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COHERENT

User Manual

LabMax™-TOP

Laser Power/Energy Meter



COHERENT

User Manual
LabMax-TOP
Laser Power/Energy Meter

COHERENT
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Wilsonville, OR 97070

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TABLE OF CONTENTS

Preface xi
RoHS Compliance xi
Export Control Laws Compliance xi
Signal Words and Symbols in this Manual xi
Signal Words xii
Symbols xiii
Battery Compliance xiv
Publication Updates xiv
Firmware Updates xiv

Section One: Safety 1-1
Waste Electrical and Electronic Equipment (WEEE, 2002) 1-2
Declaration of Conformity 1-2

Section Two: Quick Start 2-1
Measuring Power With a Thermopile or Optical Sensor 2-2
Measuring Energy With a Pyroelectric Sensor 2-3
Saving Data to a File on the Local Drive 2-4
Moving a File to the USB Flash Drive 2-5

Section Three: Description 3-1
Product Overview 3-1
Product Features 3-2
Menu Layout 3-3
Front Panel 3-4
Buttons 3-4
Soft Keys 3-5
Power On/Off Button 3-5
Selection Knob 3-5
Side Panel 3-6
USB Flash Drive Connector 3-6
Mini-USB Connector 3-6
RS-232 Connector 3-6
Sensor Connector 3-7
Power Jack Connector 3-7
Rear Panel 3-7
Ext Trig Connector 3-8
Analog Out Connector 3-8
GPIB Connector 3-8
Battery Indicators 3-8
Battery Charging Procedure 3-9
Dip Switch (OEM Mode) 3-10
Battery Pack Replacement 3-11

Battery Directive 3-11
AC Adapter 3-12

Section Four: Operation 4-1
Units 4-1
MEASURE 4-1
Measurement Display and Range Selection 4-2
Measure Power 4-2
Thermopile Sensors 4-2
Thermopile Quad Sensors 4-4
Optical Sensors 4-5
Measure Energy 4-6
Pulsed Thermopile Joules Mode 4-6
Collecting Pulsed Thermopile Joules Data Over a Host Port 4-7
Thermopile Sensors, Long Pulse Joules 4-7
Pyroelectric Sensors 4-10
Triggering 4-12
Internal Triggering Mode 4-12
Trigger States and the Trigger Annunciator 4-14
Pulse Sampling 4-14
Statistics 4-15
Statistics Calculations 4-15
Detailed Procedures 4-23
POSITION STABILITY 4-23
TUNE 4-25
Strip Chart 4-25
Bar Chart 4-26
TREND 4-28
TREND Screen During Data Collection 4-30
TREND Screen After Data Collection 4-32
Detailed Procedures 4-34
Name Log File 4-34
File Manager 4-36
TREND Setup 4-41
ZERO 4-44
SETUP 4-45
Display Smoothing 4-46
Speedup 4-48
Area Correction 4-49
Gain Compensation 4-51
Wavelength Correction 4-53
Wavelength Table Edit 4-54
Adding a Wavelength 4-55
Deleting a Wavelength 4-56
Power Measure Units 4-56
Resolution 4-57
Analog Output 4-58

Trigger 4-58
Communications 4-61
Date/Time 4-63
Energy Savings 4-65
Screen Contrast 4-66
Serial Number 4-68
Version 4-68
Soft Keys 4-68
Detailed Procedures 4-69
Save Current Config 4-69
Manage Configs 4-71
HELP 4-73
Context-Sensitive Help 4-73
General Help 4-74
BACKLIGHT 4-74

Section Five: Special Topics 5-1
Analog Output 5-1
Understanding the External Trigger Circuit 5-1

Section Six: Host Interface 6-1
Special Considerations 6-1
Message Terminators 6-1
Messages Received by the Meter 6-1
Messages Sent by the Meter 6-1
Using the RS-232 Interface 6-2
Data Flow Control 6-2
Service Request 6-2
Using the GPIB Interface 6-2
IEEE-488.1 Interface Capabilities 6-2
Service Request 6-3
Using the USB Interface 6-3
Service Request 6-3
Binary Streaming Data 6-3
Notation Conventions 6-3
Syntax 6-4
Host Command Quick Reference 6-5
Commands and Queries 6-13
SCPI Common Commands 6-13
IEEE-488.2 Common Commands 6-13
System Options 6-13
Local Control Lockout 6-13
System Status 6-14
Backlight Control 6-15
Power Auto-Off 6-15
Meter Configuration Management 6-16
Communications 6-17

Interface Select 6-17
Message Handshaking 6-18
Serial Port-Specific 6-18
IEEE-488.1 GPIB Port-Specific 6-19
USB Port-Specific 6-20
Error Record Reporting and Collection 6-20
Error Count Query 6-21
Error Query 6-22
All Error Query 6-22
All Error Clear 6-22
Measurement Setup and Control 6-22
Measurement Mode Select 6-22
Power Measurement Units Select 6-23
Display Mode Select 6-23
Area Correction 6-24
Analog Output Full Scale Voltage 6-25
Speedup 6-25
Display Data Smoothing 6-26
Wavelength Correction 6-26
Gain Compensation 6-27
Probe Zero 6-28
Range Select 6-28
Statistics Mode Control 6-29
Position Stability Mode Control 6-32
Tune Mode Control 6-33
Trend Mode Control 6-33
Measurement Data Format 6-42
Trigger Parameters 6-48
Numeric Display Resolution 6-49
Sample Measurement Data Collection 6-50
Data Gating 6-50
Data Query 6-51
Statistics Data Collection 6-52
Statistics Data Gating 6-52
Statistics Data Query 6-53
Display 6-54
Contrast 6-54
Display Text 6-54
Text Clear 6-55
Meter and Sensor Device Information 6-55
Meter 6-55
Sensor 6-56
Host Interface Glossary 6-58
ActiveX Control Interface 6-60
Document Overview 6-60
Scope 6-60
Installation 6-60

LabMax Low Level Control 6-60
Overview 6-60
Quick Reference 6-61
Detailed Reference 6-62

Section Seven: Calibration and Warranty 7-1
Calibration 7-1
Coherent Calibration Facilities and Capabilities 7-1
Limited Warranty 7-2
Extended Warranty 7-2
Warranty Limitations 7-3
Obtaining Service 7-3
Product Shipping Instructions 7-4

Appendix A: Specifications A-1
RS-232 Pinouts A-2
Persistent Parameters A-3

Appendix B: Errors B-1
Measurement Errors B-1
Meter and Sensor Errors B-1

Appendix C: Onscreen Indicators C-1

Index Index-1

LIST OF FIGURES

1-1. Waste Electrical and Electronic Equipment Label 1-2

2-1. Quick Start: Measuring Power With a Thermopile or Optical Sensor 2-2
2-2. Quick Start: Measuring Energy With a Pyroelectric Sensor 2-3
2-3. Quick Start: Saving Data to a File on the Local Drive 2-4
2-4. Quick Start: Moving a File to the USB Flash Drive 2-5

3-1. Menu Organization 3-3
3-2. Front Panel 3-4
3-3. Side Panel Connectors 3-6
3-4. Rear Panel Connectors 3-7
3-5. Dip Switch (OEM Mode) 3-10
3-6. Battery Pack Replacement 3-12

4-1. MEASURE POWER: Thermopile Sensors 4-2
4-2. MEASURE POWER: Thermopile Quad Sensors 4-4
4-3. MEASURE POWER: Optical Sensors 4-5
4-4. Pulsed Thermopile Joules Mode Power Curve 4-7
4-5. MEASURE ENERGY: Thermopile Sensors (Long Pulse Joules) 4-8
4-6. MEASURE ENERGY: Thermopile Sensors (Long Pulse - Active) 4-8
4-7. MEASURE ENERGY: Thermopile Sensors (Long Pulse - After Pulse) 4-9
4-8. MEASURE ENERGY: Pyroelectric Sensors 4-10
4-9. Average Power Diagram 4-12
4-10. Internal Trigger Threshold 4-13
4-11. STATS: Thermopile and Optical Sensors 4-16
4-12. STATS: Pyroelectric Sensors 4-16
4-13. STATS: Data Collection (In Process) 4-17
4-14. STATS: Statistics Readout 4-18
4-15. STATS: Change Stats 4-19
4-16. STATS: Setup (Thermopile and Optical Sensors) 4-20
4-17. STATS: Setup (Pyroelectric Sensors - Power) 4-20
4-18. STATS: Setup (Pyroelectric Sensors - Energy) 4-21
4-19. MEASURE POWER: POSITION STABILITY 4-23
4-20. POSITION STABILITY: Duration 4-24
4-21. TUNE: Strip Chart (Thermopile and Optical Sensors) 4-25
4-22. TUNE: Bar Chart (Thermopile and Optical Sensors) 4-27
4-23. TREND: Thermopile and Optical Sensors 4-28
4-24. TREND: Pyroelectric Sensors 4-29
4-25. TREND: During Data Collection 4-30
4-26. TREND: After Data Collection 4-32
4-27. TREND: File Manager (Save Data) 4-32
4-28. TREND: Save Tmp As 4-33
4-29. TREND: Name Log File 4-34
4-30. TREND: File Manager 4-36
4-31. TREND: File Manager (File Deletion Confirmation) 4-38
4-32. TREND: File Manager (Folder Deletion Confirmation) 4-39
4-33. TREND: Rename File or Folder 4-39
4-34. TREND: Create New Folder 4-41
4-35. TREND: Setup (Thermopile and Optical Sensors) 4-42
4-36. TREND: Setup (Pyroelectric Sensors) 4-43
4-37. SETUP 4-45
4-38. SETUP: Display Smoothing 4-46
4-39. SETUP: Display Smoothing (Thermopile and Optical Sensors - Manual Mode) 4-47
4-40. SETUP: Display Smoothing (Pyroelectric Sensors - Manual Mode) 4-47
4-41. SETUP: Speedup 4-48
4-42. SETUP: Area Correction 4-49
4-43. SETUP: Gain Compensation 4-52
4-44. SETUP: Wavelength Correction 4-53
4-45. SETUP: Wavelength Table Edit 4-54
4-46. SETUP: Edit Wavelength Table 4-55
4-47. SETUP: Edit Wavelength Table (Adding a Wavelength) 4-55

4-48. SETUP: Power Measure Units 4-56
4-49. SETUP: Resolution 4-57
4-50. SETUP: Analog Output 4-58
4-51. SETUP: Trigger 4-59
4-52. SETUP: Trigger (Changing the Values) 4-60
4-53. SETUP: Communications 4-61
4-54. SETUP: Communications (Changing the Values) 4-62
4-55. SETUP: Date/Time 4-63
4-56. SETUP: Date/Time (Changing the Values) 4-64
4-57. SETUP: Energy Savings 4-65
4-58. SETUP: Energy Savings (Changing the Values) 4-65
4-59. SETUP: Screen Contrast 4-66
4-60. SETUP: Screen Contrast (Changing the Values) 4-67
4-61. SETUP: Serial No. 4-68
4-62. SETUP: Version 4-68
4-63. SETUP: Save Current Config 4-70
4-64. SETUP: Manage Configs 4-71
4-65. SETUP: Manage Configs (File Deletion Confirmation) 4-71
4-66. SETUP: Rename Config 4-72
4-67. HELP (Context-Sensitive) 4-73
4-68. HELP (All Topics) 4-74

5-1. External Trigger Input Circuitry 5-1
5-2. External Trigger Minimum Pulse Width 5-2
5-3. Boosting Source Current of Triggering Device 5-2

LIST OF TABLES

3-1. Battery Life Indicator 3-8
3-2. Batteries Contained in this Product 3-11

4-1. Joules and Watts Units 4-1
4-2. Approximate Pulse Sampling Based on the Number of Incoming Pulses 4-14
4-3. Sensor Resolution Ranges 4-57
4-4. Trigger Range and Factory Defaults 4-59
4-5. Communication Values and Factory Defaults 4-61
4-6. Date/Time Ranges and Factory Defaults 4-63
4-7. Energy Savings Ranges and Factory Defaults 4-65
4-8. Custom Configuration File Meter Settings 4-69

6-1. IEEE-488.1 Interface Functions 6-2
6-2. Host Command Quick Reference 6-5
6-3. Status Bit Definitions 6-14

6-4. Error Codes and Description Strings 6-20
6-5. Display Mode Headers..... 6-23
6-6. Measurement Data Value Selections..... 6-44
6-7. FLAG Bit Definitions 6-46

7-1. Coherent Service Centers..... 7-4

A-1. Specifications..... A-1
A-2. RS-232 Pinouts A-2
A-3. Persistent Parameters A-3

B-1. Measurement Errors.....B-1
B-2. Meter and Sensor Errors B-1

C-1. Onscreen Indicators C-1

Preface

This manual contains user information for the LabMax™-TOP Laser Power/Energy Meter.

RoHS Compliance

This Coherent product is RoHS compliant.

Export Control Laws Compliance

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

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

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

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

Signal Words and Symbols in this Manual

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

Signal Words

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

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

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

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

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

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

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

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

Symbols

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



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



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



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



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



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



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

Battery Compliance

The batteries used in this product are in compliance with the EU Directive 2006/66/EC ("EU Battery Directive"). For more information, refer to "Battery Directive" (p. 3-11).

Publication Updates

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

Firmware Updates

To obtain the latest version of LabMax firmware:

1. Connect to www.Coherent.com.
2. Download the firmware to a USB flash drive.

To install the update:

1. Plug LabMax into an *AC power source* and then turn the meter ON.



NOTICE!
Do not use battery power when installing a firmware update. A power loss during the installation process will damage the meter, which must then be returned to Coherent for repair.

2. Connect the flash drive to the USB flash drive connector on the side panel of LabMax.
3. When the menu appears on the LCD, turn the Selection knob to highlight the firmware name and then press the Enter/Set button (Selection knob) to begin the installation.
4. When prompted on the installation menu, remove the flash drive and press the Exit soft key to reboot LabMax.

SECTION ONE: SAFETY

Carefully review the following safety information to avoid personal injury and to prevent damage to this meter or any sensor connected to it. This equipment contains no user-serviceable parts. For service information, refer to “Obtaining Service” (p. 7-3).



WARNING!
|The use and measuring of lasers is potentially dangerous. This instrument operates over wavelengths that include non-visible laser emissions.

Proper laser operating practice in accordance with manufacturer recommendations is vital.

Eyewear and other personal protective equipment must be used in accordance with applicable laws and regulations.

If in doubt of correct operating procedures, consult the laser manufacturer and your laser safety officer.

The equipment is not for use in critical medical environments.



WARNING!
Do not operate this instrument if its panels are removed or any of the interior circuitry is exposed.



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



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

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

NOTICE!
Do not use battery power when installing a firmware update. A power loss during the installation process will damage the meter, which must then be returned to Coherent for repair.

Waste Electrical and Electronic Equipment (WEEE, 2002)

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

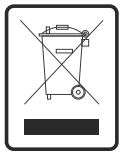


Figure 1-1. Waste Electrical and Electronic Equipment Label

Declaration of Conformity

Declaration of Conformity certificates are available upon request.

SECTION TWO: QUICK START

This section presents “mini-tutorials” that explain how to connect a sensor to your LabMax meter, begin taking measurements within minutes, and save your data for later viewing.

- Measuring power with a thermopile or optical sensor (page 2-2)
- Measuring energy with a pyroelectric sensor (page 2-3)
- Saving data to a file on the local drive (page 2-4)
- Moving a file to the USB flash drive (page 2-5)

For detailed information about each step of the procedures introduced in this section, refer to “Section Four: Operation” (p. 4-1).



WARNING!
Follow all laser safety procedures. The laser must be blocked or switched OFF before beginning any of the procedures described in this section.



NOTICE!
Power to the LabMax meter must be OFF before beginning any of the procedures described in this section.



NOTICE!
Do not exceed the power/energy density limits of the sensor.

Measuring Power With a Thermopile or Optical Sensor

The tutorial describes how to take a power measurement using a thermopile or optical sensor.

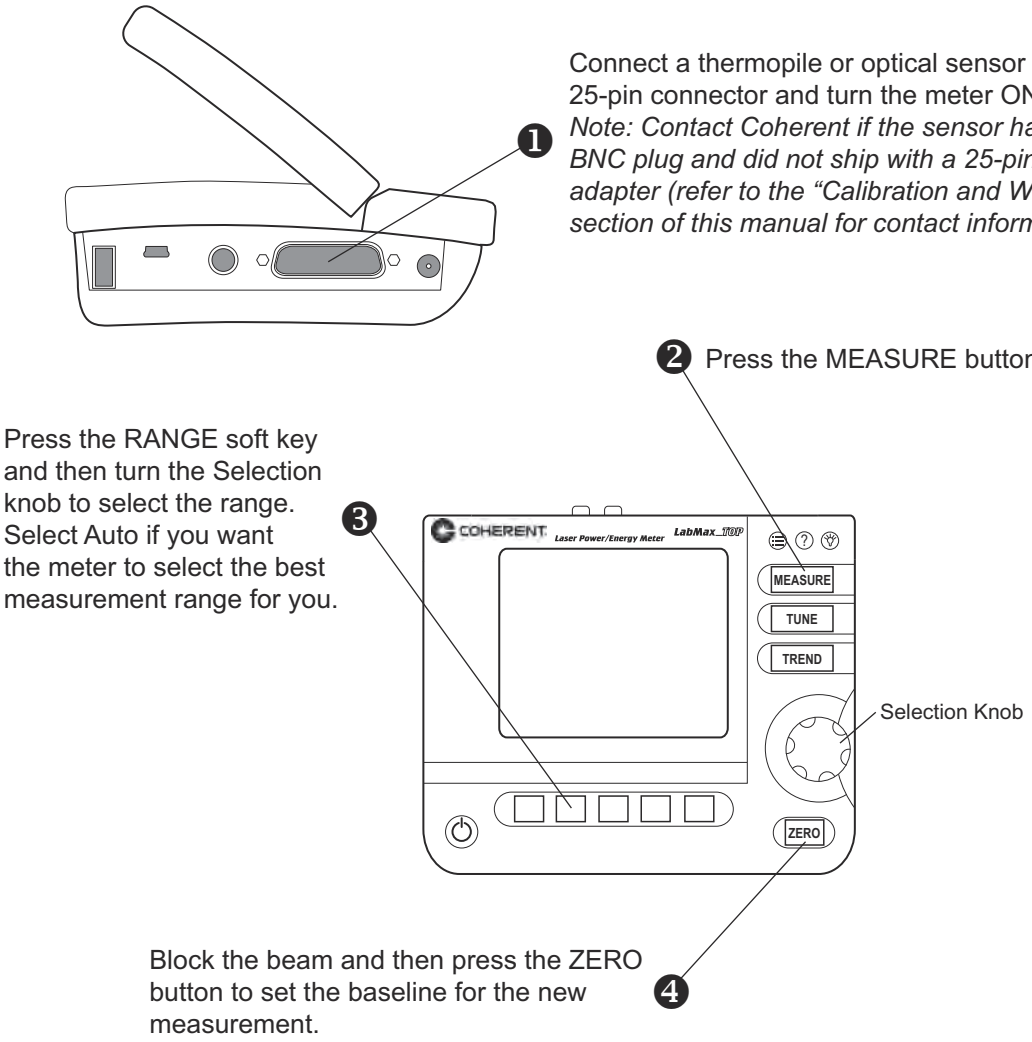
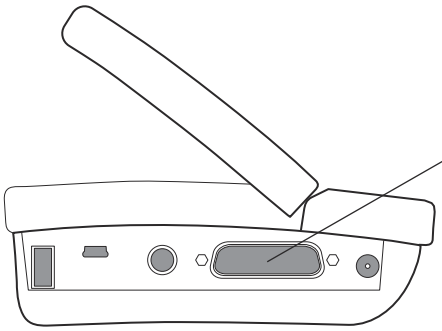


Figure 2-1. Quick Start: Measuring Power With a Thermopile or Optical Sensor

Measuring Energy With a Pyroelectric Sensor

This tutorial shows how to take an energy measurement using a pyroelectric sensor.

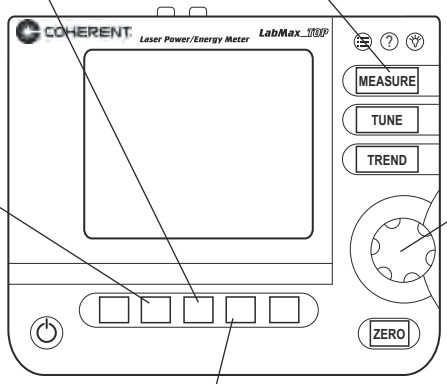


❶ Connect a pyroelectric sensor to the 25-pin connector and turn the meter ON.
Note: Contact Coherent if the sensor has a BNC plug and did not ship with a 25-pin adapter (refer to the "Calibration and Warranty" section for contact information).

❷ Press the MEASURE button.

If Watts mode is currently selected, toggle the UNITS soft key to select Joules mode. ❸

Press the RANGE soft key and then turn the Selection knob to select the range. ❹
Note: Auto range is not available for this type of sensor.



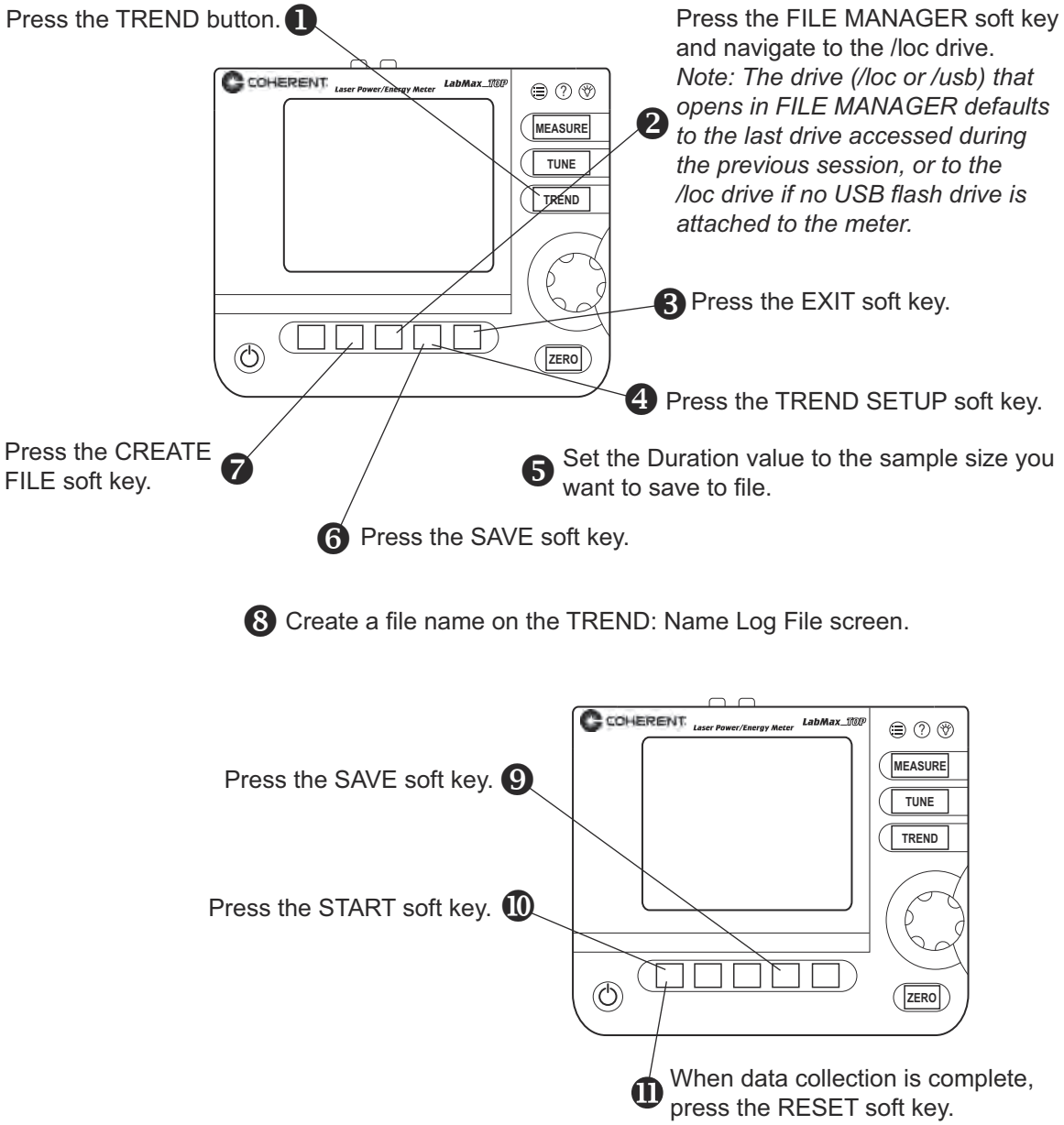
Press the TRIG LEV soft key and then turn the Selection knob to adjust the trigger threshold. Make sure the trigger threshold is set *below* the energy level you plan to measure and *above* the level at which the system triggers on noise. ❺

❻ Take the measurement and observe the result on the display.

Figure 2-2. Quick Start: Measuring Energy With a Pyroelectric Sensor

Saving Data to a File on the Local Drive

In this tutorial you will learn how to create—and save data to—a file that's stored on the local drive (/loc). The tutorial on page 2-5 shows how to move a file to the USB flash drive. You can also save data directly to the USB flash drive by navigating to the USB drive in Step 2, in the following illustration.

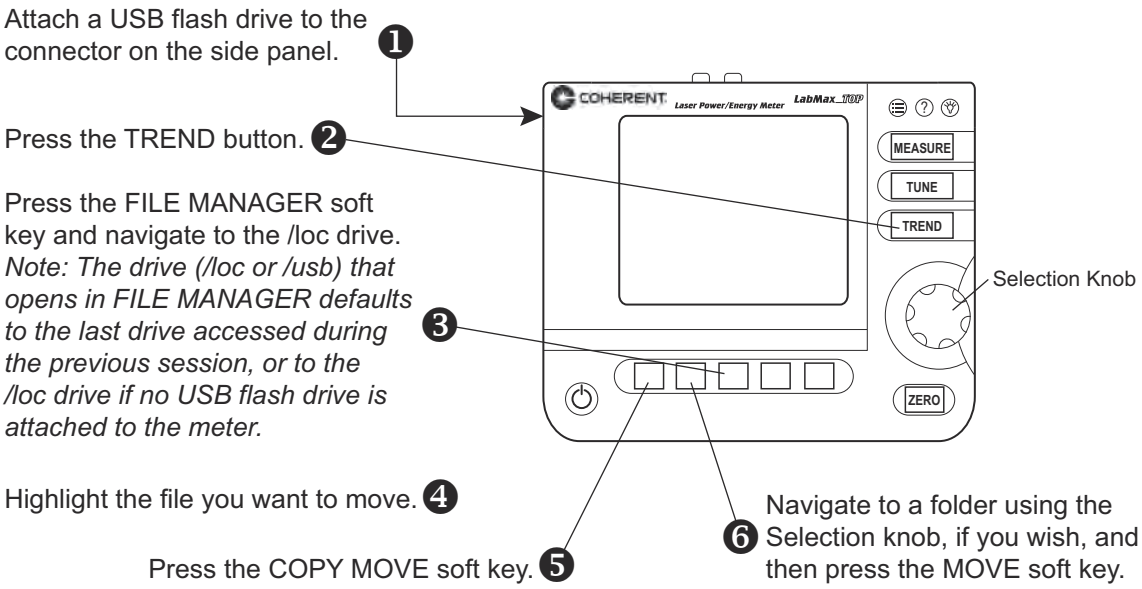


Data is now saved in the file created in step 8.

Figure 2-3. Quick Start: Saving Data to a File on the Local Drive

Moving a File to the USB Flash Drive

This tutorial shows how to move a file from the local drive (/loc) to the USB flash drive (/usb) connected to LabMax.



7 Press the ENTER/Set button to dismiss the confirmation dialog box.

The file selected in step 4 has been moved to the /usb drive and removed from the /loc drive.

Figure 2-4. Quick Start: Moving a File to the USB Flash Drive

SECTION THREE: DESCRIPTION

Thank you for purchasing the LabMax™-TOP Laser Power/Energy Meter—a versatile, easy-to-use, single-channel power/energy meter designed for anyone who needs to measure and analyze laser output.

In this section:

- Product overview (this page)
- Product features (page 3-2)
- Menu layout (page 3-3)
- Front panel (page 3-4)
- Side panel (page 3-6)
- Rear panel (page 3-7)
- Battery indicators (page 3-8)
- Dip Switch (OEM mode) (page 3-10)
- Battery pack replacement (page 3-11)
- AC adapter (page 3-12)

Product Overview

The LabMax-TOP Laser Power/Energy Meter meets your needs in new ways via onboard data logging as well as support for logging data directly to a USB flash drive. It also offers enhanced data analysis and statistics, and a form factor that allows flexible positioning and viewing angles so it can be used in areas with limited bench space. LabMax is directly compatible with most Coherent thermal, pyroelectric, and semiconductor sensors (with no need for adapters) and displays beam position for quick and accurate setup. Performance is enhanced in the form of low noise pulse energy measurement and high resolution power measurement.



