prepared to provide the following information to the Support Engineer who responds to your request:

- Model or part number of your unit
- Serial number of your unit
- A description of the problem
- Any corrective steps you may have attempted

For the latest Customer Service information, refer to the company website:

www.Coherent.com

In the USA and North America

If you are shipping products from within the United States or North America, contact LMC Technical Support directly, either:

- By phone in North America: 1-(800) 343-4912 or 1-(408)-767-4042
- By e-mail: LSMservice@coherent.com

Telephone coverage is available Monday through Friday (except during U.S. holidays). Inquiries received outside normal office hours are tracked by our automatic answering system and promptly returned the next business day.

International

To view a list of contact names, telephone numbers, and addresses worldwide, visit our website:

www.Coherent.com

If you are located in Europe, contact LMC Technical Support directly, as follows:

- Germany: +49-6071-968-0
- Japan: +813-5635-8680

For Coherent general Technical Support, contact your local Coherent Service Representative, or contact us as follows:

- By phone: 1-(408)-764-4557 or 1-(800)-367-7890

- By e-mail: Product.Support@Coherent.com

APPENDIX C: 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.

This Warranty applies only to the original purchaser and is not transferable.

Coherent, Inc. will, at its discretion, repair or replace any product or component found to be defective during the Warranty period.

Repaired or replacement units will be covered for the remainder of the original equipment Warranty period.

Conditions of Warranty

For Warranty service requiring the return of any product to Coherent, the product must be returned to a service facility designated by Coherent. The Buyer is responsible for all shipping charges, taxes and duties.

Parts replaced under Warranty shall become the property of Coherent and must be returned to Coherent, Inc., Santa Clara, or to a facility designated by Coherent. All products must be carefully packed in a suitable shipping containers.

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

Coherent does not assume responsibility for components broken in shipment due to improper packaging or handling. The Buyer is obligated to issue a purchase order for the value of the replaced parts and Coherent issues credit when the parts are received.

Limitations of Warranty

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, mishandling, abuse, negligence, or acts of nature.
- 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.
- Opening the housing

These products are designed to be operated as assembled; there are no user-serviceable components in the products.



IMPORTANT!

DO NOT disassemble the enclosure for the device.

The Warranty is void if the enclosure is disassembled!

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.

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.

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.

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LabMax-Pro SSIM User Manual

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