Product Features

Specific features of your LabMax meter include:

- Compatible with LM-, PM-, and PS- model thermopile sensors, and OP-2 and LM-2 model optical sensors. No adapters required.
- Displays beam position with LM-model sensors
- Supports 5-digit resolution with thermopile and optical sensors (user-selectable).
- Pyroelectric:
    - Measures energy to 10000 pps and captures every pulse to 1000 pps with J-model and EnergyMax sensors. Streams data over USB to 1000 Hz. Also measures rep. rate and calculates average power. (LabMax is not compatible with the legacy LM-P model energy sensors.)
- Large, graphical display with backlight. Ergonomic interface with easily accessible buttons for all features and modes. Flexible positioning of the display allows viewing from many angles.
- Digital tuning indicators - horizontal bar and trend chart formats with peak indicators.
- Onboard statistics (mean, minimum, maximum, standard deviation, range, three stability parameters, dose, and missed pulses). Display up to six user-selectable statistical parameters at a time.
- Data logging can be performed directly to a USB flash drive, or up to 400,000 points can be retained onboard the meter. The meter has a file management system that allows naming and renaming files, auto increments file names for repetitive logging events, supports folder creation and renaming, and transfers files and folders from onboard memory to USB flash drive.
- USB, RS-232, and GPIB (LabMax-TOP w/GPIB model only) computer interfaces with full host control and drivers for both VisualBasic and LabVIEW™ programmers. Plug-and-play applications software is also supplied standard, along with USB and RS-232 cables (an optional GPIB cable is also available through Coherent).
- Analog output with user-selectable full-scale voltage of 1, 2 or 4V. RCA-to-BNC converter included (standard).
- External trigger input with user-selectable slope and trigger delay.

- Field-upgradeable meter internal software and operating system, with updates available on the Coherent website or e-mailed directly to the user. This feature ensures that you always have the latest LabMax features.
- Li-ion battery powered (4400 mAh pack standard), as well as the ability to operate with an AC power adapter (PSE and UL approved). Meter contains a smart charging circuit onboard to charge the rechargeable battery pack and the display has a battery level indicator. AC power adapter and cord are included.
- LabVIEW Instrument Driver that can be used with USB, RS-232, or GPIB interfaces.
- Applications software that allows you to plug the meter into your PC and immediately analyze data and log it to a file. The software is contained on the CD that ships with the meter and will also be available on our website as a free download.

Menu Layout

The following chart graphically depicts the LabMax menu organization.

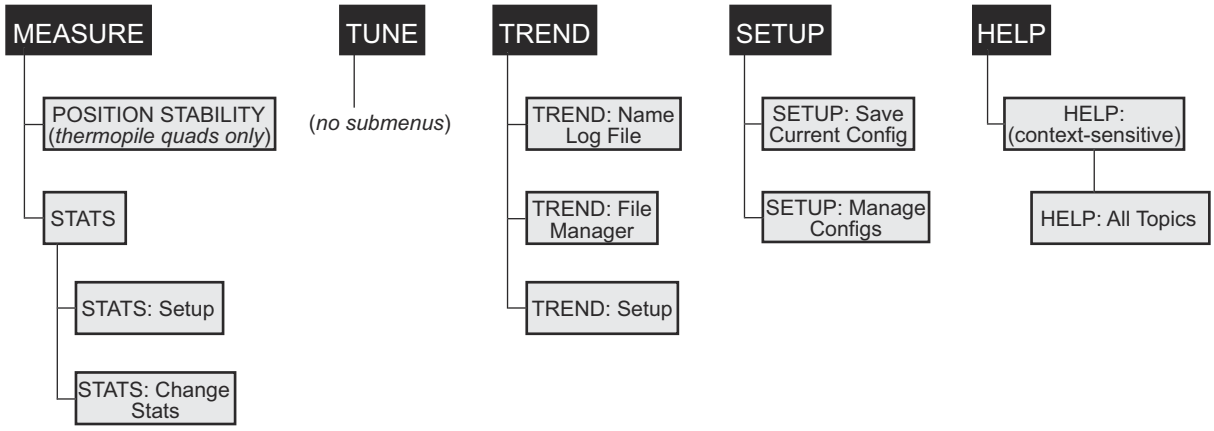


Figure 3-1. Menu Organization

Front Panel

The front panel (shown in Figure 3-2) includes a large liquid crystal display (LCD), as well as buttons, a Selection knob, and soft keys that are used to enter parameters, select modes, and change ranges.

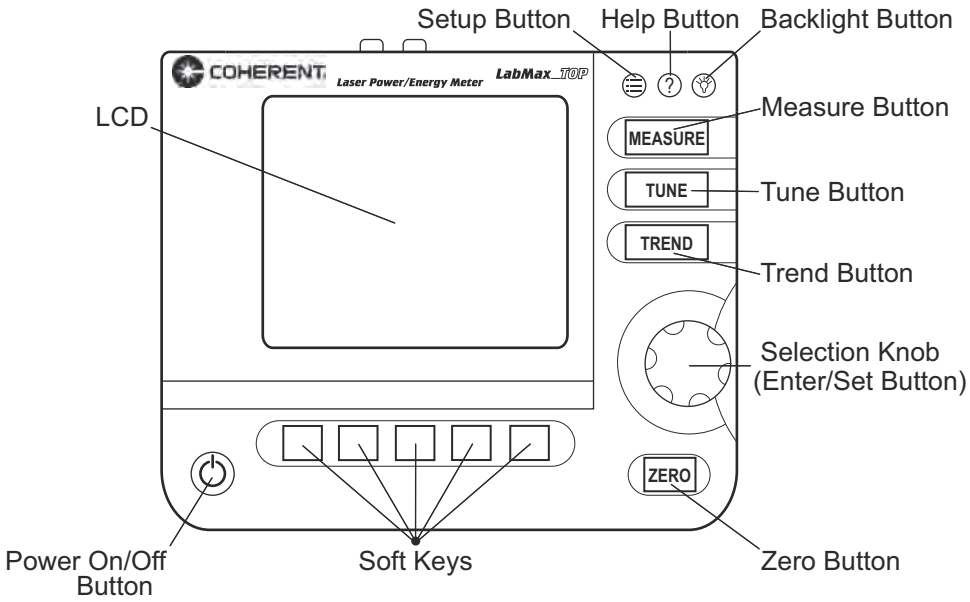


Figure 3-2. Front Panel

Buttons

LabMax has the following buttons (refer to Figure 3-2 for button locations):

- SETUP
- HELP
- BACKLIGHT
- MEASURE
- TUNE
- TREND
- ZERO
- Power On/Off
- Selection knob (which also functions as the Enter/Set button when pressed, rather than turned)

For detailed information about each of the buttons, refer to “Section Four: Operation” (p. 4-1).

Soft Keys

The five soft keys—just below the LCD—are used for three main functions:

- Navigating to a different screen. Examples: POSITION STABILITY and TREND SETUP.
- Performing an action. Examples: START and RESET.
- Making a selection from a list of possible choices. Examples: RANGE and UNITS.

For detailed information about soft keys, refer to "Section Four: Operation" (p. 4-1). To learn how to change a value, refer to "Selection Knob" (p. 3-5).

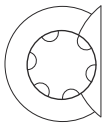
Power On/Off Button



If a sensor is connected to the meter when it is turned on, the meter defaults to the last mode (MEASURE, TUNE, TREND, or SETUP) used with that specific type of sensor (thermopile, optical, or pyroelectric). If the wavelength of the new sensor is out of range of the previously-selected wavelength for the sensor typed attached, the meter automatically switches to the calibration wavelength for that sensor.

A "Searching for sensor" error message will appear on the LCD if the meter is turned on without a sensor connected to it.—see "Meter and Sensor Errors" (p. B-1) for a complete listing and description of all error messages.

Selection Knob



To change a value, first *turn* the Selection knob to select a specific value, and then *press* the Selection knob (which also functions as an Enter/Set button when pressed, rather than turned) to save the value.

Side Panel

Figure 3-3 shows the location of the LabMax connectors on the side panel. Each of these connectors is discussed, below.

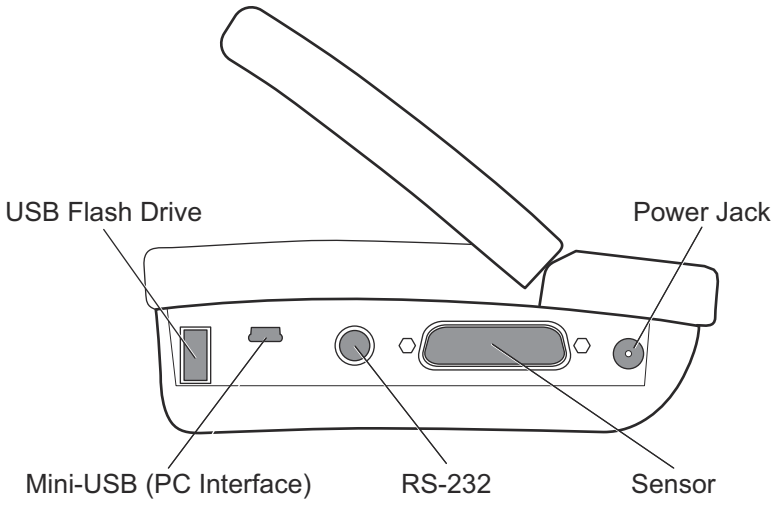


Figure 3-3. Side Panel Connectors

USB Flash Drive Connector

This is an input connector for a USB (FAT16) flash drive.

Mini-USB Connector

Attaching the cable—shipped with the meter—to this mini-USB connector allows communication between LabMax and a computer that has a USB interface.



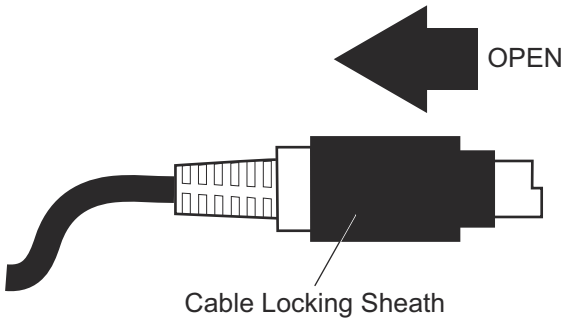
NOTICE!
Install the LabMax software *before* physically connecting the meter to the computer. For information about installing the software, refer to the *LabMax PC Software Installation and Quick Start Guide* (1175379) inside the CD case that shipped with your product.

RS-232 Connector

This is an RS-232, female, miniature 6-pin DIN. For a list of pin assignments, refer to Table A-2 (p. A-2).

To connect the RS-232 cable to the meter:

1. Hold the cable locking sheath in the open position:



2. Slide the cable into the RS-232 connector on the side of the meter.
3. Release the cable locking sheath to lock the cable in place.

Sensor Connector

Use this connection to attach a Coherent thermopile, optical, or pyroelectric sensor to LabMax.

Power Jack Connector

Connect the power cord—shipped with the meter—to this connector.

Rear Panel

The following figure shows the location of the LabMax connectors on the rear panel. Each of these connectors is discussed, below.

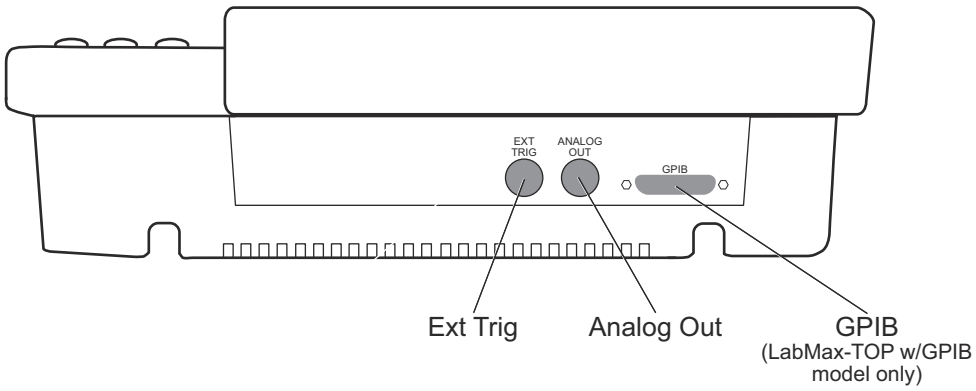


Figure 3-4. Rear Panel Connectors

Ext Trig Connector

(Trigger In) Attach an external trigger source to this connection. This source is used if external triggering is specified. For more information about trigger settings, refer to “Trigger” (p. 4-58).

Analog Out Connector

When power is on, the Analog Out connector outputs a voltage proportional to the current laser measurement with respect to the measurement range. 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 overranged. The full-scale output voltage (1, 2, or 4V) is selected in the SETUP screen or via the host interface. Factory default full-scale output voltage is 2V.

GPIB Connector

This is an IEEE-488 computer interface found on the LabMax-TOP w/GPIB model.

Battery Indicators

This section discusses three indicators that provide information on the status of the internal battery. These indicators appear in the upper left corner of the LCD.



The Battery Life indicator visually represents the percentage of remaining battery life (refer to Table 3-1). This indicator only appears on the screen when a battery is installed in the meter.



NOTICE!
The Battery Life indicator will begin flashing shortly before the battery is completely discharged. To avoid loss of data, immediately either save the current information to a file, or connect AC power to the meter.

Table 3-1. Battery Life Indicator

Number of Visible Bars	Remaining Battery Life
5	81 to 100%
4	61 to 80%
3	41 to 60%
2	21 to 40%
1	11 to 20%
0	0 to 10%

The Charging indicator signals that the battery is currently being charged. It only appears on the screen when the meter is running on AC power and the installed battery has less than 100% charge. Once the battery is completely charged, the Charging indicator disappears.

The Charging Malfunction indicator only appears when there is something wrong with the battery charging process. To attempt to solve the problem, begin by removing the battery and then re-attaching it. Then unplug the AC power source from the meter and then plug it back in. If this does not clear the error, fully drain the battery and recharge it (refer to "Battery Charging Procedure" (p. 3-9) for information about discharging and recharging the battery). If the Charging Malfunction indicator continues to display, call Coherent for assistance. Refer to Table 7-1 (p. 7-4) for contact information.

Battery Charging Procedure



NOTICE!
To achieve greater battery fuel gauge accuracy, complete the following procedure. *This procedure must be repeated whenever a new battery pack is installed (including when you first receive the meter) and can be repeated at any time to reset the fuel gauge registers.*

1. Install the battery pack into LabMax (in the case of a new meter, the battery pack comes already installed). Refer to "Battery Pack Replacement" (p. 3-11) to see how to attach the battery connector to the meter.
2. Fully-charge the battery pack by running the meter on AC power for at least eight hours.
3. Fully-discharge the battery pack by unplugging LabMax from the AC source and then running the meter using only battery power. Let the meter run until it automatically shuts off (which indicates a dead battery).

4. Fully-charge the battery pack again (> 8 hr.).

It can take up to one minute for LabMax to update the Battery Charge indicator after the installation of a new battery or after attaching an AC power adapter.

Dip Switch (OEM Mode)

Setting the Dip switch to OEM mode ensures that if power is lost while the meter is in use, it will automatically turn back on again when power is restored. The benefit of this mode is that, following a power loss, remote installations can communicate with the meter without having to manually recycle instrument power.

To activate OEM mode, move Switch 1 on the Dip switch to the ON position (see the following figure).



NOTICE!
To avoid prematurely draining the onboard battery (which could result in erratic meter readings), leave Switch 2 in the down (OFF) position.

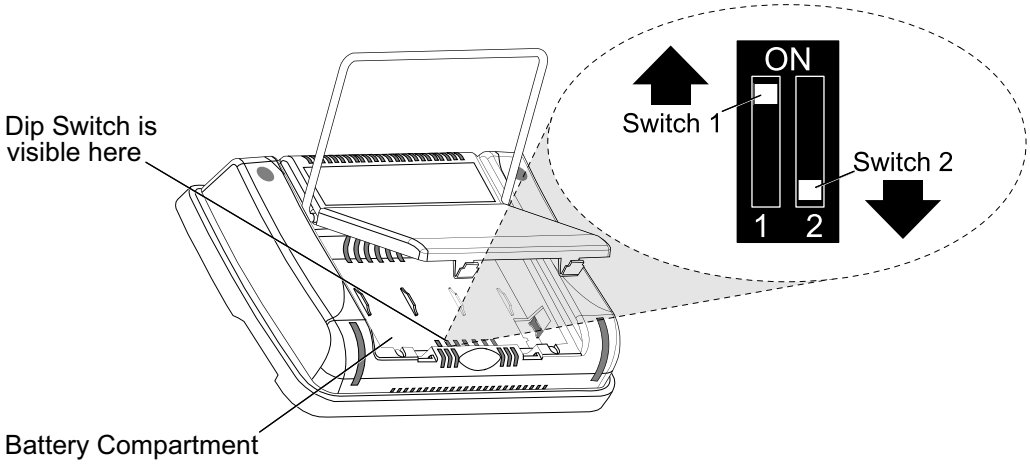


Figure 3-5. Dip Switch (OEM Mode)

Battery Pack Replacement

Figure 3-6 (p. 3-12) illustrates how to replace the LabMax standard battery pack. To review battery specifications, refer to “Appendix A: Specifications” (p. A-1).

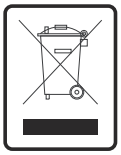
Battery Directive

The batteries used in this product are in compliance with the EU Directive 2006/66/EC (“EU Battery Directive”).

Additionally, the Lithium-Ion rechargeable battery pack used in this product has been evaluated and tested to ensure compliance with the Fourth Revised Edition of the UN Manual of Tests and Criteria, Sec 38.3, Lithium Batteries (ST/SC/AC.10/11/Rev.4) - more commonly known as the UN T1-T8 Transportation tests, and has been found to comply with the stated criteria.

Table 3-2. Batteries Contained in this Product

Description	Type
4400 mAH battery pack	Lithium Ion



Dispose of batteries according to local regulations. Do not dispose as normal waste. Consult your local waste authorities for guidance.

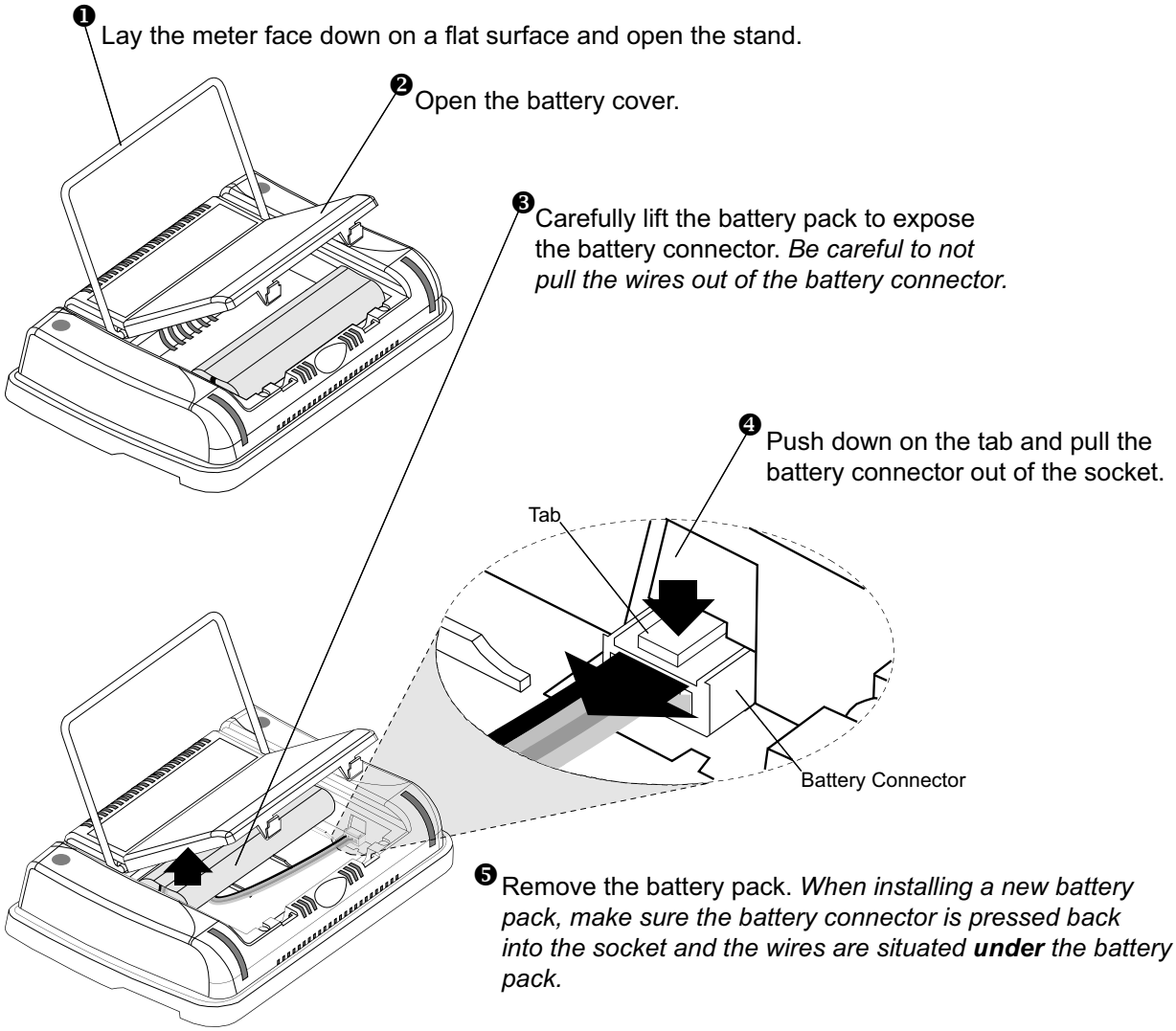


Figure 3-6. Battery Pack Replacement

AC Adapter

Using an AC adapter prolongs battery life. LabMax automatically senses when an adapter is being used.

SECTION FOUR: OPERATION

In this section:

- Units (this page)
- MEASURE (this page)
- TUNE (page 4-25)
- TREND (page 4-28)
- ZERO (page 4-44)
- SETUP (page 4-45)
- HELP (page 4-73)
- BACKLIGHT (page 4-74)

Units

Measurement units are expressed in terms listed in the following table:

Table 4-1. Joules and Watts Units

Joules[a]	Watts[a]
pJ (picojoules)	pW (picowatts)
nJ (nanojoules)	nW (nanowatts)
µJ (microjoules)	µW (microwatts)
mJ (millijoules)	mW (milliwatts)
J (joules)	W (watts)
	kW (kilowatts)

a. When area correction is enabled, all units are expressed in terms of per cm^2. In other words, the /cm^2 suffix is always appended to the units.

MEASURE

MEASURE

The MEASURE mode provides three primary functions: Measure Power, Measure Energy, and Statistics. Each of these functions are discussed in detail, below.

Measurement Display and Range Selection

The graphical display update rate for numeric measurement is three times per second.

Measurement range is selected in decade steps. Range selection is dependent on the sensor type and characteristics, as well as user-determined measurement settings.

LabMax uses the “3’s” Rule—a display formatting rule in which the display value is not allowed to exceed 3, 30, or 300, depending on where the decimal point falls, with the decimal point located in a fixed position, as determined by the current range. Typically if a reading exceeds the “3’s” limit, the instrument is over-ranged or, in the case of Auto Ranging, the instrument will automatically range up.

Over-ranging refers to a meter setup condition in which the sensor output signal is greater than the maximum allowable level for the selected range. OVR appearing on the display signifies an over-range condition. Over-ranging generates invalid data.

Measure Power

Thermopile Sensors

Figure 4-1 shows an example of how the MEASURE POWER screen looks when a thermopile sensor is connected to the meter—for thermopile quad sensors, refer to “Thermopile Quad Sensors” (p. 4-4):

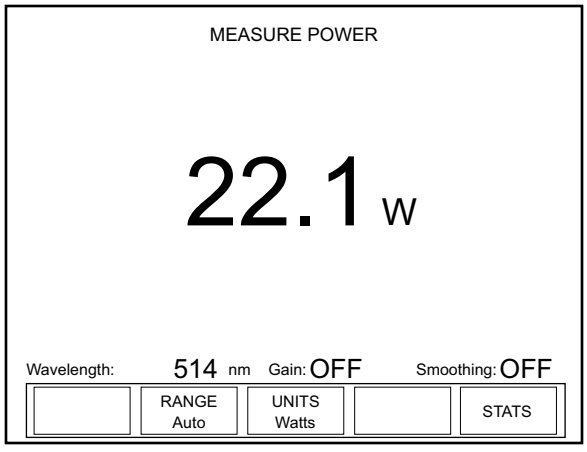


Figure 4-1. MEASURE POWER: Thermopile Sensors

This screen contains the live reading and also shows the following indicators: Wavelength, Gain, and Smoothing. Note that Figure 4-1 shows an example screen with Area Correction turned OFF. With

Area Correction turned ON, the screen looks slightly different. A summary of indicator behavior is provided in “Appendix C: Onscreen Indicators” (p. C-1).

Soft Keys

There are three soft keys on this screen: RANGE, UNITS, and STATS.

RANGE

- Available values (thermopile and optical sensors): Auto (factory default) and the allowable ranges for the attached sensor.
- Available values (pyroelectric sensors): Sensor-dependent.

To adjust the range:

1. Press the RANGE soft key.
2. Turn the Selection knob to change the range value.
3. When the desired value appears, press the RANGE soft key (or the ENTER/SET button) to lock in the RANGE value.

UNITS

Pressing the UNITS soft key toggles the measurement units between Watts and Joules.

STATS

Refer to “Statistics” (p. 4-15) for information about the STATS menu.

Over-Temperature Condition

(*thermopile sensors only*) Whenever the meter detects a sensor over-temperature condition, a Sensor Over Temp dialog message appears on the screen. *This message does not appear unless a sensor over-temperature condition exists.*



NOTICE!
If a Sensor Over Temp message appears on the screen, turn the laser off immediately and let the sensor cool down.

Thermopile Quad Sensors

Figure 4-2 shows an example of how the MEASURE POWER screen looks when a thermopile quad sensor is connected to the meter. In addition to the live display, there is a positional target that is used to make sure the beam is aligned to the center of the sensor before taking a measurement. The outer edge of the bulls eye target represents the outer edge of the sensor's active area.

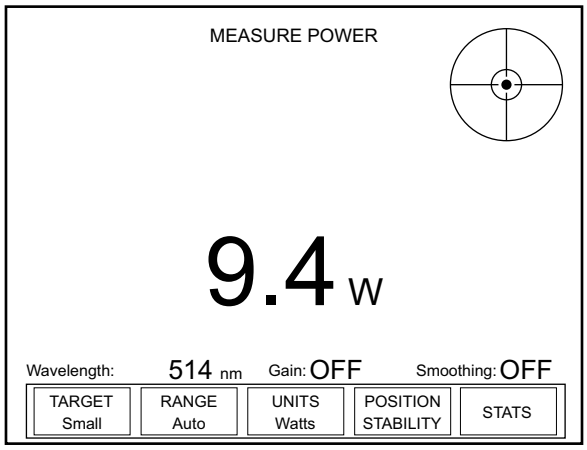


Figure 4-2. MEASURE POWER: Thermopile Quad Sensors

This screen contains the live reading and also shows the following indicators: Wavelength, Gain, and Smoothing. A summary of indicator behavior is provided in “Appendix C: Onscreen Indicators” (p. C-1).

Soft Keys

There are five soft keys on this screen: TARGET, RANGE, UNITS, POSITION STABILITY, and STATS.

TARGET

Available values: Small and Large.

To adjust the size of the target, toggle the TARGET soft key.

RANGE

- Available values (thermopile and optical sensors): Auto (factory default) and the allowable ranges for the attached sensor.
- Available values (pyroelectric sensors): Sensor-dependent.

To adjust the range:

1. Press the RANGE soft key.
2. Turn the Selection knob to change the range value.
3. When the desired value appears, press the RANGE soft key (or the ENTER/SET button) to lock in the RANGE value.

UNITS

Pressing the UNITS soft key toggles the measurement units between Watts and Joules.

POSITION STABILITY

Refer to “POSITION STABILITY” (p. 4-23).

STATS

Refer to “Statistics” (p. 4-15) for information about the STATS menu.

Optical Sensors

Figure 4-3 shows an example of how the MEASURE POWER screen looks when an optical sensor is connected to the meter:

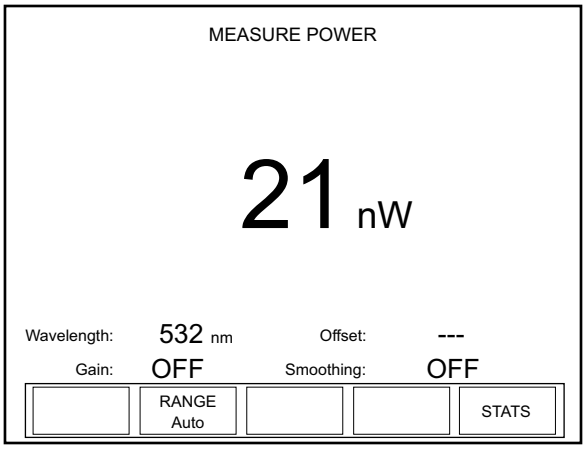


Figure 4-3. MEASURE POWER: Optical Sensors

This screen contains the live reading and also shows the following indicators: Wavelength, Offset, Gain, and Smoothing. A summary of indicator behavior is provided in “Appendix C: Onscreen Indicators” (p. C-1).

Soft Keys

There are two soft keys on this screen: RANGE and STATS.

RANGE

- Available values (thermopile and optical sensors): Auto (factory default) and the allowable ranges for the attached sensor.
- Available values (pyroelectric sensors): Sensor-dependent.

To adjust the range:

1. Press the RANGE soft key.
2. Turn the Selection knob to change the range value.
3. When the desired value appears, press the RANGE soft key (or the ENTER/SET button) to lock in the RANGE value.

STATS

Refer to “Statistics” (p. 4-15) for information about the STATS menu.

Measure Energy

Pulsed Thermopile Joules Mode

(*for long-pulsed lasers only*) When a thermopile sensor is attached, the meter has the capability of measuring energy from a finite duration laser pulse, or from a series of finite duration laser pulses. (Thermopile sensors are typically used to measure laser power and have an extremely slow response time relative to the pulse width of the laser used to generate the power signal.)

The power curve (shown below) is integrated from the pulse start to infinity. The final energy value is algorithmically calculated shortly after peak power is attained.

The trigger is *not* determined by the power threshold, but by the slope of the change in power.

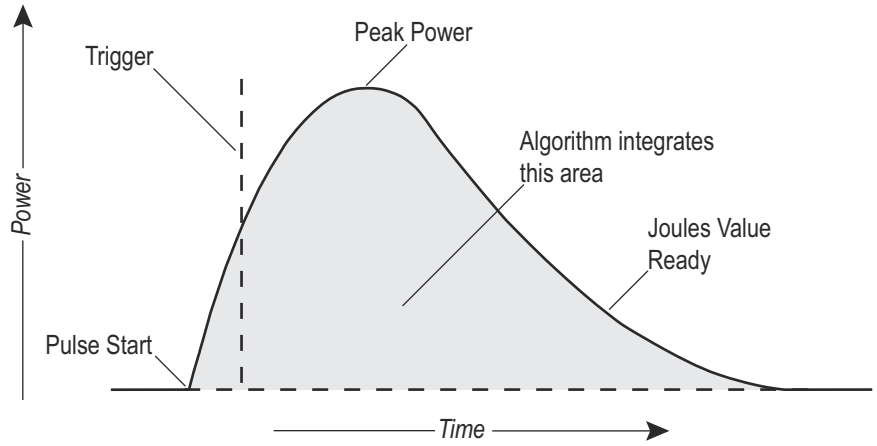


Figure 4-4. Pulsed Thermopile Joules Mode Power Curve

Collecting Pulsed Thermopile Joules Data Over a Host Port

To collect pulsed thermopile joules data:

1. Set the mode to Joules by using either the UNITS soft key on the meter, or the CONFigure:MEASure host command.
2. Query the host for measurement data by using the FETCh:NRECords query—for detailed information, refer to “Data Query” (p. 6-51).

The type of data that will be collected depends entirely on which mode is currently selected: Joules mode will collect only joules data and Watts mode will collect only watts data.

Thermopile Sensors, Long Pulse Joules

Connecting a thermopile sensor to the meter and switching to Joules mode displays the screen shown below. This mode measures the energy of single pulses between 1 millisecond and 10 seconds in

length, and with energies from 5 mJ to hundreds of joules. Measuring long mJ pulses requires more sensitive thermopiles (such as a PS10Q).

When measuring energy with a thermopile sensor, the energy range is sensor-dependent and is automatically determined by the meter. The range value cannot be manually changed.

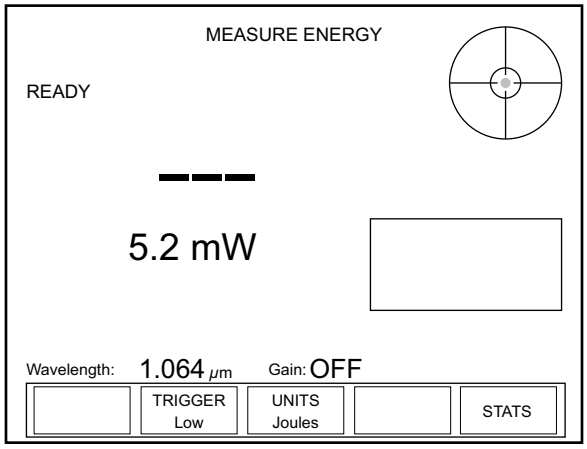


Figure 4-5. MEASURE ENERGY: Thermopile Sensors (Long Pulse Joules)

Display Smoothing and Speedup are not active in this mode. When a pulse is received, the READY indicator in the upper left of the screen changes to CALCULATING, the position indicator shows the beam position in the crosshairs of the bulls eye target (quad sensors only), and a plot of the thermopile response begins, as shown below.

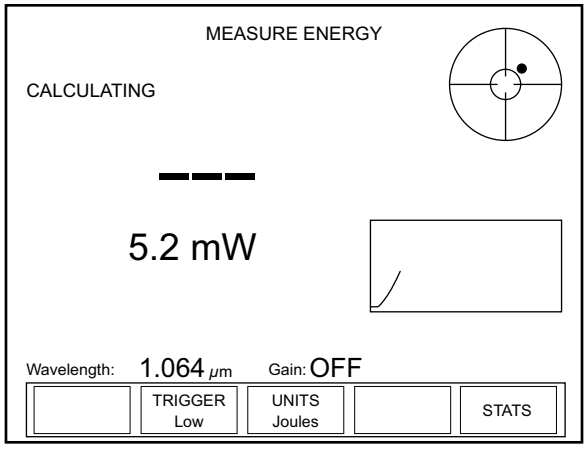


Figure 4-6. MEASURE ENERGY: Thermopile Sensors (Long Pulse - Active)

Once the calculation has been completed, the new Joules value is displayed, the CALCULATING indicator is replaced with READY, and the plot stops (Figure 4-7). At this point, the meter is ready to receive another pulse.

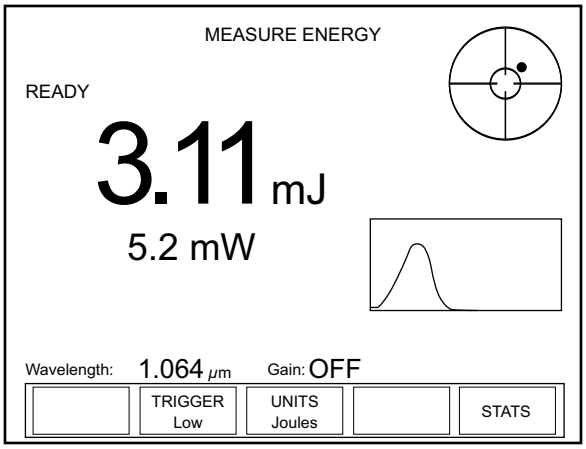


Figure 4-7. MEASURE ENERGY: Thermopile Sensors (Long Pulse - After Pulse)

Soft Keys

There are three soft keys on this screen: TRIGGER, UNITS, and STATS.

TRIGGER

- Available values: Low (factory default), Medium, and High.

The purpose of the TRIGGER is to filter out ambient noise. Low—the most sensitive of the three values—does the least filtering. If that value produces an excessive number of false triggers while taking a reading, select the Medium or High value to increase the filtering.

Pressing the TRIGGER soft key cycles through the three values.

UNITS

Pressing the UNITS soft key toggles the measurement units back to Watts and displays the MEASURE POWER screen.

STATS

Pressing the STATS soft key displays the STATS screen. For details on the STATS screen, refer to information under “Statistics” (p. 4-15).

Pyroelectric Sensors

Pressing the MEASURE button when a pyroelectric sensor is attached to the meter will display a screen similar to the one shown below.

The unit that appends to the live reading is determined by the type of measurement selected with the UNITS soft key: Joules or Watts.

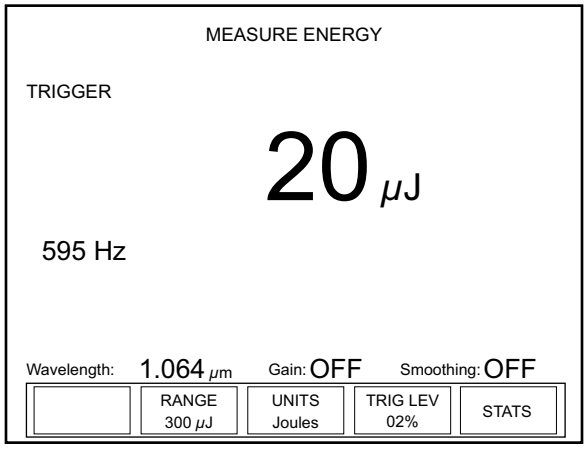


Figure 4-8. MEASURE ENERGY: Pyroelectric Sensors

This screen contains the live reading and the rep rate. It also shows the following indicators: Wavelength, Gain, and Smoothing. (A summary of indicator behavior is provided in "Appendix C: Onscreen Indicators" (p. C-1).)

Soft Keys

There are four soft keys on this screen: RANGE, UNITS, TRIG LEV(el) (for internal trigger source) or TRIG DLY(delay) (for external trigger source), and STATS.

RANGE

- Available values: Sensor-dependent.

To adjust the range:

1. Press the RANGE soft key.
2. Turn the Selection knob to change the range value.
3. When the desired value appears, press the RANGE soft key (or the ENTER/SET button) to lock in the RANGE value.

UNITS

Pressing the UNITS soft key toggles the measurement units between Watts and Joules.

TRIG LEV(el) (for internal trigger source)

Available values: 2 (factory default) to 20%.

To adjust the level:

1. Press the TRIG LEV soft key.
2. Turn the Selection knob to change the value. The result of the adjustment can be seen in the live measurement display. Adjust the trigger threshold as low as possible to avoid noise triggers while the laser is not firing.
3. When the desired value appears, either press the TRIG LEV soft key or press the ENTER/SET button to lock in the value.

TRIG DLY(delay) (for external trigger source)

Available values: 0 (factory default) to 1000.

To adjust the level:

1. Press the TRIG DLY soft key.
2. Turn the Selection knob to change the value. When the desired value appears, either press the TRIG DLY soft key or press the ENTER/SET button to lock in the value.

Trigger Delay can also be adjusted on the Trigger screen in SETUP. For more information, refer to “Trigger” (p. 4-58)

STATS

Refer to “Statistics” (p. 4-15) for information about the STATS menu.

Pyroelectric Watts Mode

Using an attached pyroelectric sensor, LabMax-TOP can measure average power from a series of pulses. By pressing the UNITS soft key, the instrument toggles between displaying energy and displaying average power.

Average power is calculated by measuring the energy of the pulses and dividing by the periods between them and, thus, requires at least two pulses to make a power measurement. Each subsequent pulse

defines the period for the previous pulse until the last pulse (see Figure 4-9). The last pulse in a pulse burst will not yield a power measurement since the period after the last pulse is indeterminate. This method allows more accurate tracking of initial average power transients for pulsed lasers.

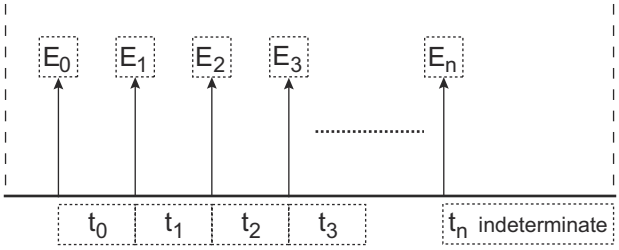


Figure 4-9. Average Power Diagram

When measuring the average power of a laser burst or continuous pulse train, the frequency of the pulses must be greater than or equal to 1 Hz, and less than or equal to the maximum repetition rate capability of a compatible pyroelectric sensor. Multiple bursts separated by one second or less are treated as a single burst and, accordingly, the gap between bursts appears as a lower power.

Short bursts with rep rates greater than 1 kHz may not yield a measurement.

Triggering

LabMax must trigger reliably for each laser pulse.

LabMax may be triggered externally via the Ext Trig connector—see “Ext Trig Connector” (p. 3-8). This is particularly useful in a noisy environment. LabMax can be set to synchronize with either the positive or negative transition of this external signal.

Without a reliable external trigger, set LabMax to use its own internal circuitry to extract a trigger from the incoming signal. This is called *Internal Triggering* (discussed, below). For more information about setting the trigger source, refer to “Trigger” (p. 4-58).

Internal Triggering Mode

Internal triggering refers to finding a trigger automatically from the incoming signal.

To successfully extract an internally-generated trigger, set the meter range so that the incoming signal is at least 5% of the full scale. Set the trigger level at least 2% above the noise level and at least 2% below the percent of full scale that you plan to measure.

For example if you plan to measure pulses that are approximately 300 mJ, set the meter to a range of 3J. A peak will occur at 10% of full scale, well above the 5% level. The trigger level should not be set higher than 8%. If the noise level is 5% of full scale (approximately 150 mJ), the trigger level should not be set lower than 7%. To find the level at which noise triggers, make sure the laser shutter is closed and start turning down the trigger threshold level. At some point you may notice that the meter picks up trigger events and displays energy measurements. This is considered the noise level. Depending upon the sensor model and the range selected, you may or may not detect noise triggers above 2% of full scale range.

In Figure 4-10, the internal trigger threshold has been set to 8% (shown as a dashed line). Pulse A will definitely not generate a reliable trigger. Pulse B may generate a trigger, but not reliably. Pulses C and D will definitely generate reliable triggers.

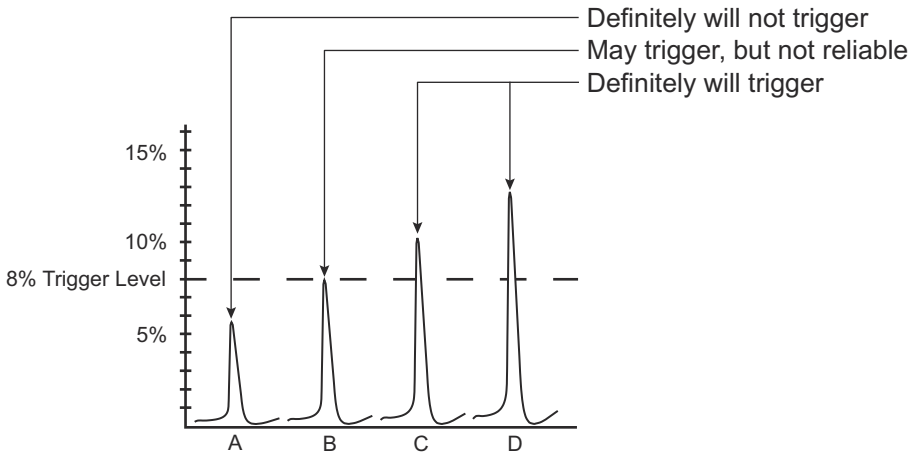


Figure 4-10. Internal Trigger Threshold

A full-scale signal on one range may not trigger on the next higher range unless the trigger level is set to less than 10%. For example, a near full-scale signal of 280 mJ on the 300 mJ range is less than 10% of full scale on the next higher range (3J), and would therefore not trigger the reading. To obtain reliable triggering in this instance, adjust the trigger level to less than 8%.

The trigger is synchronous with the leading edge of the pulse, but the actual peak is determined algorithmically by sampling the input signal near the trigger. From the trigger point forward, the algorithm searches for peaks and from the trigger point back, it searches for a baseline.

Trigger States and the Trigger Annunciator

The trigger state is always displayed when a pyroelectric sensor is attached and the trigger source is set to Internal.

Two annunciators indicate the trigger state of the meter: TRIGGER and the ? segment that follows it.

There are two possible trigger states when a pyroelectric sensor is attached: *triggered* and *wait for trigger*. The triggered state indicates that the meter is capturing laser pulses (or is triggering on noise). The wait for trigger state indicates an absence of pulse triggers. When a pulse is captured, the trigger state becomes active and the wait for trigger state becomes inactive. If no pulses are captured within 2 seconds since the last pulse was captured, the wait for trigger state becomes active and the triggered state becomes inactive. The TRIGGER annunciator reads “TRIGGER” in the triggered state and “TRIGGER?” in the wait for trigger state.

Pulse Sampling

Pulse sampling refers to how many pulses are read within a series of pulses. For example, when receiving 2,500 pulses per second, pulse sampling reads (that is, samples) every third incoming pulse. Table 4-2 shows how many pulses are sampled, depending on the number of incoming pulses per second.

Table 4-2. Approximate Pulse Sampling Based on the Number of Incoming Pulses

Incoming Pulses	Pulses Read
<1,000	Every pulse is read (pulse sampling is not active)
1,000 to 2,000	Every second pulse is read
2,001 to 3,000	Every third pulse is read
3,001 to 4,000	Every fourth pulse is read
4,001 to 5,000	Every fifth pulse is read
5,001 to 6,000	Every sixth pulse is read
6,001 to 7,000	Every seventh pulse is read
7,001 to 8,000	Every eighth pulse is read
8,001 to 9,000	Every ninth pulse is read
9,001 to 10,000	Every tenth pulse is read
>10,000	Pulse sampling continues to approximately 15 kHz but is not guaranteed to meet instrument specifications

Statistics

Statistics Calculations

Standard Deviation

$$S = \sqrt{\frac{\sum_{i=1}^{N} (x_i - x)^2}{N-1}}$$

In this formula, x is the value of the mean, N is the sample size, and x_i represents each data value from i=1 to i=N.. The Σ symbol indicates that you must add up the sum $(x_1 - x)^2 + (x_2 - x)^2 + (x_3 - x)^2 + (x_4 - x)^2 + (x_5 - x)^2 . . . + (x_N - x)^2$.

Range

The difference between the maximum and minimum values in a batch of samples.

σ

The ratio of the standard deviation divided by the batch mean value in percent. (often used for stability measurements)

2σ

Two times the sigma calculation. (often used for stability measurements)

3σ

Three times the sigma calculation. (often used for stability measurements)

Dose

The cumulative sum of all energy pulses collected within a batch when using a pyroelectric sensor in Joules mode.

Missed Pulses

The number of pulses missed during a batch when the meter is externally triggered. When the LabMax is used in energy mode with an external trigger, the meter counts how many trigger signals are sent to the meter versus how many actual energy measurements were received. Any trigger signals that do not capture a valid energy measurement are considered missed pulses and are recorded by this statistic.

Pressing the STATS soft key from the MEASURE screen will display the screen in Figure 4-11 (for thermopile or optical sensors), or Figure 4-12 (for pyroelectric sensors).

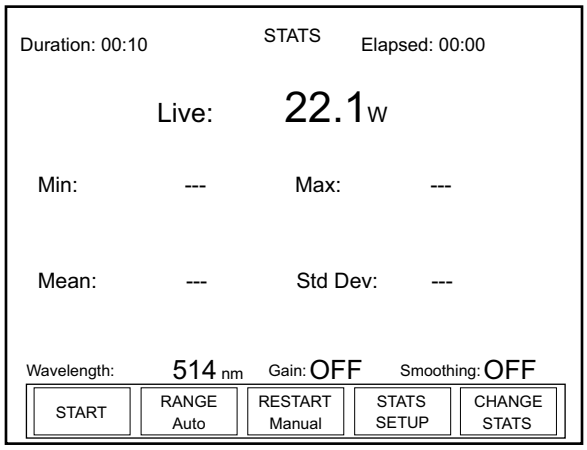


Figure 4-11. STATS: Thermopile and Optical Sensors

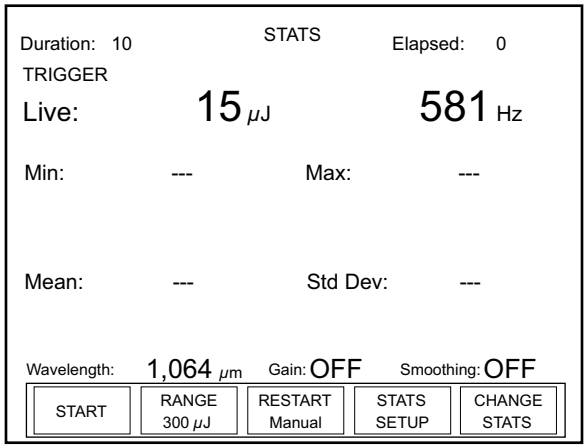


Figure 4-12. STATS: Pyroelectric Sensors

The STATS screen displays the live measurement and, by default, the Min, Mean, Max, and Standard Deviation values. It is possible to modify the parameters shown on this screen by selecting up to six statistics for display. To learn how to select different statistics, refer to “CHANGE STATS” (p. 4-19).

The Duration indicator in the upper left corner of the STATS screen can be changed in Stats Setup—discussed under “STATS SETUP Description” (p. 4-19). See “Appendix C: Onscreen Indicators” (p. C-1) for a summary of indicators and their behavior.

Soft Keys

There are five soft keys on this screen: START, RANGE, RESTART, STATS SETUP, and CHANGE STATS.

START

Pressing the START soft key begins data collection. The statistics appear on the screen as the batch is collected (see the following example):

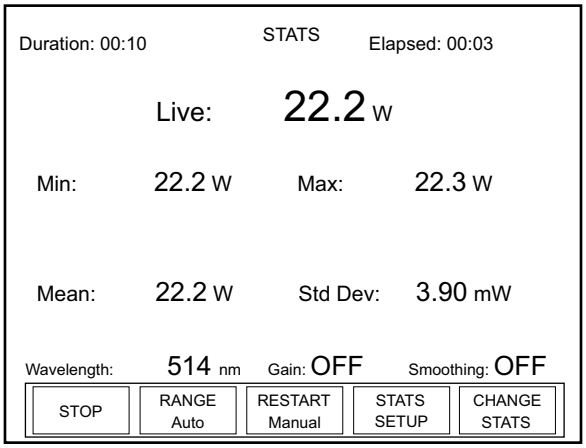


Figure 4-13. STATS: Data Collection (In Process)

Pressing the STOP key—which appears in place of the START key during data collection—ends data collection.

RANGE

- Available values (thermopile and optical sensors): Auto (factory default) and the allowable ranges for the attached sensor.
- Available values (pyroelectric sensors): Sensor-dependent.

To adjust the range:

1. Press the RANGE soft key.
2. Turn the Selection knob to change the range value.
3. When the desired value appears, press the RANGE soft key (or the ENTER/SET button) to lock in the RANGE value.

RESTART

The RESTART soft key on the STATS screen toggles between Manual (factory default) mode and Auto mode.

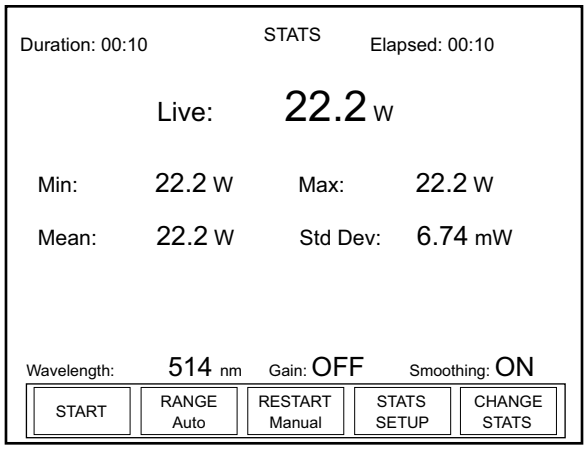


Figure 4-14. STATS: Statistics Readout

Manual Mode

In *Manual* mode, pressing the START soft key begins data collection. Data collection ends by:

- Pressing the STOP soft key—which appears in place of the START key during data collection.
- Reaching the time duration that was set for data collection—see “STATS SETUP Description” (p. 4-19) for information about setting the time duration.

Auto Mode

Auto mode acts similar to Manual mode, except that once data collection reaches the time duration, the batch automatically starts over.

As with Manual RESTART, pressing the STOP soft key immediately stops data collection.

STATS SETUP

Refer to “STATS SETUP Description” (p. 4-19).

CHANGE STATS

Pressing the CHANGE STATS soft key on the STATS screen displays the following screen:

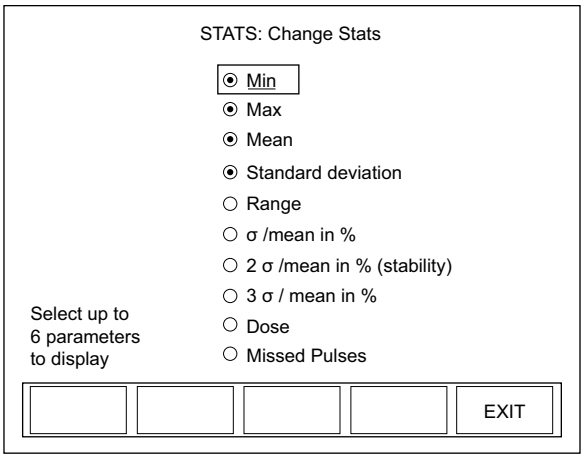


Figure 4-15. STATS: Change Stats

The Dose parameter appears only when using a pyroelectric sensor in *energy* mode. The Missed Pulses parameter is available only when in external trigger mode with a pyroelectric sensor.

Up to six items can be selected for display on the STATS screen.

To select an item:

1. Turn the Selection knob to move the highlight up or down the list.
2. Press the ENTER/SET button to select or de-select an item.
3. Press the EXIT soft key to save the settings and exit Change Stats mode.

STATS SETUP Description

Statistics batch size is specified on this screen. The total amount of time and the rate at which data is collected can be adjusted. Note that with pyroelectric energy sensors, the batch size is specified in terms of pulses, not time.

By default, thermopile and optical sensors are sampled 10 times per second. This is the maximum sampling rate possible. Pyroelectric energy sensors have a factory default sample rate of one sample per laser pulse. Using the STATS Setup screen lets you set the meter so that it does not sample every single laser pulse.

To change the current stat settings, press the STATS SETUP soft key. Depending on the type of sensor attached to the meter and the measurement being taken, one of the following STATS: Setup screens will appear:

- Thermopile or optical sensor (Figure 4-16)
- Pyroelectric sensor measuring *power* (Figure 4-17)
- Pyroelectric sensor measuring *energy* (Figure 4-18)

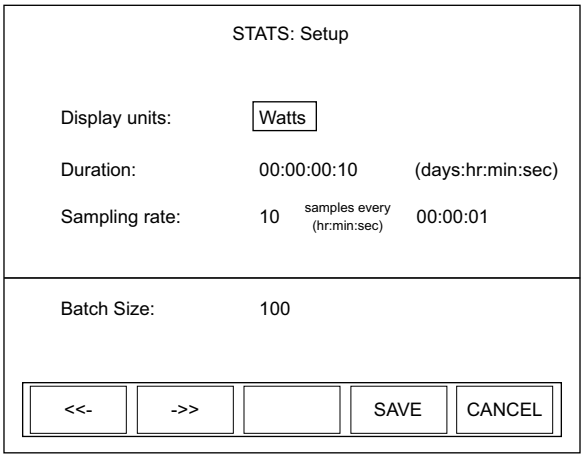


Figure 4-16. STATS: Setup (Thermopile and Optical Sensors)

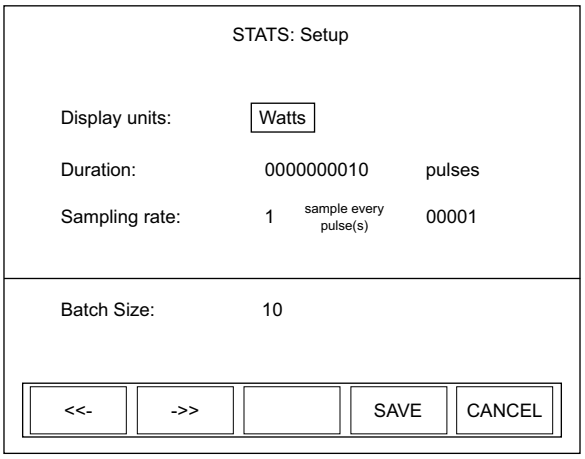


Figure 4-17. STATS: Setup (Pyroelectric Sensors - Power)

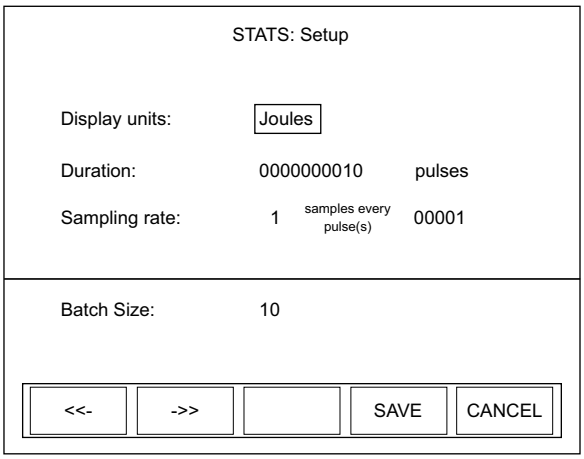


Figure 4-18. STATS: Setup (Pyroelectric Sensors - Energy)

Soft Keys

There are four soft keys on this screen: <<-/->> (Previous/Next directional arrows), SAVE, and CANCEL.

<<- and ->> (directional arrows)

Parameters on this screen are changed by using one of the following procedures. The procedure that should be used depends on the type of parameter you want to modify.

"Single" Parameters

This type of parameter—Display units, for example—has only one modifiable field. To change a value for this type of parameter:

1. Press the ENTER/SET button until the parameter you want to change is highlighted.
2. Turn the Selection knob to change the parameter value.
3. Press the ENTER/SET button to move to the next parameter.
4. Continue this process until the values for all the parameters are correct.
5. Once the values for all the parameters are correct, press the SAVE soft key to save the parameters and display the STATS screen.

"Multiple" Parameters

This type of parameter—Duration, for example—contains several fields that can be modified. To change a value for this type of parameter:

1. Press the ENTER/SET button until the parameter you want to change is highlighted.
2. Turn the Selection knob to change the parameter value.
3. Press either of the directional arrows soft keys (<<- or ->>) to move the highlight to another value within the same parameter.
4. Repeat steps 2 and 3 until all values for that parameter are correct.
5. Press the ENTER/SET button to move to the next parameter.
6. Once the values for all the parameters are correct, press the SAVE soft key to save the parameters and display the STATS screen.

SAVE

Pressing the SAVE soft key saves whatever changes were made since the last SAVE and displays the STATS screen.

CANCEL

Pressing the CANCEL soft key discards all changes that were made since the last SAVE and displays the STATS screen.

Detailed Procedures

This section provides in-depth information about specific topics that were briefly discussed earlier.

POSITION STABILITY

When a quad thermopile sensor is attached to the meter, pressing the POSITION STABILITY soft key on the MEASURE POWER screen will display a screen similar to the following:

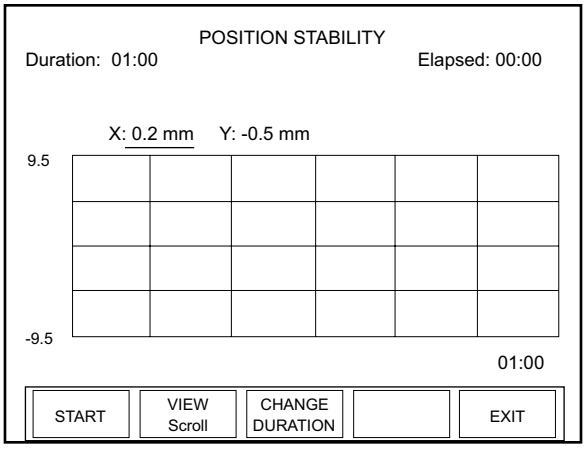


Figure 4-19. MEASURE POWER: POSITION STABILITY

The X-axis of the graph is time and the Y-axis is based on the diameter of the sensor active area.

The Duration indicator in the upper left shows how long the meter will collect data.The Elapsed indicator in the upper right corner begins its count when the START soft key is pressed.

The actual X and Y values (just above the graph) update as the data is collected.

Soft Keys

There are four soft keys on this screen: START, VIEW, CHANGE DURATION, and EXIT.

START

Pressing the START soft key starts data collection and toggles the soft key to STOP. When data collection completes (either by pressing the STOP button or as determined by the previously-set duration), the button toggles to START again. Pressing START when there is already data on screen, clears that data and starts data collection over.

VIEW

The VIEW soft key toggles between Scroll and Fit:

- Fit—Fits the entire duration on the X-axis in one screen
- Scroll—Pages the data every minute

CHANGE DURATION

Pressing the CHANGE DURATION soft key accesses the Duration field in the upper left corner of the screen, as shown here:

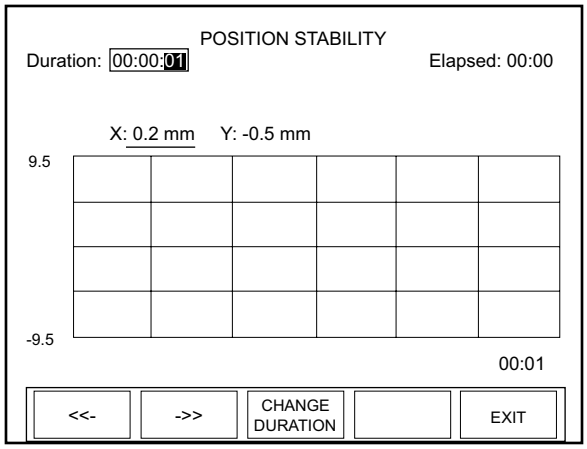


Figure 4-20. POSITION STABILITY: Duration

To change the duration:

1. Use the left and right arrow soft keys to highlight an individual duration field (hours, minutes, or seconds).
2. Turn the Selection knob to change the value of the currently-highlighted field.
3. Repeat steps 1 and 2 until the desired duration has been entered.
4. To save the duration, either press the ENTER/SET button (which will display the POSITION STABILITY screen), or press the EXIT soft key (which will exit POSITION STABILITY mode and display the MEASURE POWER screen).

EXIT

Pressing the EXIT soft key displays the MEASURE POWER screen.

TUNE

TUNE

Pressing the TUNE button on the front panel of the meter will enter the TUNE mode. This mode is used in place of an analog needle to monitor the laser output while tuning or tweaking the laser. Typically the laser output is being maximized during the process, and both tuning screens—Strip chart and Bar chart—contain peak indicators and display the maximum measured value since the laser Reset event. Details of the strip chart and bar chart are discussed next.

Strip Chart

Figure 4-21 shows an example Strip chart screen for both thermopile and optical sensors. Press the RESET soft key to reset the peak indicator, maximum measured value, and vertical scale. When the Vertical scale factor is set to 1X, pressing the RESET soft key will also clear the display. When in a higher scale factor, the screen is not cleared but the factors are reset and the plot is centered on the live reading.

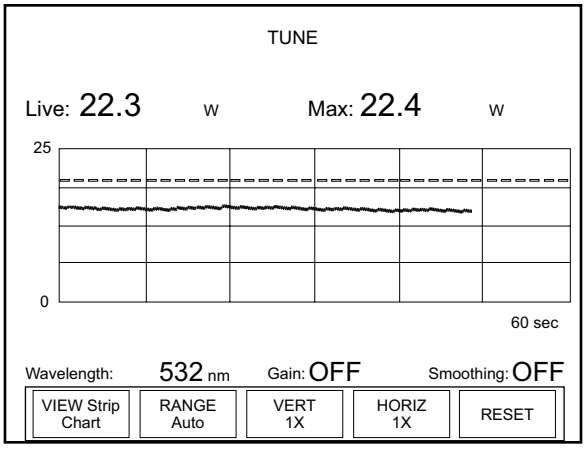


Figure 4-21. TUNE: Strip Chart (Thermopile and Optical Sensors)

Soft Keys

There are five soft keys on this screen: VIEW, RANGE, VERT, HORIZ, and RESET.

VIEW

Pressing the VIEW soft key at the bottom of the TUNE screen toggles between the Strip chart and the Bar chart—for more information about Bar charts, refer to “Bar Chart” (p. 4-26).

RANGE

- Available values (thermopile and optical sensors): Auto (factory default) and the allowable ranges for the attached sensor.

- Available values (pyroelectric sensors): Sensor-dependent.

To adjust the range:

1. Press the RANGE soft key.
2. Turn the Selection knob to change the range value.
3. When the desired value appears, press the RANGE soft key (or the ENTER/SET button) to lock in the RANGE value.

VERT

Pressing the VERT soft key zooms in and out on the Y-axis presented in the TUNE chart. Zooming does not disturb data collection. Available zoom levels are 1, 2, 5, 10, and 20X.

To change the VERT level:

1. Press the VERT soft key.
2. Turn the Selection knob to change the VERT value.
3. When the desired value appears, press the VERT soft key (or the ENTER/SET button) to lock in the VERT value.

HORIZ

Pressing the HORIZ soft key zooms in and out on the X-axis presented in the TUNE chart. Zooming does not disturb data collection. Available zoom levels are 1, 2, 5, 10, and 20X.

To change the HORIZ level:

1. Press the HORIZ soft key.
2. Turn the Selection knob to change the HORIZ value.
3. When the desired value appears, press the HORIZ soft key (or the ENTER/SET button) to lock in the HORIZ value.

RESET

Pressing this soft key resets the Max value.

Bar Chart

Figure 4-22 (p. 4-27) shows an example Bar chart screen for thermopile and optical sensors. Press the RESET soft key to reset the peak indicator, maximum measured value, and vertical scale. When

the Zoom scale factor is set to anything greater than 1X, pressing the RESET soft key will also reset the x-axis scale factors to center the indicator bar on the live value.

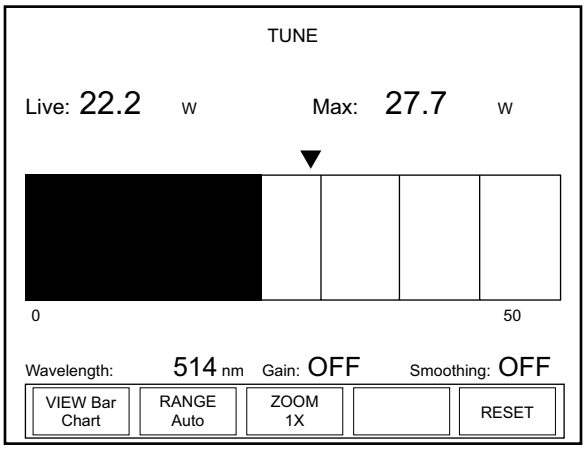


Figure 4-22. TUNE: Bar Chart (Thermopile and Optical Sensors)

Soft Keys

There are four soft keys on this screen: VIEW, RANGE, ZOOM, and RESET.

VIEW

Pressing the VIEW soft key at the bottom of the TUNE screen toggles between the Bar chart and the Strip chart—for more information about Strip charts, refer to “Strip Chart” (p. 4-25).

RANGE

- Available values (thermopile and optical sensors): Auto (factory default) and the allowable ranges for the attached sensor.
- Available values (pyroelectric sensors): Sensor-dependent.

To adjust the range:

1. Press the RANGE soft key.
2. Turn the Selection knob to change the range value.
3. When the desired value appears, press the RANGE soft key (or the ENTER/SET button) to lock in the RANGE value.

ZOOM

Pressing the ZOOM soft key zooms in and out on the Y-axis presented in the TUNE chart. Zooming in on the displayed data is useful if you are trying to resolve small changes in laser output that

cannot be easily seen in the full scale, non-zoomed state. Zooming does not disturb data collection. Available zoom levels are 1, 2, 5, 10, and 20X.

To change the ZOOM level:

1. Press the ZOOM soft key.
2. Turn the Selection knob to change the ZOOM value.
3. When the desired value appears, press the ZOOM soft key (or the ENTER/SET button) to lock in the ZOOM value.

RESET

Pressing this soft key resets the Max value.

TREND

TREND

Trend is the mode in which data can be logged to a file onboard the meter or to a USB flash drive. Additionally, the trend history of the data is displayed as it is logged.

Versatile data logging in trend mode is supported by a File Management function that provides file naming (including auto-sequencing of file names), folder creation, as well as saving, moving, and deleting files and folders.

Depending upon the sensor and display units in use, pressing the TREND button on the front panel displays one of the following screens:

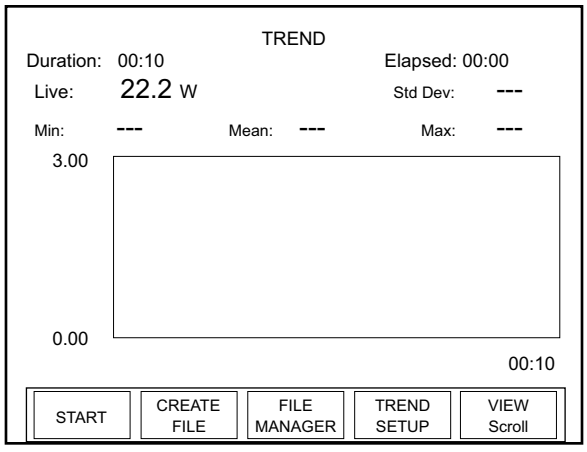


Figure 4-23. TREND: Thermopile and Optical Sensors

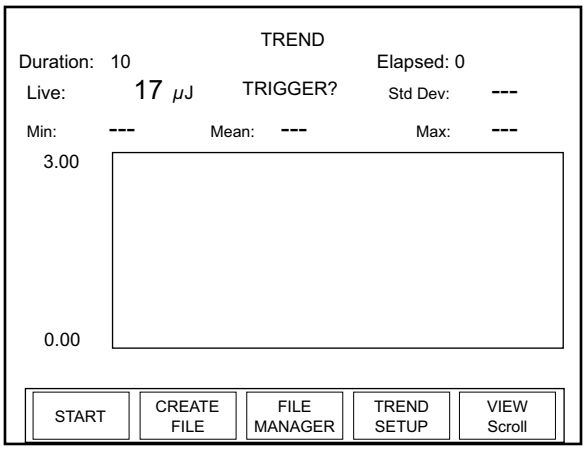


Figure 4-24. TREND: Pyroelectric Sensors

The indicator in the upper left corner—Duration—displays the factory default batch size setting. If this setting is acceptable, press the START soft key to begin data collection. To change the duration:

- Press the TREND SETUP soft key on the TREND screen to display the TREND: Setup menu.
- Use the left arrow and right arrow soft keys to advance through the individual duration fields (days, hours, minutes, or seconds).
- When a specific field is highlighted, turn the Selection knob to change the value of that field.
- Press the SAVE soft key to save the new duration and display the TREND screen.
- Press the START soft key to begin data collection.

To save the data locally, do one of the following:

- Use the CREATE FILE soft key to create and name a file *before* starting data collection—refer to “Name Log File” (p. 4-34).
- Use the SAVE DATA soft key—which appears in place of the CREATE FILE soft key once data collection is complete—to save a file *after* data collection. This is useful if you decide you want to keep the data after collecting it and viewing it on the trend chart. For more information, refer to “TREND Screen After Data Collection” (p. 4-32).

Soft Keys

There are five soft keys on the main TREND screen: START, CREATE FILE, FILE MANAGER, TREND SETUP, and VIEW.

START

Pressing the START soft key on the main TREND screen starts data collection.

CREATE FILE

Refer to “Name Log File” (p. 4-34).

FILE MANAGER

The FILE MANAGER screen is discussed in detail under “File Manager” (p. 4-36).

TREND SETUP

The TREND SETUP screen is discussed in detail under “TREND Setup” (p. 4-41).

VIEW

The VIEW soft key on the main TREND screen toggles between Scroll and Fit:

- Fit—Fits the entire duration on the X-axis in one screen
- Scroll—Pages the data every minute

TREND Screen During Data Collection

Figure 4-25 shows an example of how the TREND screen looks during data collection:

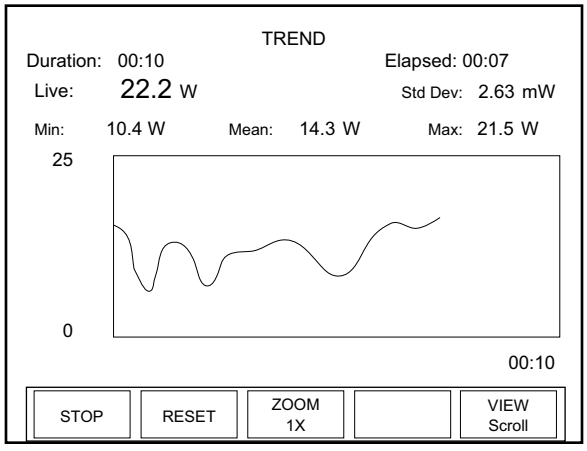


Figure 4-25. TREND: During Data Collection

Soft Keys

There are four soft key on this screen: STOP, RESET, ZOOM, and VIEW

STOP

Pressing the STOP soft key immediately stops batch collection and displays the soft keys described under the heading “TREND Screen After Data Collection” (p. 4-32).

RESET

Pressing the RESET soft key stops batch collection, clears the screen, and displays the soft keys described under the heading “TREND” (p. 4-28).

ZOOM

The ZOOM soft key zooms in or out on the Y-axis presented in the TREND chart. Zooming does not disturb data collection.

To change the zoom:

1. Press the ZOOM soft key.
2. Turn the Selection knob to select a new zoom level.
3. When the desired value appears, press the ZOOM soft key (or the ENTER/SET button) to lock in the ZOOM value.

VIEW

The VIEW soft key toggles between Fit and Scroll. It is possible to toggle back and forth between Fit and Scroll during data collection.

- Fit—Fits the entire duration on the X-axis in one screen. The collected data is decimated to allow it to be viewable on a single screen.
- Scroll—Pages the data. After the trend is completed, the data on previous pages can be viewed. If viewing in Scroll mode, turn the Selection knob to scroll back through the data. In this viewing mode, every logged data point is visible.

TREND Screen After Data Collection

Figure 4-25 shows and example of what the TREND screen looks like after data collection:

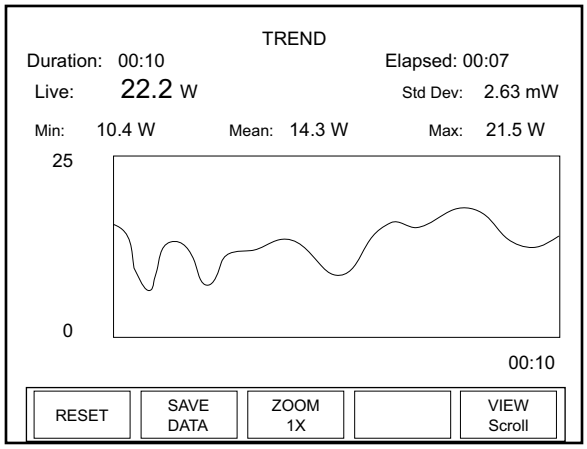


Figure 4-26. TREND: After Data Collection

Soft Keys

There are four soft keys on this screen: RESET, SAVE DATA, ZOOM, and VIEW.

RESET

Pressing the RESET soft key stops batch collection, clears the screen, and displays the soft keys described under the heading “TREND” (p. 4-28).

SAVE DATA

Pressing this soft key displays the following screen:

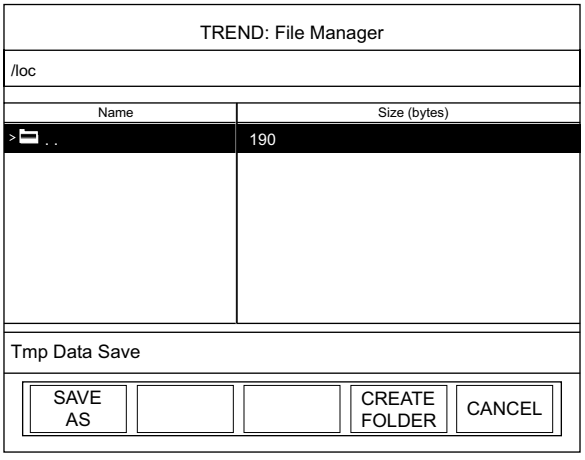


Figure 4-27. TREND: File Manager (Save Data)

There are three soft keys on this screen: SAVE AS, CREATE FOLDER, and CANCEL.

Pressing the SAVE AS soft key will display the TREND: Save Tmp As screen:

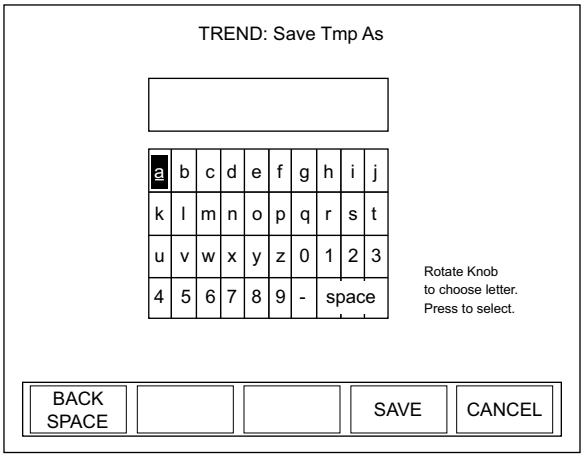


Figure 4-28. TREND: Save Tmp As

To create a file:

1. Select the first character of the file name by turning the Selection knob and then pressing the ENTER/SET button when the desired letter or number is highlighted. The character will appear in the blank box immediately below the screen heading.

To delete a character, use the BACKSPACE soft key.

---

2. Repeat step 1 until the entire new file name appears in the box.
3. Press the SAVE soft key, which will display a file management dialog screen confirming the file is being copied.
4. Once copying is complete (as indicated by the bar on the dialog screen displaying the text, *100%*), press the ENTER/SET button to dismiss the dialog box.

Pressing the CREATE FOLDER soft key on the TREND: File Manager screen displays the TREND: Create New Folder screen—refer to “CREATE FOLDER” (p. 4-40).

Pressing the CANCEL soft key displays the main TREND screen.

ZOOM

The ZOOM soft key zooms in or out on the Y-axis presented in the TREND chart. Zooming does not disturb data collection.

To change the zoom:

1. Press the ZOOM soft key.
2. Turn the Selection knob to select a new zoom level.
3. When the desired value appears, press the ZOOM soft key (or the ENTER/SET button) to lock in the ZOOM value.

VIEW

The VIEW soft key toggles between Fit and Scroll.

- Fit—Fits the entire duration on the X-axis in one screen
- Scroll—Pages the data every minute

Detailed Procedures

This section provides in-depth information about specific topics that were briefly discussed earlier.

Name Log File

Use this screen to create a file before starting data collection. The log file is saved to the location previously navigated in File Manager. For example, if you use File Manager to navigate to a USB flash drive that is attached to the meter, and then subsequently create a named log file, the file will be saved to the folder in the USB flash drive you had previously navigated to. If you did not previously navigated to a specific location in File Manager, the file is saved to the local drive in the meter.

To create a file:

1. Press the CREATE FILE soft key on the TREND screen to display the TREND: Name Log File screen (Figure 4-29):

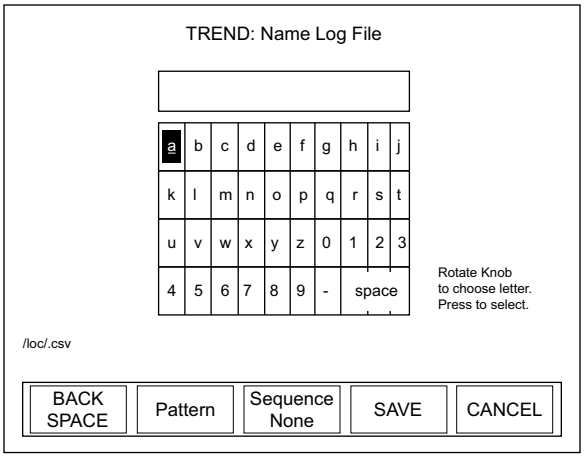


Figure 4-29. TREND: Name Log File

2. Select the first character of the file name by turning the Selection knob and then pressing the ENTER/SET button when the desired letter or number is highlighted. The character will appear in the blank box immediately below the screen heading.

To delete a character, use the BACKSPACE soft key.

---

3. Repeat step 2 until the entire file name appears in the box.
4. Press the SAVE soft key to save the new file name and display the TREND screen.

The new file name will appear on the bottom left of the TREND screen (just above the START soft key).

Soft Keys

There are five soft keys on this screen: BACKSPACE, Pattern, Sequence, SAVE, and CANCEL.

BACKSPACE

This soft key backspaces one editable field and deletes the character that was there.

Pattern

Pressing this soft key appends the current date to the file name. This feature is a useful way to manage logged data. The date is appended to any name you entered in the Name File dialog box. For example, if today is February 2, 2008, and you name a file */loc/test.csv*, pressing the Pattern soft key will change the file name to */loc/test02-04-08.csv*. Note that pressing this soft key also changes the soft key name from Pattern to Pattern Date.

Sequence

The Sequence soft key toggles between Auto and None (factory default).

- Auto—Appends a sequentially-incrementing identification number to the file name. As files are created by pressing the START and STOP soft keys (on the TREND screen), the identification number in the file name automatically increments. This is useful if you are creating several similar log files and want to prevent accidental overwriting of one of the data files. It is also useful in identifying the order in which data files were

created. The Pattern and Sequence functions can be used together.

- None—Does not append an identification number to the file name

SAVE

Pressing the SAVE soft key saves whatever changes were made since the last SAVE and displays the TREND screen.

CANCEL

Pressing the CANCEL soft key discards all changes that were made since the last SAVE and displays the TREND screen.

File Manager

This screen allows the user to modify or delete current files and directories, or create a new folder. Figure 4-30 shows an example of the TREND: File Manager screen, which is available by pressing the FILE MANAGER soft key on the main TREND screen:

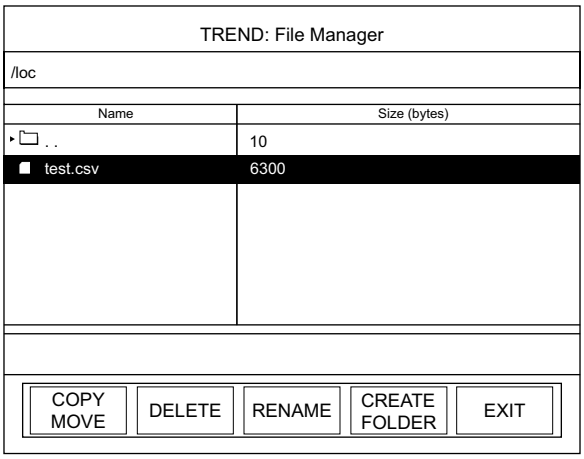


Figure 4-30. TREND: File Manager

To navigate to a specific directory:

1. Turn the Selection knob to highlight the name of the folder you want to access.
2. Press the ENTER/SET button. If the folder is closed, pressing the ENTER/SET button will open and expand its contents. Likewise, pressing this button will close an open folder.

Opening a folder displays all the subfolders and files within that particular folder.

To display a list of files and directories stored on a USB flash drive that is attached to the meter, turn the Selection knob to highlight the top line of the names ("..") that appear on the TREND: File Manager screen and then press the ENTER/SET button. The USB flash drive will be shown in the list of drives. The LOC (local) drive is flash memory onboard the meter. Files saved to the local drive are retained after powering down the meter.

Soft Keys

There are five soft keys on this screen: COPY MOVE, DELETE, RENAME, CREATE FOLDER, and EXIT.

COPY MOVE

To copy a file to another location (while retaining the file in its original location):

1. Turn the Selection knob to highlight the name of the file you want to copy.
2. Press the COPY MOVE soft key on the TREND: File Manager screen. (Pressing this soft key changes the name of the first soft key to COPY and the second soft key to MOVE.)
3. Use the Selection knob to navigate to the location where you want to copy the file. Note that you can create a new folder during this process by pressing the Create Folder soft key.
4. Press the COPY soft key, which will display a file management dialog screen confirming the file is being copied.
5. Once copying is complete (as indicated by the bar on the dialog screen displaying the text, *100%*), press the ENTER/SET button to dismiss the dialog box.

To move a file to another location (and delete the file from its original location):

1. Turn the Selection knob to highlight the name of the file you want to move.
2. Press the COPY MOVE soft key on the TREND: File Manager screen. (Pressing this soft key changes the name of the first soft key to COPY and the second soft key to MOVE.)

3. Use the Selection knob to navigate to the location where you want to move the file. Note that you can create a new folder during this process by pressing the Create Folder soft key.
4. Press the MOVE soft key, which will display a file management dialog screen confirming the file is being moved.
5. Once moving is complete (as indicated by the bar on the dialog screen displaying the text, *100%*), press the ENTER/SET button to dismiss the dialog box.

DELETE

Copying, moving, or deleting an entire folder affects all of the contents (files and subfolders) of that particular directory. These functions allow quick folder/file management to a USB flash drive or onboard local memory. Keep in mind, however, that once a folder and its contents are deleted, they cannot be recovered. Whenever a file or folder is deleted, a deletion confirmation box will appear on the screen.

To delete a file:

1. Turn the Selection knob to highlight the file name.
2. Press the DELETE soft key. The following confirmation message will appear:

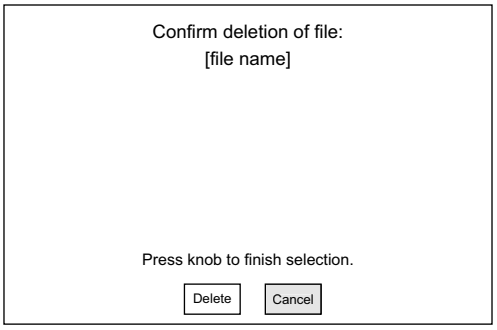


Figure 4-31. TREND: File Manager (File Deletion Confirmation)

3. Turn the Selection knob to highlight Delete in the Delete File Confirmation window.
4. Press the ENTER/SET button to delete the file and display the TREND: File Manager screen.

To delete a folder:

1. Turn the Selection knob to highlight the name of the folder you want to delete.
2. Press the DELETE soft key. The following confirmation message will appear:

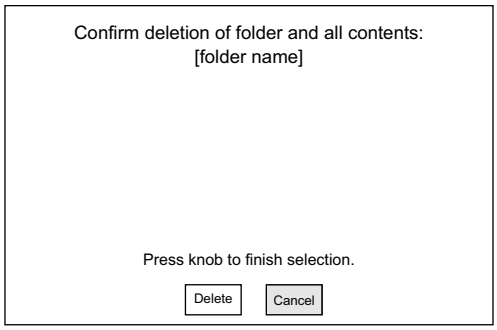


Figure 4-32. TREND: File Manager (Folder Deletion Confirmation)

3. Turn the Selection knob to highlight Delete.
4. Press the ENTER/SET button to delete the folder and display the TREND: File Manager screen.

RENAME

Use this function to rename a file or folder.

1. On the TREND: File Manager screen, turn the Selection knob to highlight the name of the file or folder you want to rename.
2. Press the RENAME soft key to display a screen similar to the one shown in Figure 4-33.

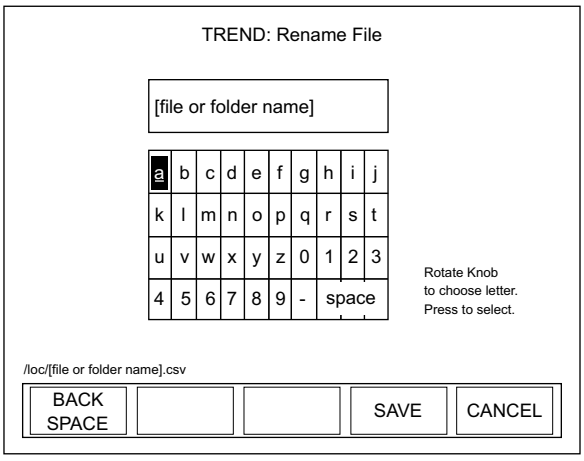


Figure 4-33. TREND: Rename File or Folder

3. Using the BACKSPACE soft key, delete the current name.

To delete a character at any time, use the BACKSPACE soft key.

---

4. Select the first character of the new name by turning the Selection knob and then pressing the ENTER/SET button when the desired letter or number is highlighted. The character will appear in the blank box immediately below the screen heading.
5. Repeat step 4 until the entire name appears in the box.
6. Press the SAVE soft key to save the new name and display the TREND: File Manager screen.

Soft Keys

There are three soft keys on the TREND: Rename File screen: BACKSPACE, SAVE, and CANCEL.

BACKSPACE

This soft key backspaces one editable field at a time and deletes the character that was there.

SAVE

Pressing the SAVE soft key saves whatever changes were made since the last SAVE.

CANCEL

Pressing the CANCEL soft key discards all changes that were made since the last SAVE and returns to the TREND: File Manager screen.

CREATE FOLDER

Use this function on the TREND: File Manager screen to create a folder on the local drive or USB flash drive. Subfolders can be created within a folder.

Pressing the CREATE FOLDER soft key displays the screen shown in Figure 4-34:

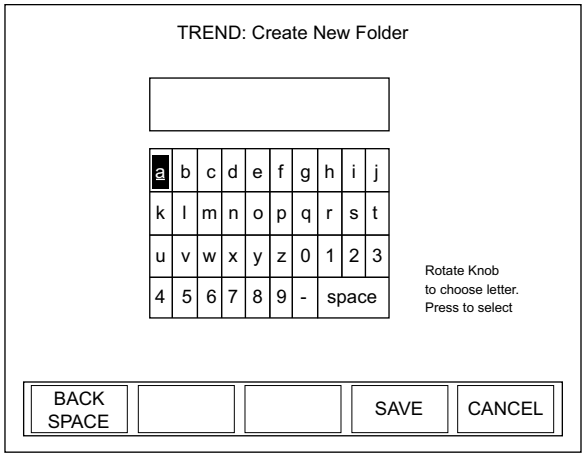


Figure 4-34. TREND: Create New Folder

Soft Keys

There are three soft keys on this screen: BACKSPACE, SAVE, and CANCEL.

BACKSPACE

This soft key backspaces one editable field at a time and deletes the character that was there.

SAVE

Pressing the SAVE soft key saves whatever changes were made since the last SAVE.

CANCEL

Pressing the CANCEL soft key discards all changes that were made since the last SAVE and returns to the TREND: File Manager screen.

EXIT

Pressing the EXIT soft key in the File Manager screen displays the main TREND screen.

TREND Setup

Use Trend Setup to select the batch duration and sampling rate:

- For thermopiles and optical sensors, the duration is in terms of *time*.
- For pyroelectric sensors the duration is in terms of *measured laser pulses*.

The factory default (and maximum) sampling rate for both thermopile and optical sensors is 10 samples per second. The factory default sampling rate for pyroelectric sensors is one sample per measured pulse.

The ability to specify both a duration and a sampling rate offers the flexibility of collecting data on the performance of a laser over a desired period of time while managing the quantity of data gathered.

Example: If you are using a thermopile sensor, you could set up the meter to log one data point per minute for seven days, resulting in 10,080 data points.

Example: If you are using a pyroelectric sensor and measuring pulses on a 1 kHz laser, you could choose to log one point per 1000 pulses for a day, resulting in 86,400 data points.

Depending upon the sensor and display units in use, pressing the TREND SETUP soft key on the main TREND screen displays a screen similar to one of the following:

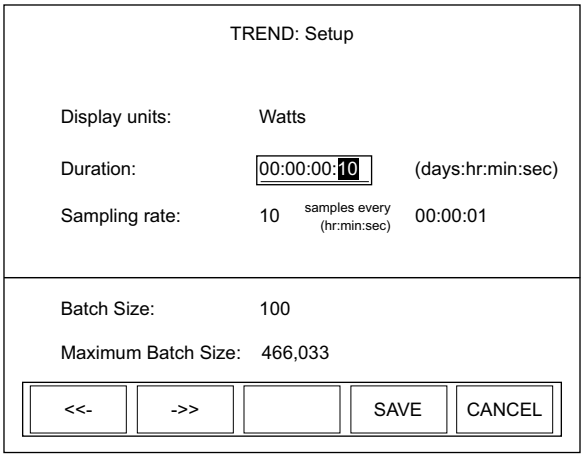


Figure 4-35. TREND: Setup (Thermopile and Optical Sensors)

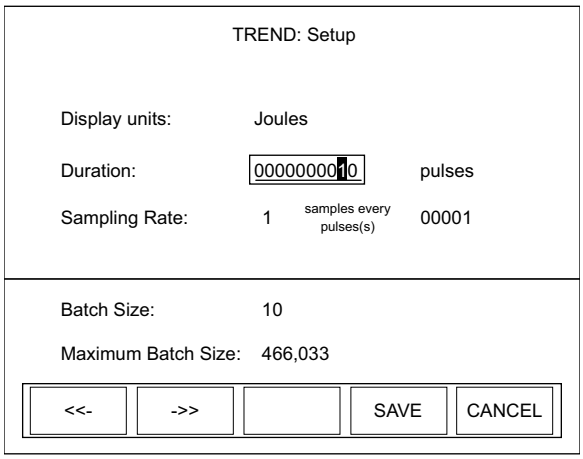


Figure 4-36. TREND: Setup (Pyroelectric Sensors)

Soft Keys

There are four soft keys on this screen: <<-/->>(Previous/Next directional arrows), SAVE, and CANCEL.

<<- and ->> (directional arrows)

Parameters on this screen are changed by using one of the following procedures. The procedure that should be used depends on the type of parameter you want to modify.

"Single" Parameters

This type of parameter—Display units, for example—has only one modifiable field. To change a value for this type of parameter:

1. Press the ENTER/SET button until the parameter you want to change is highlighted.
2. Turn the Selection knob to change the parameter value.
3. Press the ENTER/SET button to move to the next parameter.
4. Continue this process until the values for all the parameters are correct.
5. Once the values for all the parameters are correct, press the SAVE soft key to save the parameters and display the STATS screen.

"Multiple" Parameters

This type of parameter—Duration, for example—contains several fields that can be modified. To change a value for this type of parameter:

1. Press the ENTER/SET button until the parameter you want to change is highlighted.
2. Turn the Selection knob to change the parameter value.
3. Press either of the directional arrows soft keys (<<- or ->>) to move the highlight to another value within the same parameter.
4. Repeat steps 2 and 3 until all values for that parameter are correct.
5. Press the ENTER/SET button to move to the next parameter.
6. Once the values for all the parameters are correct, press the SAVE soft key to save the parameters and display the STATS screen.

SAVE

Pressing the SAVE soft key saves whatever changes were made since the last SAVE and displays the TREND screen.

CANCEL

Pressing the CANCEL soft key discards all changes that were made since the last SAVE and displays the TREND screen.

ZERO

(thermopile and optical sensors only)



Pressing the ZERO button sets the current sensor input voltage as the zero baseline voltage. ZERO is not functional when the meter is in HELP mode.

If zeroing is unsuccessful—which means that the power input is too large to null—re-zero in a more stable environment or select a different range.The meter always zeros all available ranges for the attached sensor. When a zero procedure is in process, no other button events are queued or activated until the procedure ends. The zero procedure immediately terminates if the sensor is disconnected or if an error is encountered.

Normally you should press ZERO while the laser is turned off, or while the laser beam is blocked. If a finite power level is present at the sensor, the instrument will attempt to null it out.

The meter is only able to zero a finite level of offset. When zeroing on a selected range is unsuccessful, the text "Zeroing…" is replaced with the following error dialog: "Bad zero. The power input is too large to null. Re-zero in a more stable environment or select a different range."

SETUP

Pressing the SETUP button on the front panel will display the main SETUP screen (Figure 4-37):

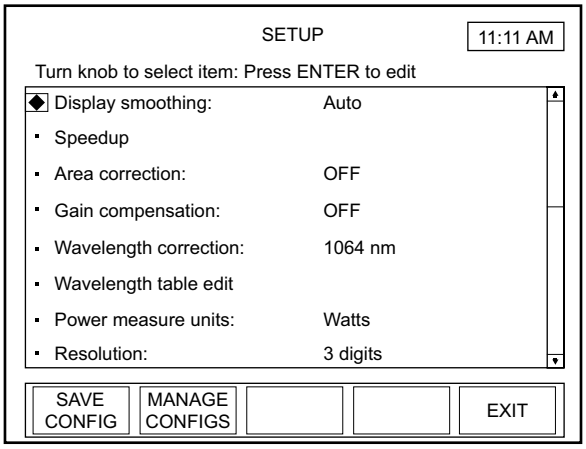


Figure 4-37. SETUP

On the SETUP screen, a diamond indicator appears to the left of the currently-selected item. To change the value of an item, *turn* the Selection knob to move the indicator up or down the list and when the bullet is next to the desired item, *press* the ENTER/SET button (the Selection knob) to select that item—see Figure 3-3 (p. 3-6) for the location of the Selection knob, all buttons, and the soft keys. Depending on which item is selected, editing will be available either on a list that appears to the right of the selected item, or on a new screen that will automatically open when an item is selected.

To leave SETUP:

- Press the EXIT soft key (directly below the LCD, first key on the right),

  or

- Press the MEASURE, TUNE, or TREND button

Unless a setting is incompatible with the attached sensor, all SETUP parameters remain in effect—even if the meter is shut down and powered up at a later time.

Display Smoothing

Display smoothing uses a rolling box-car average to smooth the displayed measurement. This can be useful if individual measurement values are too noisy. Smoothing is applied to all displayed measurements on all screens. In the case of quadrant position-sensing thermopile sensors, display smoothing is applied to the position indicator within the bulls eye.

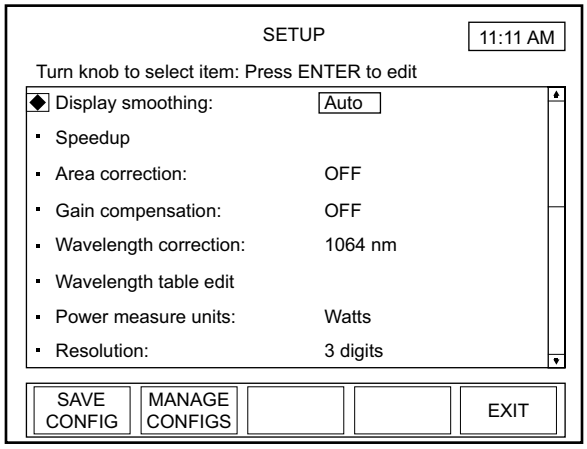


Figure 4-38. SETUP: Display Smoothing

Available values: AUTO (factory default), MANUAL, and OFF.

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Display smoothing.
2. Press the ENTER/SET button to highlight the editable field (Figure 4-38).
3. Turn the Selection knob to change the value.

4. Press the ENTER/SET button to save the value and return to the main SETUP screen.

If you select Manual as the Display Smoothing value, pressing the ENTER/SET button will display either the screen shown in Figure 4-39 (for thermopile and optical sensors) or the screen shown in Figure 4-40 (for pyroelectric sensors). This allows the results of smoothing the setting to be observed on the live measurement during setup. Continue to step 5.

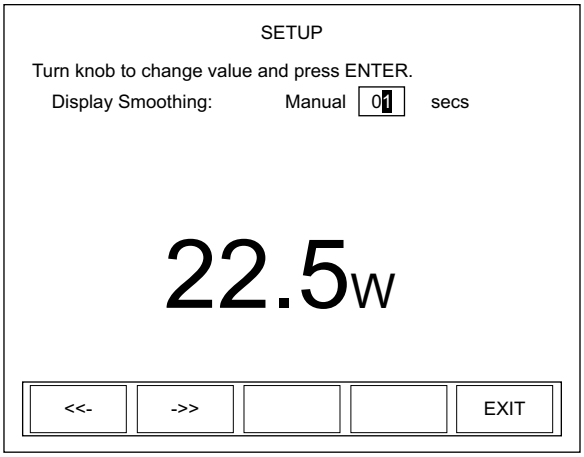


Figure 4-39. SETUP: Display Smoothing (Thermopile and Optical Sensors - Manual Mode)

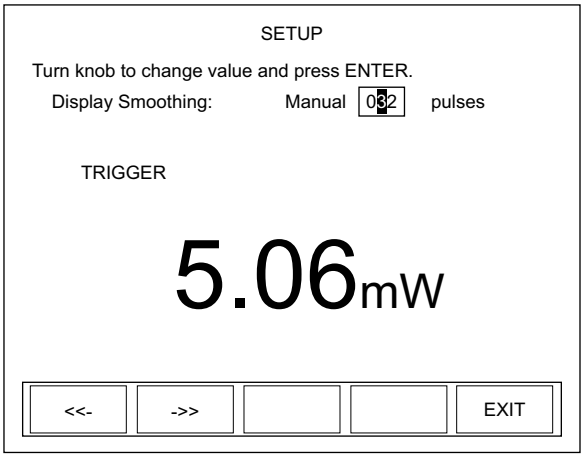


Figure 4-40. SETUP: Display Smoothing (Pyroelectric Sensors - Manual Mode)

Turn the Selection knob to change the number of seconds (thermopile and optical sensors) or pulses (pyroelectric sensors).**The directional arrow soft keys (<<- and ->>) can be used to move the highlight to a different digit before using the Selection knob to change the value.**

5. Press the ENTER/SET button—or the EXIT soft key—to save the value and exit Display Smoothing mode.

Press the EXIT soft key at any time to save all current values and return to the main SETUP screen.

Speedup

(thermopile sensors only) This command selects the speedup mode for the host interface data output.

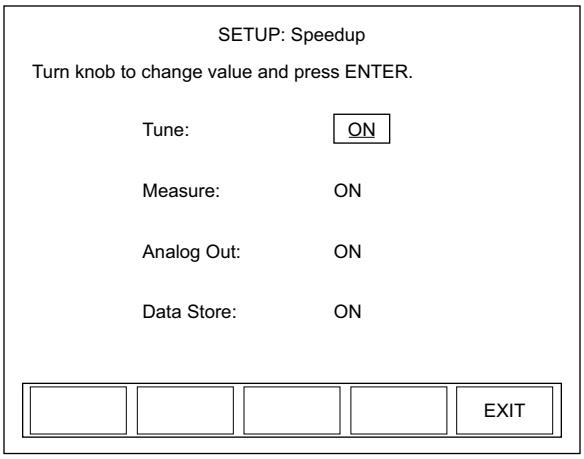


Figure 4-41. SETUP: Speedup

Available values: ON (factory default) and OFF.

Speedup can be turned ON or OFF for the following features: Tune, Measure, Analog Out, and Data Store.

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Speedup.
2. Press the ENTER/SET button to Display the SETUP: Speedup screen (Figure 4-41).

3. Press the ENTER/SET button to highlight the value of the feature you want to change.
4. Turn the Selection knob to change the value.
5. Press the ENTER/SET button to lock in the current value and move the highlight to the next editable field.

Pressing the ENTER/SET button after highlighting Data Store, or pressing the EXIT soft key at any time will save all the locked-in values, exit Speedup mode, and return to the main SETUP screen.

Area Correction

Area Correction allows the measurement value to be displayed in terms of a unit area. The measured value (in watts or joules) is divided by the area entered here. This mode is most commonly used in processes where the energy density (fluence) or power density—rather than the absolute energy or power—is of paramount importance. Typically in these applications the sensor aperture is completely flooded by laser light, and the sensor aperture is entered here.

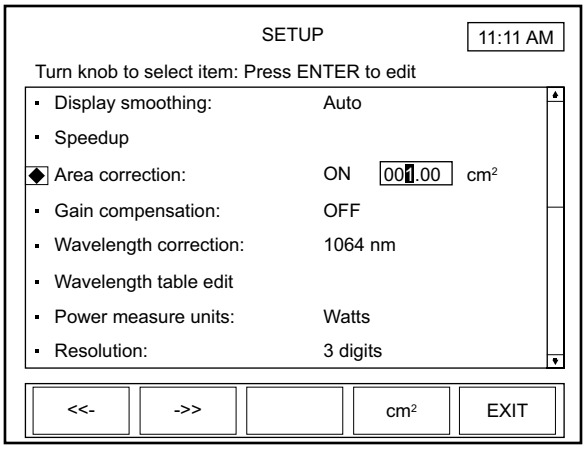


Figure 4-42. SETUP: Area Correction

Available values: ON and OFF (factory default).

Available range: 0.01 to 500.00 cm^2 or 0.1 to 250 mm.

Available units: cm^2 and mm. The area can be entered in terms of area in square centimeters or in terms of the diameter of the active area in millimeters. When entering the active area in terms of the diameter, the active area must be circular.

Most Coherent sensors utilize circular apertures, so the ability to enter the active area in terms of the diameter in millimeters is often an easier process than calculating the area yourself.

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Area Correction.
2. Press the ENTER/SET button to highlight the editable field (Figure 4-42).
3. Turn the Selection knob to change the value.
4. Press the ENTER/SET button to save the value.

If you select ON as the Area Correction value, pressing the ENTER/SET button will display the range field (shown as 001.00 in Figure 4-42, above) and the unit of measurement (cm^2 in Figure 4-42). Continue to step 5.

---

5. Turn the Selection knob to change the range value.

The directional arrow soft keys (<<- and ->>) can be used to move the highlight to a different digit before using the Selection knob to change the value.

---

6. Press the ENTER/SET button to save the value and exit Area Correction mode.

Pressing the EXIT soft key at any time while in SETUP will leave the SETUP program.

To change the unit of measurement:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Area Correction.

2. Press the ENTER/SET button to highlight the first field and set Area Correction to ON.
3. Press the ENTER/SET button to move the highlight to the Area Correction value field. This action will display the Unit soft key (next to EXIT at the bottom of the LCD).
4. Toggle the Unit soft key to select either cm^2 or mm as the unit of measurement.
5. Press the ENTER/SET button to save the value.

If there is a diameter in the sensor EEPROM, it is used as the default when the meter powers up; otherwise, the last-entered value is used.

Gain Compensation

Gain Compensation lets the user adjust the measured values based upon the gain factor entered here. Measurement values are multiplied by the gain factor.

Gain compensation has several uses:

- Accounting for filters or other optical attenuators upstream in the beam path.
- Measuring a small pick-off beam from a beamsplitter and wanting to calibrate the meter to display the power or energy of the main beam.

- Self-calibrating a meter and sensor system, based upon the your own calibration system.

If you are using gain as a calibration factor, be sure to save a custom configuration—refer to "Save Current Config" (p. 4-69). It is possible to save multiple configurations for multiple sensor serial numbers, which allows you to recall particular configurations by pressing the MANAGE CONFIGS soft key and then selecting a particular configuration file.

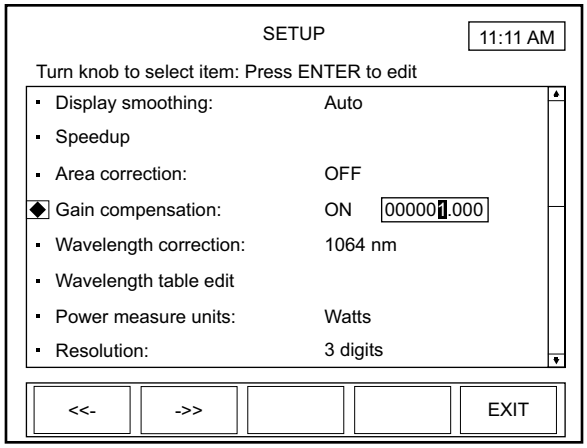


Figure 4-43. SETUP: Gain Compensation

Available values: ON and OFF (factory default).

Available range: 0.001 to 100000

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Gain Compensation.
2. Press the ENTER/SET button to highlight the first field.
3. Turn the Selection knob and display ON in the Gain Compensation field and then press the ENTER/SET button to move the highlight to the Gain Compensation value field (shown as 000001.000 in Figure 4-43).
4. Turn the Selection knob to change the value.

The directional arrow soft keys (<<- and ->>) can be used to move the highlight to a different digit before using the Selection knob to change the value.

---

5. Press the ENTER/SET button to save the value and exit Gain Compensation mode.

Pressing the EXIT soft key at any time while in SETUP will leave the SETUP program.

Wavelength Correction

Wavelength Correction lets the user select the sensor wavelength.

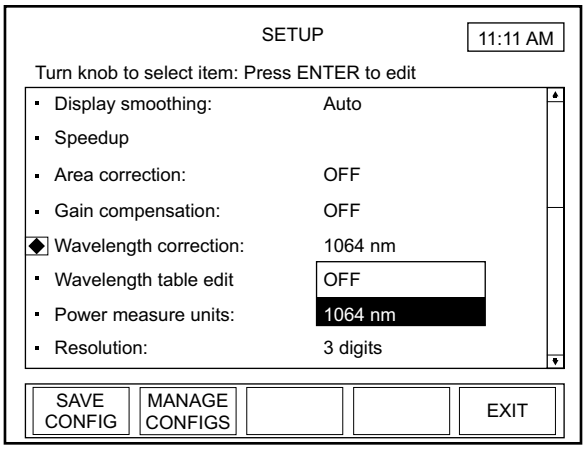


Figure 4-44. SETUP: Wavelength Correction

Available values: OFF and wavelengths that are available for the attached sensor.

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Wavelength Correction.
2. Press the ENTER/SET button to display a dropdown list of available wavelengths (similar to the list shown in Figure 4-44).
3. Turn the Selection knob to highlight the desired value.
4. Press the ENTER/SET button to save the value and exit Wavelength Correction mode.

Wavelength Table Edit

This item lets the user add or delete sensor wavelengths.

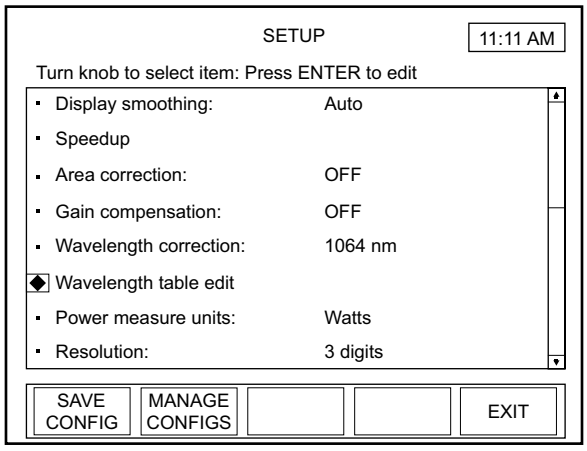


Figure 4-45. SETUP: Wavelength Table Edit

Available values: All available pre-set wavelengths.

To access the Edit Wavelength Table screen:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Wavelength Table Edit (Figure 4-45).
2. Press the ENTER/SET button to display the SETUP: Edit Wavelength Table screen. From this screen, you can add or delete a wavelength, as explained next.

On this screen, wavelengths below 1000 nm display in terms of nanometers, and wavelengths above 1000 nm display in terms of microns.

Adding a Wavelength

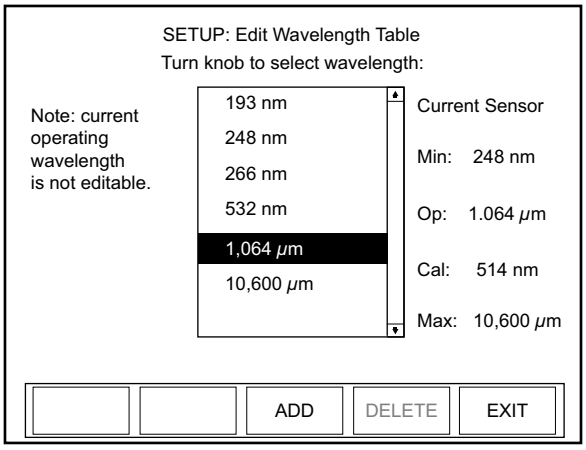


Figure 4-46. SETUP: Edit Wavelength Table

From the SETUP: Edit Wavelength Table screen (Figure 4-46):

1. Press the ADD soft key.
2. Turn the Selection knob to display a new wavelength. The wavelength will appear at the bottom of the dropdown list (in the following example, the new wavelength is 00337 nm).

The directional arrow soft keys (<<- and ->>) can be used to move the highlight to a different digit before using the Selection knob to change the value.

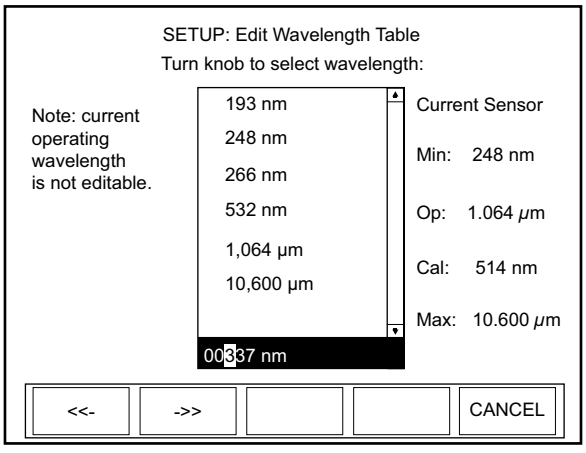


Figure 4-47. SETUP: Edit Wavelength Table (Adding a Wavelength)

3. Press the ENTER/SET button to add the new wavelength to the dropdown list.

4. Press the EXIT soft key to exit Edit Wavelength Table mode and return to the main SETUP screen.

Deleting a Wavelength

From the SETUP: Edit Wavelength Table screen (Figure 4-46):

1. Turn the Selection knob to highlight the wavelength you want to delete.
2. Press the DELETE soft key to remove the wavelength from the dropdown list.
3. Press the EXIT soft key to exit Edit Wavelength Table mode and return to the main SETUP screen.

Power Measure Units

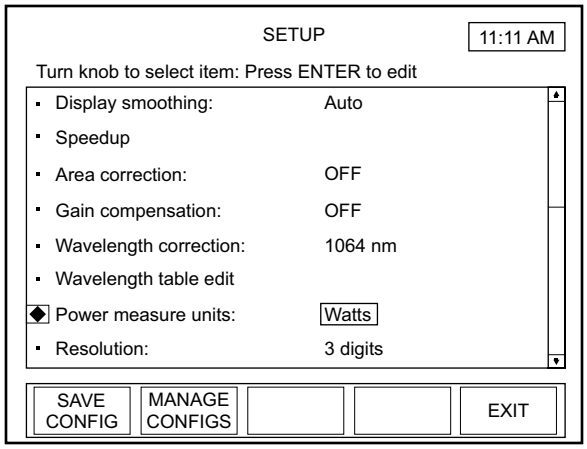


Figure 4-48. SETUP: Power Measure Units

Available values: Watts (factory default) and dBm.

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Power Measure Units.
2. Press the ENTER/SET button to highlight the value field (Figure 4-48).
3. Turn the Selection knob to change the value.
4. Press the ENTER/SET button to save the value and exit Power Measure Units mode.

Resolution

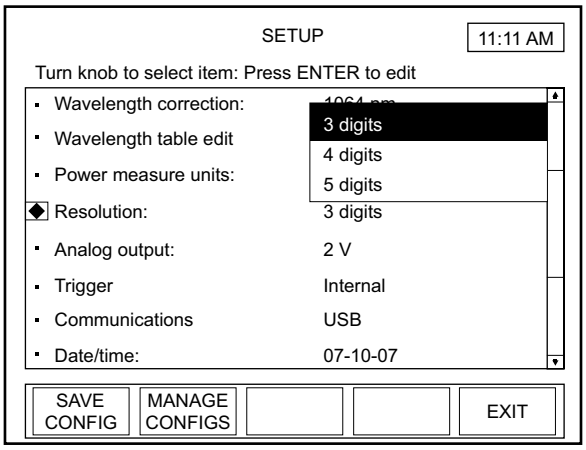


Figure 4-49. SETUP: Resolution

Available values: See the following table:

Table 4-3. Sensor Resolution Ranges

Sensor Type	Range	Factory Default
Thermopile	3, 4, 5	3
Optical	3, 4, 5	3
Pyroelectric	3, 4	3

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Resolution.
2. Press the ENTER/SET button to display a dropdown list of available resolutions (similar to the list shown in Figure 4-49).
3. Turn the Selection knob to highlight the desired value.
4. Press the ENTER/SET button to save the value and exit Resolution mode.

Analog Output

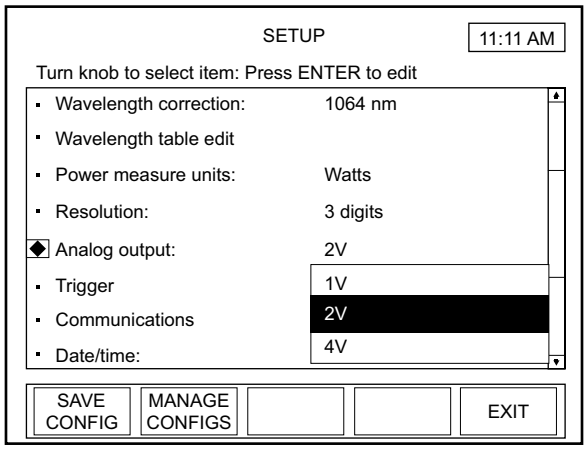


Figure 4-50. SETUP: Analog Output

Available values: 1, 2 (factory default), and 4V.

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Analog Output.
2. Press the ENTER/SET button to display a dropdown list of available voltages (similar to the list shown in Figure 4-50).
3. Turn the Selection knob to highlight the desired value.
4. Press the ENTER/SET button to save the value and exit Analog Output mode.

Trigger

(pyroelectric sensors only) This is where the trigger source—either internal or external—is defined. If the laser has a trigger output, use external triggering to provide the most accurate readings. Since the meter is not looking for trigger events itself, the measured value will be an actual laser pulse. Using external trigger also allows monitoring the missed pulses in Statistics mode, which can be useful when diagnosing laser problems.

External triggers can be selected as negative or positive, and a trigger delay can be entered if the laser pulse occurs after the external trigger event.

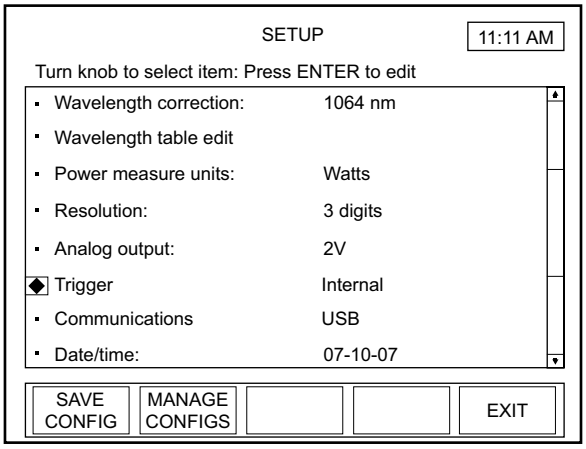


Figure 4-51. SETUP: Trigger

Available values: See the following table:

Table 4-4. Trigger Range and Factory Defaults

Setting	Range	Factory Default
Source	Internal, External	Internal
Delay	0 to 1000 µs	0 µs
Trigger Edge	Positive, Negative	Positive

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Trigger (Figure 4-51).

2. Press the ENTER/SET button to display the SETUP: Trigger screen (Figure 4-52).

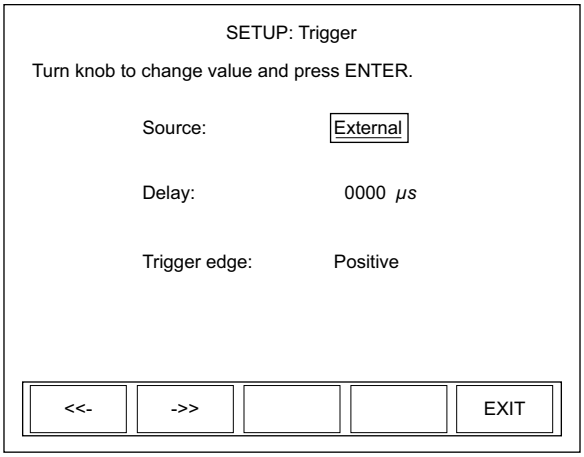


Figure 4-52. SETUP: Trigger (Changing the Values)

3. Turn the Selection knob to change the value of the source.
4. If you select Internal as the source, press the EXIT soft key to save the value, exit Trigger mode, and return to the main SETUP screen; there are no other option selections available. Selecting External as the source value (as shown in Figure 4-52) will display editable fields next to Delay and Trigger Edge. Continue to step 5.
5. Press the ENTER/SET button to move the highlight to the Delay field.
6. Turn the Selection knob to change the value.

The directional arrow soft keys (<<- and ->>) can be used to move the highlight to a different digit within the Delay field before using the Selection knob to change the value.

---

7. Press the ENTER/SET button to lock in the Delay value and move the highlight to Trigger Edge field.
8. Turn the Selection knob to select a value.
9. Press the EXIT soft key to save all the Trigger values, exit Trigger mode, and return to the main SETUP screen.

Communications

Use Communications to define the host interface type that will be used to communicate with a PC. The factory default is USB. If you cannot communicate with the meter via a PC, the most likely reason is that the Communications type is not set correctly on this screen.

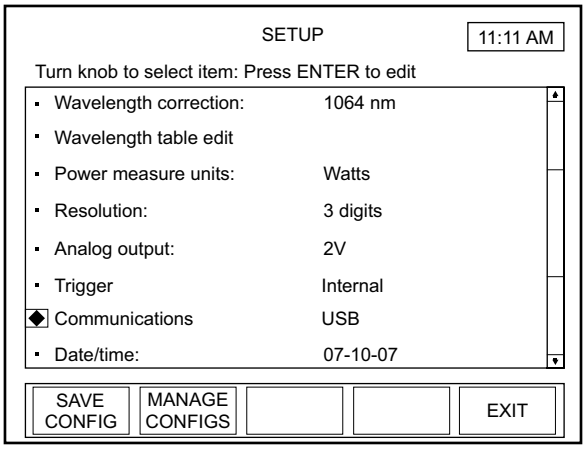


Figure 4-53. SETUP: Communications

Available values: See the following table:

Table 4-5. Communication Values and Factory Defaults

Setting Label	Values	Factory Default
Host	USB, GPIB, RS-232	USB
RS-232 Baud Rate	9600, 19200, 38400, 57600, 115200	19200
RS-232 Stop Bits	1, 2	1
RS-232 Parity	None, Odd, Even	None
RS-232 Flow Control	None, Xon/Xoff	None
GPIB Id	1 to 30	1

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Communications (Figure 4-53).

2. Press the ENTER/SET button to Display the SETUP: Communications screen (Figure 4-54).

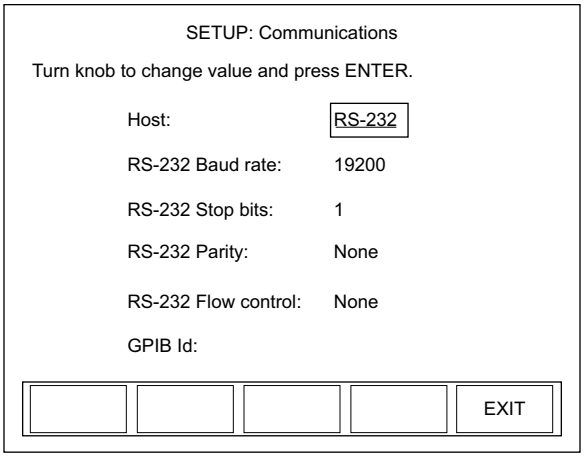


Figure 4-54. SETUP: Communications (Changing the Values)

3. Turn the Selection knob to change a value.

Selecting RS-232 or GPIB as the Host value will display the editable fields shown in Figure 4-54. Continue to step 4.

---

4. Press the ENTER/SET button to lock in the value and move the highlight to the next editable field (except for USB, which does not have other editable fields).
5. Continue the process until all the values on the screen are correct.
6. Press the EXIT soft key to save the values and exit Communications mode.

Date/Time

Enter the date and time here. Date/time is only used for naming files and for date and time information within the Microsoft Windows operating system file manager.

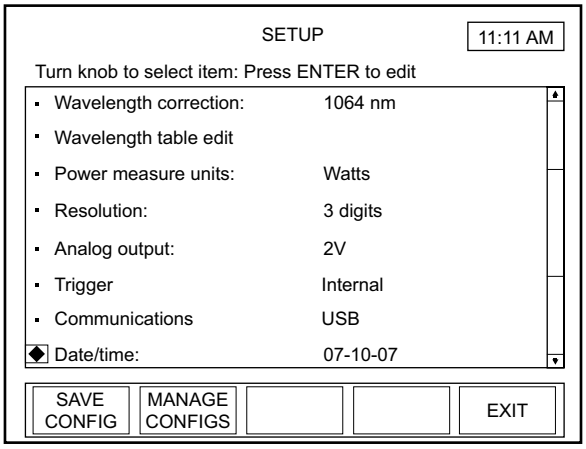


Figure 4-55. SETUP: Date/Time

Available values: See the following table:

Table 4-6. Date/Time Ranges and Factory Defaults

Setting	Range	Factory Default
Date Format	mm-dd-yy dd-mm-yy	mm-dd-yy
Date	Limits of Data function	Initially set during Factory testing
Time	hr:min (24-hour format)	Initially set during Factory testing

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Date/Time (Figure 4-55).

2. Press the ENTER/SET button to Display the SETUP: Date screen (Figure 4-56).

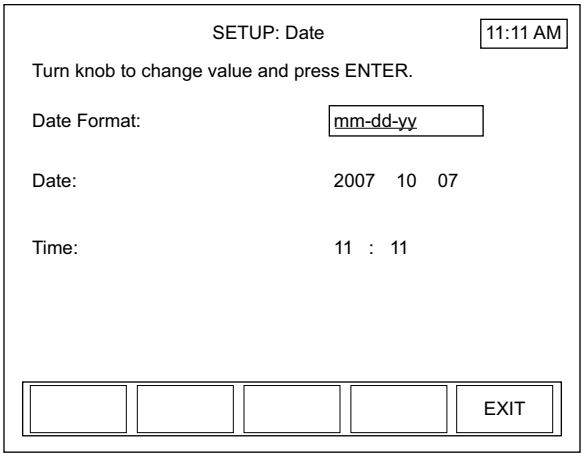


Figure 4-56. SETUP: Date/Time (Changing the Values)

3. Turn the Selection knob to change a value.
4. Press the ENTER/SET button to lock in the value and move to the next editable field.
5. Continue the process until all the values on the screen are correct.
6. Press the EXIT soft key to save the values and exit Date mode.

Pressing the EXIT soft key at any time will save the current values and return to the main SETUP screen.

Energy Savings

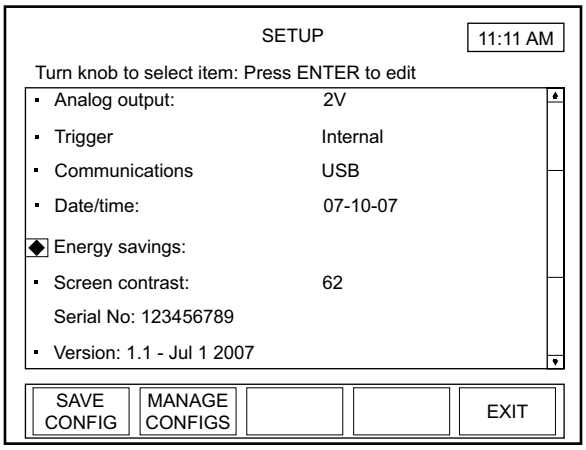


Figure 4-57. SETUP: Energy Savings

Available values: See the following table

:

Table 4-7. Energy Savings Ranges and Factory Defaults

Setting	Range	Factory Default
Backlight Auto Off	OFF, ON (1 to 60 min. idle)	Battery: OFF AC: OFF
Meter Auto Off	OFF, ON (1 to 60 min. idle)	Battery: OFF AC: N/A

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Energy Savings (Figure 4-57).
2. Press the ENTER/SET button to Display the SETUP: Energy Savings screen (Figure 4-58).

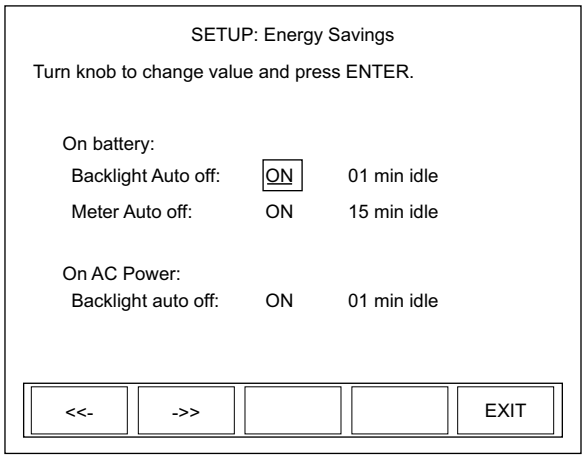


Figure 4-58. SETUP: Energy Savings (Changing the Values)

3. Turn the Selection knob to change a value.

Selecting ON as a value on the SETUP: Energy Savings screen will display an editable field next to that value (as shown in Figure 4-58). Continue to step 4.

---

4. Press the ENTER/SET button to move the highlight to the next editable field.
5. Turn the Selection knob to change the value.

The directional arrow soft keys (<<- and ->>) can be used to move the highlight to a different digit before using the Selection knob to change the value.

---

6. Press the ENTER/SET button to move the highlight to the next field.
7. Continue that process until all values are correct.
8. Press the EXIT soft key to save the values and exit Energy Savings mode.

Pressing the EXIT soft key at any time will save the current values and return to the main SETUP screen.

Screen Contrast

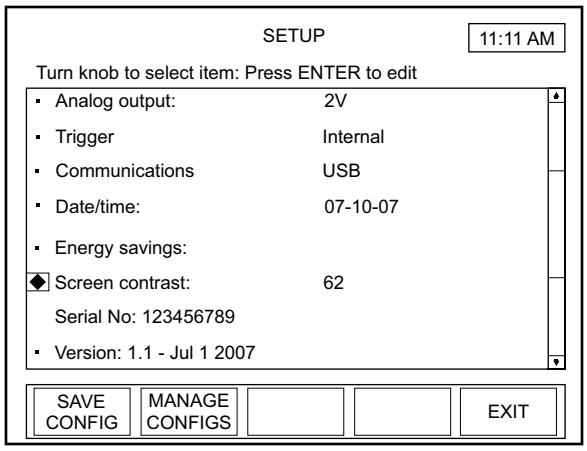


Figure 4-59. SETUP: Screen Contrast

Available values: 1 to 99.

To change a value:

1. On the main SETUP screen, turn the Selection knob to move the diamond indicator to Screen Contrast (Figure 4-59).
2. Press the ENTER/SET button to Display the SETUP: Contrast screen (Figure 4-60).

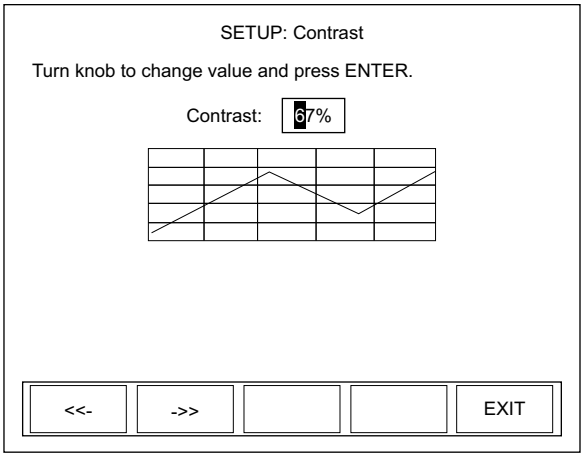


Figure 4-60. SETUP: Screen Contrast (Changing the Values)

3. Turn the Selection knob to change the contrast value.

The directional arrow soft keys (<<- and ->>) can be used to move the highlight to a different digit before using the Selection knob to change the value.

---

4. Press the EXIT soft key to save the value and exit Contrast mode.

Serial Number

This field displays the instrument serial number.

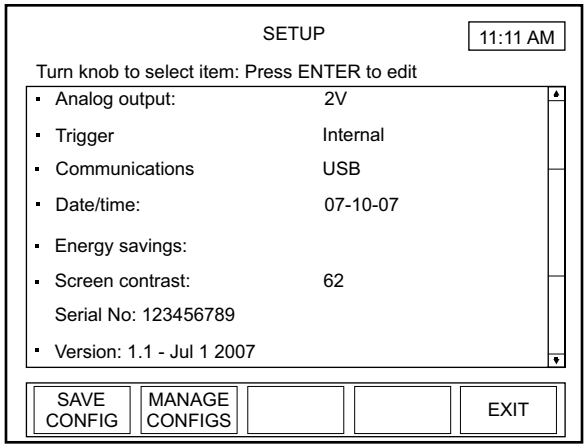


Figure 4-61. SETUP: Serial No.

Version

This field displays the version number of the installed firmware.

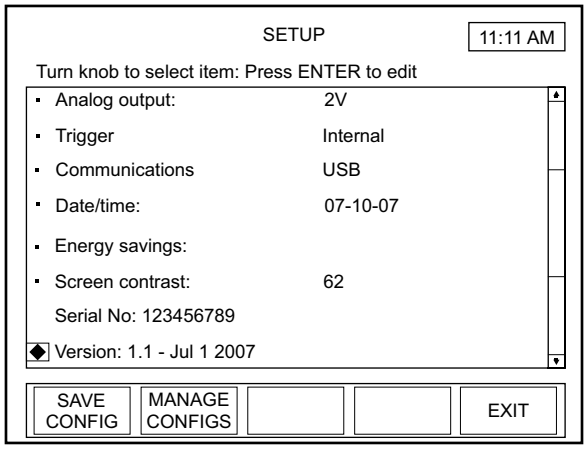


Figure 4-62. SETUP: Version

Soft Keys

There are three soft keys on the main SETUP screen: SAVE CONFIG, MANAGE CONFIGS, and EXIT.

SAVE CONFIG

Refer to “Save Current Config” (p. 4-69).

MANAGE CONFIG

Refer to “Manage Configs” (p. 4-71).

EXIT

Pressing this soft key will exit SETUP and display the screen last viewed prior to entering SETUP mode.

Detailed Procedures

This section provides in-depth information about specific topics that were briefly discussed earlier.

Save Current Config

This function saves a custom configuration file that records the meter settings listed in the following table:

Table 4-8. Custom Configuration File Meter Settings

Analog output voltage scale	Power measure units
Area correction area	RS-232 baud rate
Area correction area specification units	RS-232 flow control
Area correction on/off state	RS-232 parity
Auto range on/off state	RS-232 stop bits
Backlight auto off time under AC power	Speedup applied to analog output on/off state
Backlight auto off time under battery power	Speedup applied to host data on/off state
Backlight on/off state under AC power	Speedup applied to numerical display on/off state
Backlight on/off state under battery power	Speedup applied to tune graph on/off state
Current full scale range	Statistics batch size for pyroelectric sensors
Date format	Statistics batch size for thermopile and optical sensors
Display contrast	Statistics display sub mode
Display mode	Statistics output selections
Display smoothing on/off state for pyroelectric sensors	Statistics restart mode
Display smoothing on/off state for thermopile and optical sensors	Statistics sub sample rate for pyroelectric sensors
Display smoothing window size for pyroelectric sensors	Statistics sub sample rate for thermopile and optical sensors
Display smoothing window size for thermopile and optical sensors	Trend batch size for pyroelectric sensors
External trigger delay	Trend batch size for thermopile and optical sensors
Favorite wavelength list	Trend display sub mode
Gain compensation factor	Trend sub sample rate for pyroelectric sensors
Gain compensation on/off state	Trend sub sample rate for thermopile and optical sensors
GPIB address (LabMax-TOP w/GPIB meters only)	Trend view mode
Host communication port	Trigger level
Joules/Watts mode	Trigger slope
Meter auto off time	Trigger source
Meter on/off state	Tune view mode
Numerical display resolution	Wavelength correction on/off state
Position stability graph duration	Wavelength of operation
Position stability view mode	

Pressing the SAVE CONFIG soft key on the main SETUP screen displays the following screen:

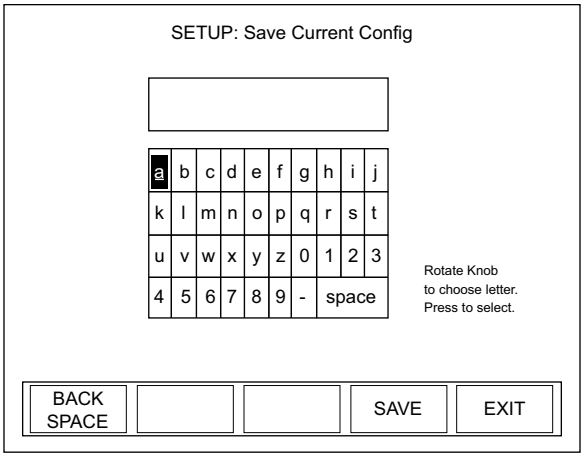


Figure 4-63. SETUP: Save Current Config

To create a new configuration file name:

1. Select the first character of the file name by turning the Selection knob and then pressing the ENTER/SET button when the desired letter or number is highlighted. The character will appear in the blank box immediately below the screen heading.

To delete a character, use the BACKSPACE soft key.

---

2. Repeat step 1 until the entire file name appears in the box.
3. Press the SAVE soft key to save the new file name, exit Save Current Config mode, and display the SETUP: Manage Configs screen, discussed next.

Pressing the EXIT soft key at any time will display the main SETUP screen.

Manage Configs

This screen allows you to work with previously-created configuration files. Pressing the MANAGE CONFIGS soft key on the main SETUP screen (or saving a current configuration, as explained above) displays the following screen:

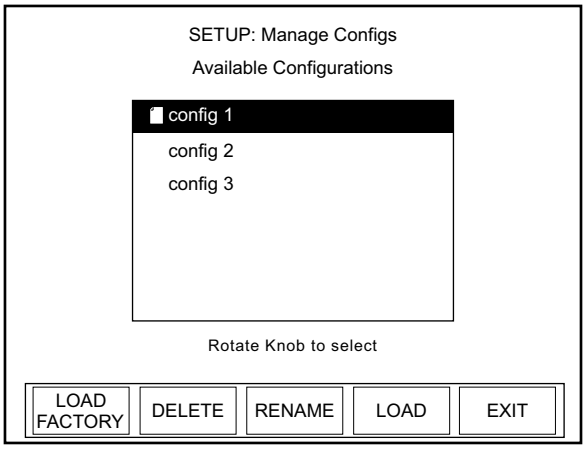


Figure 4-64. SETUP: Manage Configs

Soft Keys

There are five soft keys on this screen: LOAD FACTORY, DELETE, RENAME, LOAD, and EXIT.

LOAD FACTORY

To load the configuration file that was shipped with your LabMax, press the LOAD FACTORY soft key. This action will load the factory defaults and exit the Setup program.

DELETE

To delete a file:

1. Turn the Selection knob to highlight the file name you want to delete.
2. Press the DELETE soft key. The following confirmation message will appear:

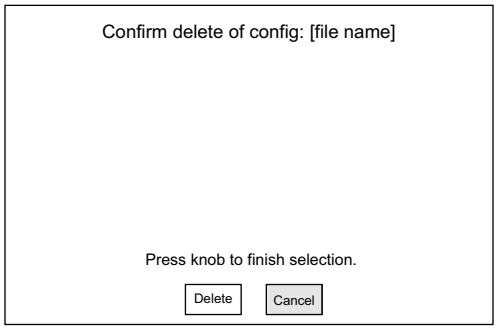


Figure 4-65. SETUP: Manage Configs (File Deletion Confirmation)

3. Turn the Selection knob to highlight Delete.
4. Press the ENTER/SET button to delete the file and return to the SETUP: Manage Configs screen. The file that was just deleted will no longer appear on the list of available configurations.

RENAME

To rename a configuration file:

1. Turn the Selection knob to highlight the file you want to rename.
2. Press the RENAME soft key to display the following screen:

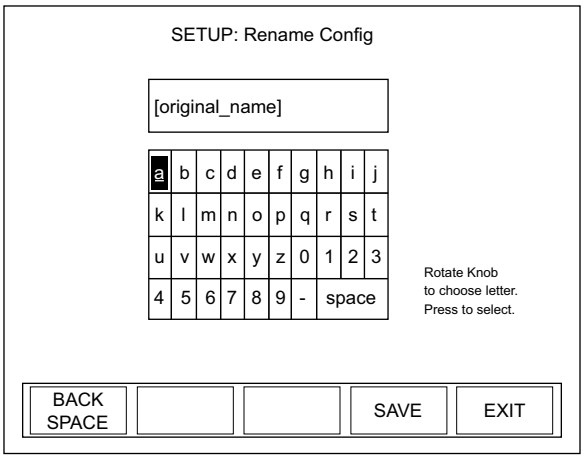


Figure 4-66. SETUP: Rename Config

3. Press the BACKSPACE soft key to erase the old file name (labeled original_name in Figure 4-66).
4. Select the first character of the new file name by turning the Selection knob and then pressing the ENTER/SET button when the desired letter or number is highlighted. The character will appear in the blank box immediately below the screen heading.

To delete a character, use the BACKSPACE soft key.

---

5. Repeat step 1 until the entire file name appears in the box.
6. Press the SAVE soft key to save the new file name and display the SETUP: Manage Configs screen. The file that was just renamed will appear on the list of available configurations.

LOAD

To load a previously-saved configuration file:

1. Turn the Selection knob to highlight the file name in the Available Configurations list.
2. Press the LOAD soft key. This action will load the highlighted file and return to the main SETUP screen.

EXIT

Pressing this soft key will exit Manage Configs mode and display the main SETUP screen.

HELP

LabMax offers two types of Help: Context-sensitive and general. This section describes both types.

Context-Sensitive Help

Pressing this front panel button at any time will access information specific to the current screen. For example, pressing the HELP button while viewing the TUNE screen will display help specific to TUNE:

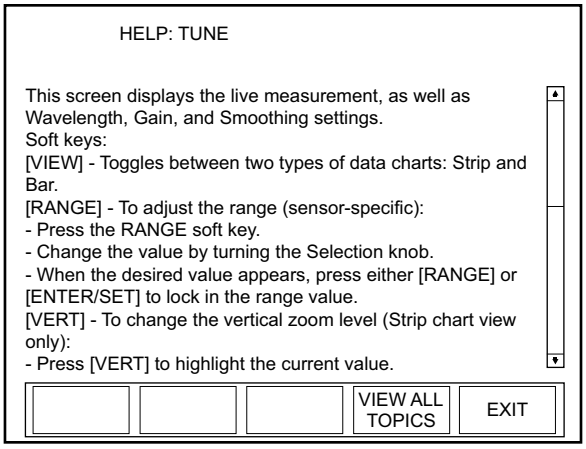


Figure 4-67. HELP (Context-Sensitive)

If the Help information is more than one screen long, turn the Selection knob to scroll.

Soft Keys

There are two soft keys on this screen: VIEW ALL TOPICS and EXIT.

VIEW ALL TOPICS

Pressing this soft key will access a list of all available Help topics (refer to “General Help” (p. 4-74).

EXIT

Pressing this soft key will exit SETUP and display the screen last viewed prior to entering SETUP mode.

General Help

Pressing the VIEW ALL TOPICS soft key at the bottom of any context-sensitive Help screen will access a list of all available Help topics:

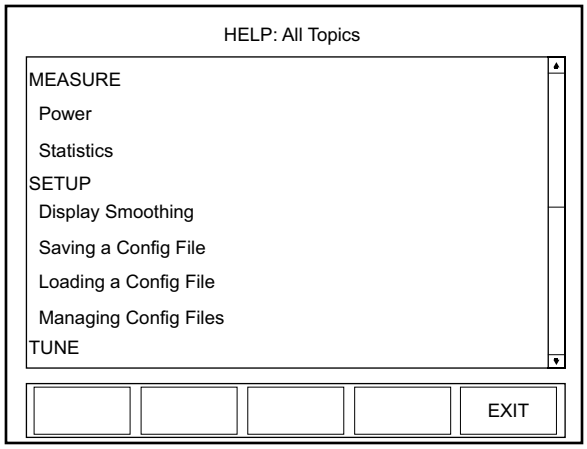


Figure 4-68. HELP (All Topics)

Turn the Selection knob to highlight an item and then press the ENTER/SET button to view the Help for that specific topic.

Soft Keys

There is one soft key on this screen: EXIT.

EXIT

Pressing this soft key will exit SETUP and display the screen last viewed prior to entering SETUP mode.

BACKLIGHT



Press this button to turn the LCD backlight ON or OFF.

SECTION FIVE: SPECIAL TOPICS

This section discusses:

- Analog output (this page)
- Understanding the external trigger circuit (this page)

Analog Output

When power is on, the Analog Out connector outputs a voltage proportional 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 overranged. The full-scale output voltage (1, 2, or 4V) is selected via the meter or the host interface. Factory default full-scale output voltage is 2V.

Understanding the External Trigger Circuit

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

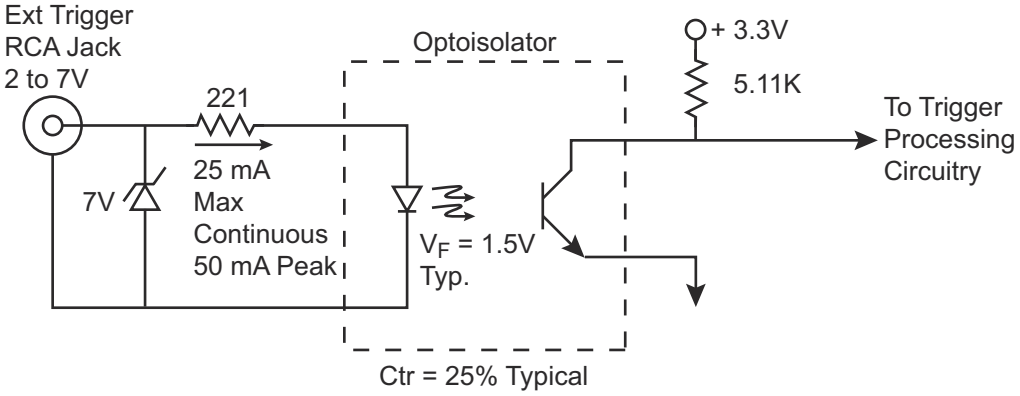
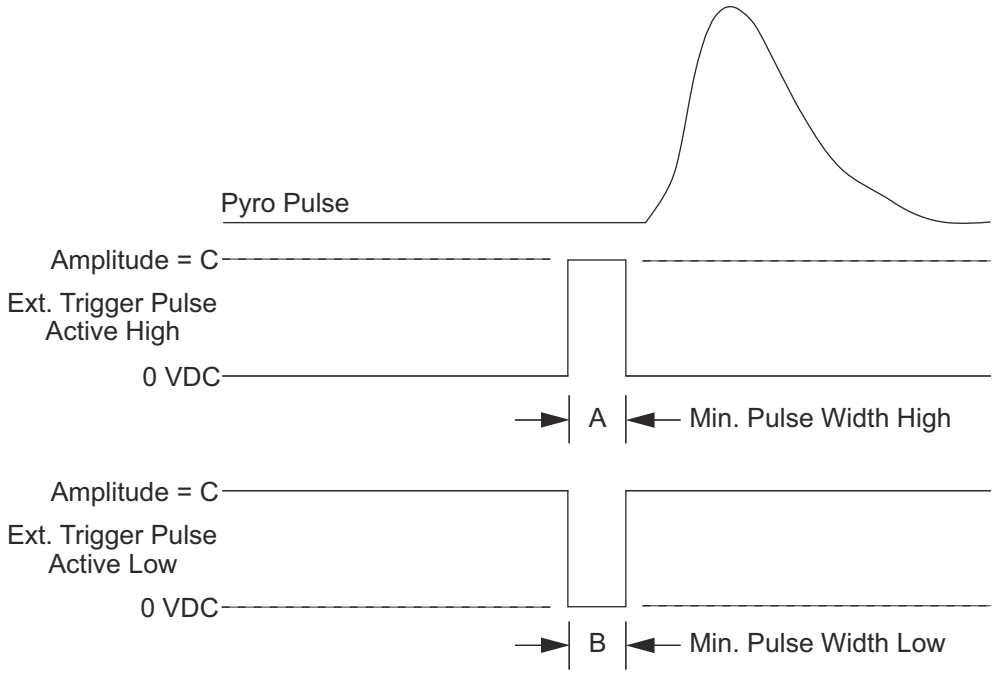


Figure 5-1. External Trigger Input Circuitry

Figure 5-2 shows the minimum pulse width required by the external trigger pulse.



	C = 2 VDC	C = 5 VDC
Min. Width A	2.5 µS	350 nS
Min. Width B	350 nS	2.5 µS

Figure 5-2. External Trigger Minimum Pulse Width

To turn on the optoisolator LED, the external trigger source must be capable of sourcing at least 5 mA at a minimum of 2 VDC into the external trigger input. If the trigger source is not capable of sourcing these minimum values, the trigger source will need to be buffered. One possible buffer circuit is shown in Figure 5-3.

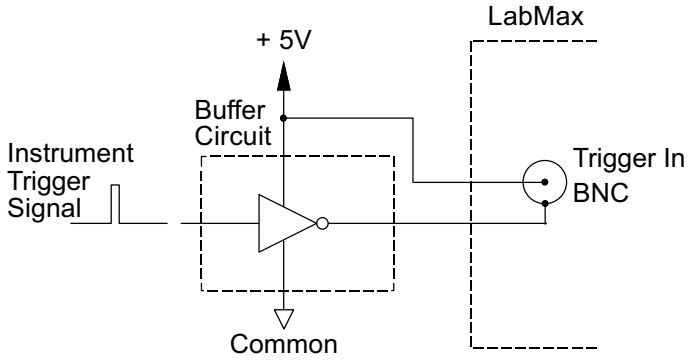


Figure 5-3. Boosting Source Current of Triggering Device

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



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

SECTION SIX: HOST INTERFACE

In this section:

- Special considerations (this page)
- Host Command quick reference (page 6-5)
- Commands and queries (page 6-13)
- Host Interface glossary (page 6-58)
- ActiveX control interface (page 6-60)

Special Considerations

Message Terminators

Messages between the meter and the host computer are comprised entirely of ASCII string characters. No binary messages are supported. All message strings passing through the host interface will be 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) and line feed (decimal 10) pair. A command or query is considered incomplete without the terminator.

Messages Sent by the Meter

All messages sent by the meter, with the exception of USB Binary Streaming Data, are terminated by a carriage return (decimal 13) and line feed (decimal 10) pair. The EOI control line is used to indicate the end of the message transmission (the string message followed by the carriage return and line feed terminator) when a GPIB interface module is selected for use. The maximum length of any message sent by the meter is limited to 4096 bytes.

Using the RS-232 Interface

Data Flow Control

The host controls the flow of data from the meter using software flow control. Software flow control uses standard bi-directional XON/XOFF methods for serial communication software flow control. Flow control selection is user-configurable.

Service Request

The meter signals the host that data is available to read—specifically, when either the measurement data or error queues transition from empty to non-empty. The host waits for the service request marker (ASCII ENQ or decimal 5 byte), which will indicate that data is available. Available data is either measurement data records or statistics data records—see “Sample Measurement Data Collection” (p. 6-50), or error records—see “Error Record Reporting and Collection” (p. 6-20). The service request marker is not sent when the meter sends a reply from a query.

Using the GPIB Interface

IEEE-488.1 Interface Capabilities

IEEE-488.1 is available only on the LabMax-TOP w/GPIB model. Table 6-1 contains a list of the IEEE-488.1 Interface functions for the meter.

Table 6-1. IEEE-488.1 Interface Functions

SH1	Source Handshaking (fully supported)
AH1	Acceptor Handshaking (fully supported)
T6	Basic Talker
L4	Basic Listener
SR0	Incoming Service Request (not supported)
RL1	Remote/Local mode (fully supported)
PP0	Parallel Pole operations (not supported)
DC1	Device Clear (fully supported)
DT0	Device Trigger (not supported)
C0	Bus Controller functionality (not supported)

Service Request

Out-going Service Requests are issued to provide a means of asynchronous communication over the IEEE-488 bus. The meter asserts the Service Request hardware line (SRQ) to indicate that data or error information is available to be read (specifically, when either the measurement data or error queues transition from empty to non-empty). Available data is either measurement data records or statistics data records—see "Sample Measurement Data Collection" (p. 6-50), or error records—see "Error Record Reporting and Collection" (p. 6-20).

When the host senses the assertion of SRQ, it uses a serial poll of the Status Byte Register (STB) for each device on the bus to determine the device requesting the service. The currently polled device is requesting service if bit 6 of the STB register is set. When the host discovers that the meter is requesting service, it issues the appropriate commands to determine the type of records that are available to be read.

Using the USB Interface

Service Request

The meter signals the host that data is available to read—specifically, when either the measurement data or error queues transition from empty to non-empty. The host waits for the attention message, which will indicate that data is available. Available data is either measurement data records or statistics data records—see "Sample Measurement Data Collection" (p. 6-50), or error records—see "Error Record Reporting and Collection" (p. 6-20). The attention message is not sent when the meter sends a reply from a query.

Binary Streaming Data

When the meter is connected to a host and USB is enabled, the meter can optionally send a binary record for each measurement sample. This capability may be enabled by the host via the streaming data commands.

Notation Conventions

Notation conventions specified by the SCPI and IEEE 488.2 Standards are followed unless otherwise specified.

Syntax

Syntax specified by the SCPI and IEEE 488.2 Standards is followed unless otherwise specified.

The base-10 numeric data format specification is used heavily in this section and covered in the IEEE 488.2 Standard. Unless otherwise specified, numeric data items are represented as:

- Integer values
- Non-scientific notation floating point values
- Scientific notation floating point values (upper or lower case 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.

The meter interprets hexadecimal data using the following rules:

- Upper case and lower case are accepted (“FE” is the same as “fe”)
- Leading zeroes are not required and will be accepted (“0A” is the same as “A”)
- The data string may optionally be preceded by a “0x” or “0X” C hexadecimal notation idiom (0xD2C4 is the same as D2C4)
- Following the optional “0x” prefix, the acceptable characters comes 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.

Host Command Quick Reference

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

Table 6-2. Host Command Quick Reference (Sheet 1 of 8)

SCPI Common Commands		
Command	**Description**	**Page #**
IEEE-488.2 Common Commands		
*IDN?	Queries the meter identification string, such as model name, firmware version, and firmware date.	6-13
System Options		
Command	**Description**	**Page #**
Local Control Lockout		
SYSTem:REMote	Places the meter in remote mode.	6-13
SYSTem:LOCal	Places the meter in local mode.	6-14
System Status		
SYSTem:STATus?	Queries the system status.	6-14
Backlight Control		
DISPlay:BACKlight	Controls the backlight on/off state.	6-15
DISPlay:BACKlight?	Queries the backlight on/off state.	6-15
SYSTem:OPTion:BACKlight:AOFF:ACPower	Controls the LCD backlight auto-off timeout timer when the meter is under AC power.	6-15
SYSTem:OPTion:BACKlight:AOFF:ACPower?	Queries the LCD backlight auto-off timeout timer when the meter is under AC power.	6-15
SYSTem:OPTion:BACKlight:AOFF:BPOWer	Controls the LCD backlight auto-off timeout timer when the meter is under battery power.	6-15
SYSTem:OPTion:BACKlight:AOFF:BPOWer?	Queries the LCD backlight auto-off timeout timer when the meter is under battery power.	6-15
Power Auto-Off		
SYSTem:OPTion:POWer:AOFF	Sets the power auto-off timeout when the meter is under battery power.	6-15
SYSTem:OPTion:POWer:AOFF?	Queries the power auto-off timeout when the meter is under battery power.	6-15
Meter Configuration Management		
MEMory:STATe:CATalog?	Queries the list of stored configuration files that was saved by the user.	6-16
MEMory:STATe:SAVE	Stores the current configuration to the named configuration file.	6-16
MEMory:STATe:RECall	Loads and activates the configuration held in the named configuration file.	6-17
MEMory:STATe:DELete	Deletes the named configuration file.	6-17
MEMory:STATe:RENname	Renames the named configuration file.	6-17

Table 6-2. Host Command Quick Reference (Sheet 2 of 8)

Communications		
Command	**Description**	**Page #**
Interface Select		
SYSTem:COMMunicate:INTerface	Selects the interface for host communication.	6-17
SYSTem:COMMunicate:INTerface?	Queries the interface for host communication.	6-17
Message Handshaking		
SYSTem:COMMunicate:HANDshaking	Selects the state of SCPI message round trip hand-shaking.	6-18
SYSTem:COMMunicate:HANDshaking?	Queries the state of SCPI message round trip hand-shaking.	6-18
Serial Port-Specific		
SYSTem:COMMunicate:SERial:BAUD	Selects the transmit and receive baud rates together.	6-18
SYSTem:COMMunicate:SERial:BAUD?	Queries the transmit and receive baud rates together.	6-18
SYSTem:COMMunicate:SERial:PARity	Selects the parity bit setting.	6-18
SYSTem:COMMunicate:SERial:PARity?	Queries the parity bit setting.	6-18
SYSTem:COMMunicate:SERial:SBITs	Selects the number of stop bits used.	6-19
SYSTem:COMMunicate:SERial:SBITs?	Queries the number of stop bits used.	6-19
SYSTem:COMMunicate:SERial:PACE	Selects the flow control method for meter to host communication.	6-19
SYSTem:COMMunicate:SERial:PACE?	Queries the flow control method for meter to host communication.	6-19
SYSTem:COMMunicate:SERial:SERVice	Selects the state of the service request marker feature	6-19
SYSTem:COMMunicate:SERial:SERVice?	Queries the state of the service request marker feature	6-19
IEEE-4888.1 GPIB Port-Specific		
SYSTem:COMMunicate:GPIB:ADDRess	Selects the GPIB bus address of the meter.	6-19
SYSTem:COMMunicate:GPIB:ADDRess?	Queries the GPIB bus address of the meter.	6-19
USB Port-Specific		
SYSTem:COMMunicate:USB:STREam	Enables the transmission of binary streaming data on the USB interface.	6-20
SYSTem:COMMunicate:USB:STREam?	Queries the transmission of binary streaming data on the USB interface.	6-20
Error Record Reporting and Collection		
Command	**Description**	**Page #**
Error Count Query		
SYSTem:ERRor:COUNT?	Queries the number of error records in the error queue	6-21
Error Query		
SYSTem:ERRor:NEXT?	Queries the next error record(s) in the error queue.	6-22
All Error Query		
SYSTem:ERRor:ALL?	Queries all error records in the error queue.	6-22

Table 6-2. Host Command Quick Reference (Sheet 3 of 8)

All Error Clear		
SYSTem:ERRor:CLEar	Clears all error records in the error queue.	6-22
Measurement Setup and Control		
Command	**Description**	**Page #**
Measurement Mode Select		
CONFigure:MEASure	Sets the meter measurement mode	6-22
CONFigure:MEASure?	Queries the meter measurement mode	6-22
Power Measurement Units Select		
CONFigure:PUNits	Sets the display measurement units for power measurements	6-23
CONFigure:PUNits?	Queries the display measurement units for power measurements	6-23
Display Mode Select		
CONFigure:DISPlay:PRImary CONFigure:DISPlay:STATistics CONFigure:DISPlay:PSTability CONFigure:DISPlay:TUNE CONFigure:DISPlay:TRENd	Sets the display mode.	6-23
CONFigure:PSTability:VMOde	Sets the position stability view mode to be used when position stability display mode is active.	6-23
CONFigure:PSTability:VMOde?	Queries the position stability view mode.	6-23
CONFigure:TUNE:VMOde	Sets the tune view mode to be used when tune display mode is active.	6-24
CONFigure:TUNE:VMOde?	Queries the tune view mode.	6-24
CONFigure:TREND:VMOde	Sets the trend chart view mode to be used when trend display mode and trend chart display sub mode are active.	6-24
CONFigure:TREND:VMOde?	Queries the trend chart view mode.	6-24
Area Correction		
CONFigure:AREA:CORRection	Enables or disables area correction.	6-24
CONFigure:AREA:CORRection?	Queries area correction.	6-24
CONFigure:AREA:APERture	Sets the aperture area	6-24
CONFigure:AREA:APERture?	Queries the aperture area	6-24
Analog Output Full Scale Voltage		
CONFigure:AOUT:FSCale	Selects the full scale output voltage at the analog output connector.	6-25
CONFigure:AOUT:FSCale?	Queries voltage at the analog output connector.	6-25
Speedup		
CONFigure:SPEedup:HOST	Selects the speedup mode for the host interface data output.	6-25
CONFigure:SPEedup:HOST?	Queries the speedup mode for the host interface data output.	6-25
CONFigure:SPEedup:AOUT	Selects the speedup mode for the analog output.	6-25

Table 6-2. Host Command Quick Reference (Sheet 4 of 8)

CONFigure:SPEedup:AOUT?	Queries the speedup mode for the analog output.	6-25
CONFigure:SPEedup:DISPlay	Selects the speedup mode for the panel numeric display.	6-25
CONFigure:SPEedup:DISPlay?	Queries the speedup mode for the panel numeric display.	6-25
CONFigure:SPEedup:TUNE	Selects the speedup mode for the panel tune display.	6-25
CONFigure:SPEedup:TUNE?	Queries the speedup mode for the panel tune display.	6-25
Display Data Smoothing		
CONFigure:AVERage:PULSe	Sets the display data smoothing window size in number of pulses.	6-26
CONFigure:AVERage:PULSe?	Queries the display data smoothing window size.	6-26
CONFigure:AVERage:TIME	Sets the display data smoothing window size in seconds.	6-26
CONFigure:AVERage:TIME?	Queries the display data smoothing window size.	6-26
Wavelength Correction		
CONFigure:WAVElength:CORRection	Enables or disables wavelength corrrection.	6-26
CONFigure:WAVElength:CORRection?	Queries wavelength corrrection.	6-26
CONFigure:WAVElength:WAVElength	Sets the operational wavelength.	6-27
CONFigure:WAVElength:WAVElength?	Queries the operational wavelength.	6-27
CONFigure:WAVElength:LIST	Sets the wavelength table entries for the meter.	6-27
CONFigure:WAVElength:LIST?	Queries the wavelength table entries.	6-27
Gain Compensation		
CONFigure:GAIN:COMPensation	Enables or disables gain compensation.	6-27
CONFigure:GAIN:COMPensation?	Queries gain compensation.	6-27
CONFigure:GAIN:FACTor	Sets the gain compensation factor	6-28
CONFigure:GAIN:FACTor?	Queries the gain compensation factor	6-28
Probe Zero		
CONFigure:ZERO	Sets the current sensor input voltage as the zero baseline voltage.	6-28
CONFigure:ZERO?	Queries the current sensor input voltage.	6-28
Range Select		
CONFigure:RANGe:SELect	Selects the meter measurement range.	6-28
CONFigure:RANGe:SELect?	Queries the meter measurement range.	6-28
CONFigure:RANGe:AUTO	Enables or disables automatic selection of the meter measurement range.	6-29
CONFigure:RANGe:AUTO?	Queries the meter measurement range.	6-29
Statistics Mode Control		
CONFigure:STATistics:BSIZe:PULSe	Sets the statistics batch size (pulses).	6-30
CONFigure:STATistics:BSIZe:PULSe?	Queries the statistics batch size.	6-30
CONFigure:STATistics:BSIZe:TIME	Sets the statistics batch size (time).	6-30

Table 6-2. Host Command Quick Reference (Sheet 5 of 8)

CONFigure:STATistics:BSIZe:TIME?	Queries the statistics batch size.	6-30
CONFigure:STATistics:RATE:PULSe	Sets the statistics sampling rate (pulses).	6-30
CONFigure:STATistics:RATE:PULSe?	Queries the statistics sampling rate (pulses).	6-30
CONFigure:STATistics:RATE:FREQuency	Sets the statistics sampling rate (time).	6-31
CONFigure:STATistics:RATE:FREQuency?	Queries the statistics sampling rate.	6-31
CONFigure:STATistics:RMOde	Selects the action to be taken at the end of a statistical batch.	6-31
CONFigure:STATistics:RMOde?	Queries the action to be taken at the end of a statistical batch.	6-31
CONFigure:STATistics:STARt	Terminates the current statistical batch and starts a new one.	6-31
CONFigure:STATistics:STOP	Terminates the current statistical batch if a batch is in progress.	6-32
Position Stability Mode Control		
CONFigure:PSTability:DURation	Sets the position stability cycle time.	6-32
CONFigure:PSTability:DURation?	Queries the position stability cycle time.	6-32
CONFigure:PSTability:STARt	Terminates the current position stability display cycle and starts a new one.	6-32
CONFigure:PSTability:STOP	Terminates the current position stability display cycle if a position stability display cycle is in progress.	6-33
Tune Mode Control		
CONFigure:TUNE:SCHart:ZOOM:VERTical	Sets the vertical zoom mode when the tune strip chart display mode is active.	6-33
CONFigure:TUNE:SCHart:ZOOM:VERTical?	Queries the vertical zoom mode when the tune strip chart display mode is active.	6-33
CONFigure:TUNE:SCHart:ZOOM:HORizontal	Sets the horizontal zoom mode when the tune strip chart display mode is active.	6-33
CONFigure:TUNE:SCHart:ZOOM:HORizontal?	Queries the horizontal zoom mode when the tune strip chart display mode is active.	6-33
CONFigure:TUNE:CLEar	Clears the tune strip or bar chart display, depending on which one is active.	6-33
Trend Mode Control		
CONFigure:TRENd:STARt	Terminates the current trend cycle and starts a new one.	6-34
CONFigure:TRENd:STOP	Terminates the current trend cycle if a cycle is in progress.	6-34
CONFigure:TRENd:BSIZe:PULSe	Sets the trend cycle duration.	6-34
CONFigure:TRENd:BSIZe:PULSe?	Queries the trend cycle duration.	6-34
CONFigure:TRENd:BSIZe:TIME	Sets the trend cycle duration.	6-35
CONFigure:TRENd:BSIZe:TIME?	Queries the trend cycle duration.	6-35
CONFigure:TRENd:RATE:PULSe	Sets the trend sampling rate.	6-35
CONFigure:TRENd:RATE:PULSe?	Queries the trend sampling rate.	6-35

Table 6-2. Host Command Quick Reference (Sheet 6 of 8)

CONFigure:TRENd:RATE:FREQuency	Sets the trend sampling rate.	6-35
CONFigure:TRENd:RATE:FREQuency?	Queries the trend sampling rate.	6-35
MMEMory:CATalog?	Queries trend data file mass storage information and a list of trend data files stored in the current working directory.	6-37
MMEMory:CDIRectory	Sets the current working directory.	6-38
MMEMory:CDIRectory?	Queries the current working directory.	6-38
MMEMory:MDIRectory	Creates a new directory.	6-38
MMEMory:DELete	Deletes a file.	6-38
MMEMory:RDIRectory	Removes a directory.	6-38
MMEMory:REName	Renames a file or directory.	6-39
MMEMory:COPY	Copies a source file to a destination.	6-39
MMEMory:STORe	Stores data generated from the last completed and unnamed trend cycle to a trend data file in mass storage.	6-40
MMEMory:NAME	Sets the name of the file that will apply when the next open command is sent.	6-41
MMEMory:OPEN	Opens the previously-named file for transmission by placing all data records contained in the file in the record transmit queue.	6-41
MMEMory:FETCh:NRECords?	Queries the number of unread data records available from the data stream of the currently-open trend data file.	6-41
MMEMory:FETCh:NEXT?	Queries the next unread and available data record(s) of the currently-open trend data file.	6-41
MMEMory:FETCh:ALL?	Queries all unread and available data records of the currently-open trend data file.	6-42
MMEMory:CLOSE	Closes the currently-open file.	6-42
Measurement Data Format		
CONFigure:READings:SEND	Selects which values are sent when sample data records are reported over the host interface.	6-44
CONFigure:READings:SEND?	Queries which values are sent when sample data records are reported over the host interface.	6-44
CONFigure:READings:HEADers	Selects whether or not data value identification strings will prefix data values reported over the host interface.	6-47
CONFigure:READings:HEADers?	Queries whether or not data value identification strings will prefix data values reported over the host interface.	6-47
CONFigure:READings:CONTinuous	Selects if data delivery is presented in a continuous stream or the last available data record.	6-48
CONFigure:READings:CONTinuous?	Queries type of data delivery.	6-48
Trigger Parameters		
TRIGger:SOURce	Selects the trigger source.	6-48

Table 6-2. Host Command Quick Reference (Sheet 7 of 8)

TRIGger:SOURce?	Queries the trigger source.	6-48
TRIGger:LEVel	Sets the trigger level.	6-48
TRIGger:LEVel?	Queries the trigger level.	6-48
TRIGger:SLOPe	Selects the external trigger edge.	6-49
TRIGger:SLOPe?	Queries the external trigger edge.	6-49
TRIGger:DELay	Selects the external trigger delay time.	6-49
TRIGger:DELay?	Queries the external trigger delay time.	6-49
Numeric Display Resolution		
CONFigure:RESolution:THERmopile	Sets the number of display digits used when a thermopile sensor is attached.	6-49
CONFigure:RESolution:THERmopile?	Queries the number of display digits used when a thermopile sensor is attached.	6-49
CONFigure:RESolution:OPTical	Sets the number of display digits used when an optical sensor is attached.	6-49
CONFigure:RESolution:OPTical?	Queries the number of display digits used when an optical sensor is attached.	6-49
CONFigure:RESolution:PYRoelectric	Sets the number of display digits used when an optical sensor is attached.	6-50
CONFigure:RESolution:PYRoelectric?	Queries the number of display digits used when an optical sensor is attached.	6-50
Sample Measurement Data Collection		
Command	**Description**	**Page #**
Data Gating		
INITiate	Enables measurement data collection.	6-50
ABORt	Disables measurement data collection.	6-51
Data Query		
FETCh:NRECords?	Queries the number of unread data records available at the time of the query.	6-51
FETCh:NEXT?	Queries the next unread available measurement data record(s) at the time of the query.	6-51
FETCh:ALL?	Queries all unread available measurement data records at the time of the query.	6-51
FETCh:MISSing?	Queries the missing data count due to a measurement data transmission queue full condition.	6-52
Statistics Data Collection		
Command	**Description**	**Page #**
Statistics Data Gating		
STATistics:INITiate	Enables statistical data collection	6-52
STATistics:ABORt	Disables statistics data collection	6-53
Statistics Data Query		
STATistics:FETCh:NRECords?	Queries the current number of unread statistics data records available	6-53

Table 6-2. Host Command Quick Reference (Sheet 8 of 8)

STATistics:FETCh:NEXT?	Queries the next unread available statistics data record(s)	6-53
STATistics:FETCh:ALL?	Queries all unread available statistics data records	6-53
STATistics:FETCh:MISSing?	Queries the missing record count due to a statistics data transmission queue full condition	6-54
Display		
Command	**Description**	**Page #**
Display Contrast		
DISPlay:CONTrast	Sets the display contrast.	6-54
DISPlay:CONTrast?	Queries the contrast value.	6-54
Display Text		
DISPlay:TEXT	Sets the display text in the measurement display area.	6-54
Text Clear		
DISPlay:CLEar	Clears the display text and enables measurement data to be displayed live.	6-55
Meter and Sensor Device Information		
Command	**Description**	**Page #**
Meter		
SYSTem:TIME	Sets the time maintained within the meter.	6-55
SYSTem:TIME?	Queries the time maintained within the meter.	6-55
SYSTem:DATE	Sets the date maintained within the meter.	6-55
SYSTem:DATE?	Queries the date maintained within the meter.	6-55
SYSTem:DATE:FORMat	Sets the panel display date format used by the meter.	6-55
SYSTem:DATE:FORMat?	Queries the panel display date format used by the meter.	6-55
SYSTem:INFormation:INSTrument:SNUMber?	Queries the meter serial number.	6-56
SYSTem:INFormation:INSTrument:CDATe?	Queries the calibration date of the meter.	6-56
SYSTem:INFormation:INSTrument:TYPE	Sets the meter type.	6-56
SYSTem:INFormation:INSTrument:TYPE?	Queries the meter type.	6-56
Sensor		
SYSTem:INFormation:PROBe:TYPE?	Queries the currently-connected sensor type.	6-56
SYSTem:INFormation:PROBe:MODel?	Queries the currently-connected sensor model.	6-57
SYSTem:INFormation:PROBe:SNUMber?	Queries the serial number of the sensor.	6-57
SYSTem:INFormation:PROBe:RESPonsivity?	Queries the currently-connected sensor calibration responsivity.	6-57
SYSTem:INFormation:PROBe:CDATe?	Queries the calibration date of the sensor.	6-57
SYSTem:INFormation:PROBe:TEMPerature?	Queries the head temperature of the sensor.	6-58
SYSTem:INFormation:PROBe:DIAMeter?	Queries the sensor diameter.	6-58

Commands and Queries

SCPI Common Commands

The SCPI Standard specifies a standard set of IEEE-488.2 common commands. All common commands and queries start with an asterisk.

IEEE-488.2 Common Commands

To maintain compatibility with the USB and RS-232 communication channels of the meter, only those commands which are common to all channels are supported.

Identification Query

Queries the meter identification string, such as model name, firmware version, and firmware date.

Query: *IDN?
Reply: “Coherent, Inc - LabMax - “ + <version> + “ - “ + <firmware date>

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

For example, a typical identification string looks like:

“Coherent, Inc - LabMax - V1.3 - Jul 05 2006” (note that the quotes are not transmitted)

System Options

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

Local Control Lockout

Remote Mode

This command places the meter in remote mode. The data wheel and all front panel buttons, except the power button, are ignored while remote mode is active. To cancel remote mode, either turn off the software controlling the meter or press any key on the meter to bring up a dialog that will allow remote mode to be canceled. Note: It is possible for the software to get out of sync with the meter if local control is taken while the application software is running.

Command: SYSTem:REMote

Query: None

Local Mode

This command places the meter in local mode. The data wheel and all front panel buttons are enabled while local mode is active.

Command: SYSTem:LOCal

Query: None

System Status

This query gets the system status. Status is returned in a string expressed in upper case hexadecimal integer form. The 32-bit status word is a bit-mapped status indicator. If a bit is set, the associated status is active; otherwise it is inactive. Table 6-3 describes the status bit mapping.

Table 6-3. Status Bit Definitions

Bit Number	Mask	Status Description
0	00000001	Battery is low
1	00000002	Sensor damage temperature is exceeded
2	00000004	Valid sensor is attached
3	00000008	USB flash drive is attached
4	00000010	Future use
5	00000020	Batch data collection is in progress
6	00000040	Trend data collection is in progress
7	00000080	Meter power is on (will always be 1)
8	00000100	Future use
9	00000200	Data logging to flash active
10	00000400	Data logging to in-memory FIFO active
11	00000800	Remote mode enabled
12	00001000	Host file copy in progress

Unspecified bits are reserved and will be zero.

Command: None

Query: SYSTem:STATus?
Reply: <status>

As an example, if the battery is low and the sensor damage temperature has been exceeded, the system status query will return:

00000003 (Battery is low, sensor damage temperature exceeded)

Backlight Control

On/Off State

This command controls the backlight on/off state. The backlight automatically turns off at the expiration of the backlight auto-off timer, if the backlight auto-off is enabled.

Command: DISPlay:BACKlight {DEFault|ON|OFF}
Default: ON

Query: DISPlay:BACKlight?
Reply: ON|OFF

Auto-Off Mode

The meter can be configured to automatically turn off the backlight after the specified front panel idle period. The backlight timeout value is expressed in minutes, rounded to the nearest integer. Specifying OFF disables the backlight timeout timer.

Under AC Power

This command controls the LCD backlight auto-off timeout timer when the meter is under AC power.

Command: SYSTem:OPTion:BACKlight:AOFF:ACPower
{DEFault|OFF|1..60}
Default: OFF

Query: SYSTem:OPTion:BACKlight:AOFF:ACPower?
Reply: OFF|1..60

Under Battery Power

This command controls the LCD backlight auto-off timer when the meter is under battery power.

Command: SYSTem:OPTion:BACKlight:AOFF:BPOWer
{DEFault|OFF|1..60}
Default: OFF

Query: SYSTem:OPTion:BACKlight:AOFF:BPOWer?
Reply: OFF|1..60

Power Auto-Off

This command sets the power auto-off timeout when the meter is under battery power. The power auto-off timeout value is expressed in minutes rounded to the nearest integer. The meter can be configured to automatically power off after the specified front panel idle period when the meter is under battery power. Setting the timeout to OFF will disable the power auto-off function.

Command: SYSTem:OPTion:POWer:AOFF
{DEFault|OFF|1..60}
Default is OFF

Query: SYSTem:OPTion:POWer:AOFF?
Reply: OFF|1..60

Meter Configuration Management

Meter configurations are stored as named files. If the software implementation requires a file extension for internal configuration file storage, the file extension is not used as part of the configuration file name.

The following rules apply to naming configuration files:

- The configuration name may use space characters, dash characters, and all alphabet and number characters
- The configuration name length will not exceed 40 characters
- The first character of the configuration name is not a space character
- Configuration name matching for comparison purposes is case-insensitive
- A configuration name containing the string “Factory Settings” is considered an invalid name

An attempt to specify an invalid configuration name in a command will raise error 101.

Catalog

This query gets the list of stored configuration files that was saved by the user. Note that the length of the meter response is limited to the maximum message size.

Command: None

Query: MEMory:STATe:CATalog?
Reply: <comma separated list of quoted configuration names>

Save

This command stores the current configuration to the named configuration file. The named configuration file is overwritten if the configuration name matches an existing configuration file. An attempt to save to the “Factory Settings” configuration raises error 101.

Command:
MEMory:STATe:SAVE <quoted configuration name>
Default: not applicable.

Query: None

Recall

This command loads and activates the configuration held in the named configuration file. An attempt to recall a non-existent configuration raises error 101.

Command: MEMory:STATe:RECall <quoted configuration name>
Default: not applicable.

Query: None

Delete

This command deletes the named configuration file. An attempt to delete a non-existent configuration raises error 101. An attempt to delete the “Factory Settings” configuration raises error 101.

Command: MEMory:STATe:DELete <quoted configuration name>
Default: not applicable.

Query: None

Rename

This command renames the named configuration file. Error 101 is raised if the source configuration does not exist. This Error 101 is raised if the destination configuration exists.

Command: MEMory:STATe:REName <quoted source configuration name>,<quoted destination configuration name>
Default: not applicable.

Query: None

Communications

Communications parameters may be changed remotely. Any changes to the communications settings take effect immediately after the command is processed and the handshaking response, if any, is transmitted.

Interface Select

This command selects the interface for host communication.

Command: SYSTem:COMMunicate:INTerface {DEFault|RS232|GPIB|USB}
Default: USB

Query: SYSTem:COMMunicate:INTerface?
Reply: RS232|GPIB|USB

Message Handshaking

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

Command: SYSTem:COMMunicate:HANDshaking {ON|OFF}

Reply: OK if ON is selected; otherwise no reply is sent

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

If handshaking is ON:

- Empty commands (commands with only whitespace characters) reply with “OK\r\n”
- Valid commands with valid data reply with “OK\r\n”
- Valid queries with valid data reply as explicitly defined elsewhere in this section, followed by “OK\r\n”
- Valid commands or queries which result in an error reply with “ERR<n>\r\n” where <n> is the error code number Available data is either measurement data records—see “Sample Measurement Data Collection” (p. 6-50)) or error records—see “Error Record Reporting and Collection” (p. 6-20).
- Unrecognized commands or queries reply with “ERR100\r\n”
- Error queuing occurs as explicitly defined elsewhere in this section

If handshaking is OFF:

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

Serial Port-Specific

Baud Rate

This command selects the transmit and receive baud rates together.

Command: SYSTem:COMMunicate:SERial:BAUD {DEFault|9600|19200|38400|57600|115200}
Default: 19200

Query: SYSTem:COMMunicate:SERial:BAUD?
Reply: 9600|19200|38400|57600|115200

Parity

This command selects the parity bit setting.

Command: SYSTem:COMMunicate:SERial:PARity
{DEFault|EVEN|ODD|NONE}
Default: NONE

Query: SYSTem:COMMunicate:SERial:PARity?
Reply: EVEN|ODD|NONE

Stop Bits

This command selects the number of stop bits used.

Command: SYSTem:COMMunicate:SERial:SBITs
{DEFault|1|2}
Default: 1

Query: SYSTem:COMMunicate:SERial:SBITs?
Reply: 1|2

Flow Control

This command selects the flow control method for meter to host communication. XON represents the XON/XOFF pacing method—see“Data Flow Control” (p. 6-2).

Command: SYSTem:COMMunicate:SERial:PACE
{DEFault|XON|NONE}
Default: NONE

Query: SYSTem:COMMunicate:SERial:PACE?
Reply: XON| NONE

Service Request

This command selects the state of the service request marker feature—see“Service Request” (p. 6-2).

Command: SYSTem:COMMunicate:SERial:SERVice
{DEFault|OFF|ON}
Default: OFF

Query: SYSTem:COMMunicate:SERial:SERVice?
Reply: OFF|ON

IEEE-488.1 GPIB Port-Specific

IEEE-488.1 is available only on the LabMax-TOP w/GPIB model.

Device Address

This command selects the GPIB bus address of the meter. The address value must be an integer value.

Command: SYSTem:COMMunicate:GPIB:ADDRess {DEFault|1..30}
Default: 1

Query: SYSTem:COMMunicate:GPIB:ADDRess?
Reply: 1..30

USB Port-Specific

Binary Streaming Data

This command enables the transmission of binary streaming data on the USB interface.

Command: SYSTem:COMMunicate:USB:STREam {DEFault|ON|OFF}
Default: OFF

Query: SYSTem:COMMunicate:USB:STREam?
Reply: ON|OFF

Error Record Reporting and Collection

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

<error code>,<quoted error string><CR><LF>

The host queries for errors in two steps. First, the host queries for the number of error records available (N) and 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.

The possible error strings are shown in Table 6-4.

Table 6-4. Error Codes and Description Strings (Sheet 1 of 2)

Error Code Number	Quoted Error String	Error Description
-350	“Queue overflow”	Error queue is full
-321	“Out of memory”	Meter internal memory is exhausted
-310	“System error”	Unexpected/unrecoverable hardware or software fault
-254	“Media full”	No more storage available on the mass storage volume
-200	“Execution error”	Command is out of order
0	“No error”	No error
100	“Unrecognized command/query”	The command or query is not recognized
101	“Invalid parameter”	The command or query parameter is invalid
200	“Directory does not exist”	The specified directory does not exist

Table 6-4. Error Codes and Description Strings (Sheet 2 of 2)

Error Code Number	Quoted Error String	Error Description
201	“File does not exist”	The specified file does not exist
202	“Directory already exists”	The specified directory already exists
203	“File already exists”	The specified file already exists
204	“Directory is not empty”	The specified directory is not empty
205	“File query is not possible”	The file query is not possible because the file is not opened
206	“File to open not named”	The file open is not possible because the named file has not been named

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

Error -321 is raised when there is an internal memory allocation error. This error typically happens when malloc(), calloc(), or strdup() fails and usually leads to an unrecoverable meter firmware condition.

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

Error -254 is raised when an attempt to write a trend data file to the local or USB mass storage volumes exceeds the storage limit of the volume. When a mass storage volume becomes full, the growing file that caused the error is immediately closed and error -254 is raised.

Error -200 is raised when a file name/open/close sequence happens out of order.

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

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

The remaining errors are raised for specific mass storage operational errors described elsewhere in this section.

Error Count Query

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

Command: none

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

Error Query

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

Command: none

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

All Error Query

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

After the completion of the reply transmission:

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

Command: none

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

All Error Clear

This command clears all error records in the error queue.

Command: SYSTem:ERRor:CLEar

Query: none

Measurement Setup and Control

The meter may be configured to measure data through the host interface or the front panel. Many of the setup commands have an identical corresponding host command.

Measurement Mode Select

This command sets the meter measurement mode to select either power (Watts) or energy (Joules) measurement mode.

Command: CONFigure:MEASure {DEFault|J|W}
Default: W (Watts) mode when a thermopile or optical sensor is attached and J (Joules) mode when a pyroelectric sensor is attached.

Query: CONFigure:MEASure?
Reply: J|W

The command is ignored when an optical sensor is attached or if a valid sensor is not attached.

Power Measurement Units Select

This command sets the display measurement units for power measurements (Watts or dBm).

Command: CONFigure:PUNits {DEFault|W|DBM}
Default: W (Watts)

Query: CONFigure:PUNits?
Reply: W|DBM

Display Mode Select

This command sets the display mode.

Command: CONFigure:DISPlay:PRImary

Command: CONFigure:DISPlay:STATistics

Command: CONFigure:DISPlay:PSTability

Command: CONFigure:DISPlay:TUNE

Command: CONFigure:DISPlay:TRENd

Query: None

The position stability display mode command (CONF:DISP:PST) is ignored if an LM sensor is not attached.

The command header that follows CONFigure:DISPlay: has the function shown in Table 6-5.

Table 6-5. Display Mode Headers

Header	Display Mode
PRImary	Non-statistics
STATistics	Statistics
PSTability	Position stability
TUNE	Tune
TRENd	Trend

Display View Mode Select

Position Stability View Mode

This command sets the position stability view mode to be used when position stability display mode is active.

Command: CONFigure:PSTability:VMOde
{DEFault|SCRoll|FTSCreen}
Default: SCRoll

Query: CONFigure:PSTability:VMOde?
Reply: SCR|FTSC

Tune View Mode

This command sets the tune view mode to be used when tune display mode is active.

Command: CONFigure:TUNE:VMOde
{DEFault|SCHart|BCHart}
Default: SCHart

Query: CONFigure:TUNE:VMOde?
Reply: SCH|BCH

Trend Chart View Mode

This command sets the trend chart view mode to be used when trend display mode and trend chart display sub mode are active.

Command: CONFigure:TREND:VMOde
{DEFault|SCRoll|FTSCreen}
Default: SCRoll

Query: CONFigure:TREND:VMOde?
Reply: SCR|FTSC

Area Correction

Enable/Disable State

This command enables or disables area correction.

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

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

Aperture Area

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

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

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

Analog Output Full Scale Voltage

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

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

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

Speedup

Host Data Output

This command selects the speedup mode for the host interface data output.

Command: CONFigure:SPEedup:HOST
{DEFault|OFF|ON}
Default: ON

Query: CONFigure:SPEedup:HOST?
Reply: OFF|ON

Analog Output

This command selects the speedup mode for the analog output.

Command: CONFigure:SPEedup:AOUT
{DEFault|OFF|ON}
Default: ON

Query: CONFigure:SPEedup:AOUT?
Reply: OFF|ON

Panel Numeric Display

This command selects the speedup mode for the panel numeric display.

Command: CONFigure:SPEedup:DISPlay
{DEFault|OFF|ON}
Default: ON

Query: CONFigure:SPEedup:DISPlay?
Reply: OFF|ON

Tune Display

This command selects the speedup mode for the panel tune display.

Command: CONFigure:SPEedup:TUNE
{DEFault|OFF|ON}
Default: ON

Query: CONFigure:SPEedup: TUNE?
Reply: OFF|ON

Display Data Smoothing

Display data smoothing is controlled differently, depending on the type of sensor attached.

Pulses

This command sets the display data smoothing window size expressed in number of pulses rounded to the nearest integer. This command applies only when a pyroelectric sensor is attached. Display data smoothing is not active in Joules mode when a thermopile sensor is attached.

Command: CONFigure:AVERage:PULSe
{DEFault|OFF|AUTO|2..999}
Default: AUTO

Query: CONFigure:AVERage:PULSe?
Reply: OFF|AUTO|2..999

Time

This command sets the display data smoothing window size expressed in seconds rounded to the nearest integer. This command applies only when a thermopile or optical sensor is attached in Watts mode.

Command: CONFigure:AVERage:TIME
{DEFault|OFF|AUTO|1..60}
Default: AUTO

Query: CONFigure:AVERage:TIME?
Reply: OFF|AUTO|1..60

Wavelength Correction

Enable/Disable State

This command enables or disables wavelength corrrection.

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

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

Operational Wavelength

This command sets the operational wavelength expressed in units of nm rounded to the nearest integer. When MIN is specified, the minimum allowable wavelength for the attached sensor is used. When MAX is specified, the maximum allowable wavelength for the attached sensor is used. Otherwise, the range of wavelengths permitted for this command is controlled by MIN and MAX.

Command: CONFigure:WAVElength:WAVElength
{MIN|MAX|1..99999}
Default: not applicable.

Query: CONFigure:WAVElength:WAVElength?
[MAXimum|MINimum]
Reply: 1..99999

Using the optional MAX and MIN parameters results in the maximum or minimum wavelengths that can be used for the currently connected sensor. If there is no sensor attached, the maximum is 99999 nm and the minimum is 1 nm.

The numerically-specified wavelength must be one of the wavelengths in the wavelength table for the attached sensor type. Error 101 is raised if the numerically specified wavelength is not one of the wavelengths in the wavelength table for the attached sensor type. If no sensor is attached, any numerically-specified wavelength within the range stated above is accepted.

Wavelength Table Definition

This command sets the wavelength table entries for the meter. The old list is replaced by the list of wavelengths specified in the command. Each wavelength is expressed in units of nm rounded to the nearest integer. Each wavelength ranges from 1 to 99999. Error 101 is raised if the list length exceeds 100 entries. Note that the list returned by the query will always include the calibration wavelength of the current sensor.

Command: CONFigure:WAVElength:LIST
<comma separated list of wavelengths>
Default: not applicable.

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

Gain Compensation

Enable/Disable State

This command enables or disables gain compensation.

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

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

Factor

This command sets the gain compensation factor. The gain compensation factor has no units.

Command: CONFigure:GAIN:FACTor
{DEFault|0.001..100000.0}
Default: 1.0

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

Probe Zero

This command sets the current sensor input voltage as the zero baseline voltage. Using command will result in no internal action taken if a pyroelectric sensor is attached or if a valid sensor is not attached.

Command: CONFigure:ZERO

The zero query returns the offset in Watts used to generate the zeroed output if a valid thermopile or optical sensor is attached. Otherwise, 0 is returned.

Query: CONFigure:ZERO?
Reply: <zero offset in Watts>

Range Select

Range Value Select

This command selects the meter measurement range expressed in the units defined under the current measurement mode (Joules or Watts). The measurement range is selected by expressing the maximum expected measurement, which must be greater than 0.0. The <granted full scale range> value is the lowest available full-scale range that can measure the <maximum expected measurement>. For example, if the list of available ranges is
3 mW, 30 mW and 300 mW, and the maximum expected measurement is 10 mW, the granted range is 30 mW. The <granted full scale range> is the top range available if the <maximum expected measurement> exceeds the top range value.

Command: CONFigure:RANGe:SELect
<maximum expected measurement>
Default: not applicable.

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

Using the optional MAX and MIN parameters will result in the maximum or minimum available range, respectively. It is possible that the range returned from the query will not be the same as the range selected, if auto ranging is active.

Auto Range Enable/Disable State

This command enables or disables automatic selection of the meter measurement range. The meter hunts for the best measurement range for the current sensor 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 sensor is attached.

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

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

Statistics Mode Control

Sets statistics calculation parameters to be used in the statistics operating mode.

Display Item Select

This command selects the statistics display items, which takes effect at the end of the current statistical batch. The data argument is a comma-separated list of one or more tokens shown below. At least one token must be specified. The tokens may be specified in any order. Duplicated tokens are ignored. Error 101 is raised if the list length exceeds 10 entries.

One or more display items may be selected but only the first six list items are displayed. The query returns all selected tokens—including non-displayed tokens—following the order stated in the reply list below.

Command: CONFigure:STATistics:DISPlay
{DEFault|MEAN,MIN,MAX,STDV,1SIG,2SIG,3SIG,RANGe,DOSE,MISSed}
Default: MEAN,MIN,MAX,STDV

Query: CONFigure:STATistics:DISPlay?
Reply:
MEAN,MIN,MAX,STDV,1SIG,2SIG,3SIG,RANGe,DOSE,MISSed

Batch Size

Pulses

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. This command applies only under one of the following conditions:

- a pyroelectric sensor is attached
- a thermopile sensor is attached and Joules mode is selected

Command: CONFigure:STATistics:BSIZe:PULSe {DEFault|2..99999}
Default: 100

Query: CONFigure:STATistics:BSIZe:PULSe?
Reply: 2..99999

Time

This command sets the statistics batch size, which takes effect at the end of the current statistical batch. The batch size includes 0 to 999 days and is expressed in units of days:hours:minutes:seconds**s**. Each numeric component of hours:minutes:seconds must be an integer. Days must range from 0 to 999. Hours must range from 0 to 24. Minutes must range from 0 to 59. Seconds must range from 0 to 59. This command applies only when a thermopile or optical sensor is attached in Watts mode.

Command: CONFigure:STATistics:BSIZe:TIME {DEFault|00:00:01..24:00:00}
Default: 00:01:00

Query: CONFigure:STATistics:BSIZe:TIME?
Reply: 00:00:01..24:00:00

Sampling Rate

Pulse Event Based Measurements

This command sets the statistics sampling rate, which takes effect at the end of the current statistical batch. The sampling rate units are expressed pulses rounded to the nearest integer. This command applies only under one of the following conditions:

- a pyroelectric sensor is attached
- a thermopile sensor is attached and Joules mode is selected

Measurement data is added to the batch on a sub-sampled basis ranging from as low as 1 pulse added per 99999 measured to as high as 1 pulse added per 1 measured. The statistics sampling rate will indicate the number of pulses that will be measured for every one pulse added to the batch.

Command: CONFigure:STATistics:RATE:PULSe
{DEFault|1..99999}
Default: 1

Query: CONFigure:STATistics:RATE:PULSe?
Reply: 1..99999

Time Based Measurements

This command sets the statistics sampling rate, which takes effect at the end of the current statistical batch. The sampling interval rate is expressed in units of samples per second. This command applies only when a thermopile or optical sensor is attached and is in Watts mode.

The sampling rate is 1, 2, 5, or 10 (max.) samples/sec. The true sampling rate is integer submultiples of 10 samples/sec as the internal sensor sampling rate is fixed at exactly 10 samples/sec.

Command: CONFigure:STATistics:RATE:FREQuency
{DEFault|1.157E-5..1.0E1}
Default: 1.0E1

Query: CONFigure:STATistics:RATE:FREQuency?
Reply: 1.157E-5..1.0E1

Restart Mode

This command selects the action to be taken at the end of a statistical batch. AUTomatic begins a new batch immediately upon logging the data from the previous batch. MANual requires the start signal—see “Start a New Batch” (p. 6-31).

Command: CONFigure:STATistics:RMOde
{DEFault|MANual|AUTomatic}
Default: MANual

Query: CONFigure:STATistics:RMOde?
Reply: MAN|AUT

Batch Initiation and Termination

Start a New Batch

This command terminates the current statistical batch and starts a new one.

Command: CONFigure:STATistics:STARt

Query: None

The command is ignored if statistics display mode is not active.

Stop a Batch

This command terminates the current statistical batch if a batch is in progress.

Command: CONFigure:STATistics:STOP

Query: None

The command is ignored if statistics display mode is not active or a batch is not in progress.

Position Stability Mode Control

Cycle Duration

This command sets the position stability cycle time, which takes effect at the end of the current position stability cycle. The position stability cycle time is expressed in units of hours:minutes:seconds. Each numeric component of hours:minutes:seconds must be an integer. Hours must range from 0 to 24. Minutes must range from 0 to 59. Seconds must range from 0 to 59. This command applies only when a quad thermopile sensor is attached in one of the position stability display modes.

Command: CONFigure:PSTability:DURation
{DEFault|00:00:01..24:00:00}
Default: 00:01:00

Query: CONFigure:PSTability:DURation?
Reply: 00:00:01..24:00:00

Cycle Initiation and Termination

Start a New Cycle

This command terminates the current position stability display cycle and starts a new one.

Command: CONFigure:PSTability:STARt

Query: None

The command is ignored if position stability display mode is not active.

Stop a Cycle

This command terminates the current position stability display cycle if a position stability display cycle is in progress.

Command: CONFigure:PSTability:STOP

Query: None

The command is ignored if position stability display mode is not active or a position stability display cycle is not in progress.

Tune Mode Control

Zoom Level

Strip Chart

Vertical

This command sets the vertical zoom mode when the tune strip chart display mode is active. The vertical zoom mode value is unit-less.

Command: CONFigure:TUNE:SCHart:ZOOM:VERTical {DEFault|AUTO|1|2|5|10|20}
Default: AUTO

Query: CONFigure:TUNE:SCHart:ZOOM:VERTical?
Reply: AUTO|1|2|5|10|20

Horizontal

This command sets the horizontal zoom mode when the tune strip chart display mode is active. The horizontal zoom mode value is unit-less.

Command: CONFigure:TUNE:SCHart:ZOOM:HORizontal {DEFault|1|2|5|10|20}
Default: 1

Query: CONFigure:TUNE:SCHart:ZOOM:HORizontal?
Reply: 1|2|5|10|20

Clear

This command clears the tune strip chart display.

Command: CONFigure:TUNE:CLEar

Query: None

Trend Mode Control

The trend mode is controllable from the CONFigure and MMEMory command nodes from the host interface. The CONFigure commands provide all host configuration of the trend mode operation. The

MMEMory commands provide all data file management and data file transfer commands and queries for data generated when trend display mode is active.

Operational Control

Cycle Initiation and Termination

Start a New Cycle

This command terminates the current trend cycle and starts a new one. An optional, fully-qualified filename may be included to specify the location where the trend data will be stored. Fully-qualified filenames are defined under the heading, “Data Storage” (p. 6-36). If a filename is not specified, the data will be buffered internally and may be saved at a later time using mass memory commands.

Command:
CONFigure:TRENd:STARt [<quoted fully qualified filename>]

Query: None

The command is ignored if trend display mode is not active.

Stop a Cycle

This command terminates the current trend cycle if a cycle is in progress.

Command: CONFigure:TRENd:STOP

Query: None

The command is ignored if trend display mode is not active or a trend cycle is not in progress.

Cycle Parameters

Cycle Duration

Pulses

This command sets the trend cycle duration, which takes effect at the end of the current trend cycle. The trend cycle duration units are pulses rounded to the nearest integer value. This command applies only under one of the following conditions:

- a pyroelectric sensor is attached
- a thermopile sensor is attached and Joules mode is selected

Command: CONFigure:TRENd:BSIZe:PULSe
{DEFault|2..99999}
Default: 10

Query: CONFigure:TRENd:BSIZe:PULSe?
Reply: 2..99999

Time

This command sets the trend cycle duration, which takes effect at the end of the current trend cycle. The trend cycle duration is expressed in units of hours:minutes:seconds. Hours must range from 0 to 24. Minutes must range from 0 to 59. Seconds must range from 0 to 59. This command applies only when a thermopile or optical sensors is attached in Watts mode.

Command: CONFigure:TRENd:BSIZe:TIME
{DEFault|00:00:01..24:00:00}
Default: 00:01:00

Query: CONFigure:TRENd:BSIZe:TIME?
Reply: 00:00:01..24:00:00

Sampling Rate

Pulse Event Based Measurements

This command sets the trend sampling rate, which takes effect at the end of the current trend cycle. The sampling rate units are expressed pulses rounded to the nearest integer. This command applies only under one of the following conditions:

- A pyroelectric sensor is attached
- A thermopile sensor is attached and Joules mode is selected

Measurement data is added to the trend on a sub-sampled basis ranging from as low as 1 pulse added per 99999 measured to as high as 1 pulse added per 1 measured. The trend sampling rate indicates the number of pulses that are measured for every one pulse added to the trend.

Command: CONFigure:TRENd:RATE:PULSe
{DEFault|1..99999}
Default: 1

Query: CONFigure:TRENd:RATE:PULSe?
Reply: 1..99999

Time Based Measurements

This command sets the trend sampling rate, which takes effect at the end of the current trend cycle. The sampling interval rate is expressed in units of samples per seconds. This command applies only when a thermopile or optical sensor is attached in Watts mode.

The sampling rate is 1, 2, 5, or 10 (max.) samples/sec. The true sampling rate is integer sub-multiples of 10 samples/sec as the internal sensor sampling rate is fixed at exactly 10 samples/sec.

Command: CONFigure:TRENd:RATE:FREQuency {DEFault|1.157E-5..1.0E1}
Default: 1.0E1

Query: CONFigure:TRENd:RATE:FREQuency?
Reply: 1.157E-5..1.0E1

Data Storage

Trend mode data storage (also known as mass memory) is in USB and/or internal flash memory. Data is stored in files within a hierarchical directory-based file system.

The full file format is \<volume>\[<directory>[\<directory>]…]. Files and directories are not limited to the 8.3 format. A fully-qualified combined directory path and file name will not exceed 260 characters in length. Valid directory and file name characters are ASCII characters 0x20-0x7E, except for the characters '<', '>', ':', '"' (double quote), '/' (forward slash), '\' (backward slash), and '|'.

The file name will not end with a trailing space or period. (Note that the graphical interface of the meter may only allow user entry of a subset of the file name characters supported by the host interface.) The only file names considered valid for trend data storage purposes are Comma Separated Value (CSV) files, and in all cases the ".csv" file name extension are appended to valid trend data file names.

There are two mass storage volumes: removable USB flash memory and local flash memory. The string "usb" identifies USB flash memory volume. The string "loc" identifies local flash memory volume.

Volume name, directory name, and file name matching is case-sensitive for comparison and file storage purposes. The case is preserved at all times.

Forward slashes ('/') and backward slashes ('\') separating <directory> and <volume> entries in the full file and directory formats are accepted interchangeably on input. Backward slashes are always used on full file and directory format outputs. The full file string format is a quoted concatenation of the full directory path, followed by a slash separator, which is followed by the file name.

A file or directory may be specified as a relative name (non-absolute path, starting with the conventional "." and ".." relative symbols), or a fully-qualified absolute name in command arguments. Relative names are relative to the current working directory—see "Change Directory" (p. 6-38). Files and directories returned in replies are absolute names.

Directory and File Manipulation

Directory List

Note: SCPI specifies using the term "catalog" in lieu of the term "directory" as the header to request a list of files contained in a directory. In that context, catalog and directory are synonymous.

This query gets trend data file mass storage information and a list of trend data files stored in the current working directory. The reply to the query returns data in comma-separated list format. The first list item is the estimated number of allocated trend data storage bytes used on the current volume. The second list item is the estimated number of allocated trend data storage bytes remaining for new trend data storage. All remaining list items are file entries. Each file entry is a trio of data items. Each trio is identified by position only. The first item in a file entry trio is the quoted file name. The second item is the file type, with ASC always representing ASCII file type. The third item is the file size in bytes (an estimated value in the case of active open files).

For example, a valid reply might be:

10012321,392323,"file1.csv",ASC,1250,"file2.csv",ASC,3250

The reply string indicates the following:

- 10012321 bytes of storage allocated for trend files are in use
- 392323 bytes of storage allocated for trend files are available for new trend data file storage
- There are two files in the current working directory: file1.csv and file2.csv
- file1.csv is an ASCII file containing 1250 bytes
- file2.csv is an ASCII file containing 3250 bytes

Note that the length of the meter response is limited to the maximum message size.

Command: None

Query: MMEMory:CATalog?
Reply: <bytes used>,<bytes available>,<comma separated list of file entries>

Change Directory

This command sets the current working directory. The command argument is a quoted string indicating the directory. An attempt to set the current working directory to a non-existent directory will raise error 200. The query gets the quoted current working directory. The current working directory is the root directory of the internal data storage directory tree after a power off/on cycle.

Command:
MMEMory:CDIRectory <quoted directory name>
Default: not applicable.

Query: MMEMory:CDIRectory?
Reply: <quoted current working directory name>

Create Directory

This command creates a new directory. The command argument is a quoted string indicating the directory. An attempt to create an existing directory will raise error 202. An attempt to create a directory using the name of an existing file will raise error 202. An attempt to create a new directory when the storage volume is full will raise error -254.

Command:
MMEMory:MDIRectory <quoted directory name>
Default: not applicable.

Query: None

Delete File

This command deletes a file. The command argument is a quoted string indicating the file, including the ".csv" file name extension. An attempt to delete a non-existent file will raise error 201. An attempt to delete a file being populated by the currently active trend cycle will raise error 101. An attempt to delete a file open for file transfer will raise error 101.

Command: MMEMory:DELete <quoted file name>
Default: not applicable.

Query: None

Remove Directory

This command removes a directory. An attempt to remove a directory that does not exist will raise error 200. An attempt to remove a directory that contains files or subdirectories will raise error 204.

Command:
MMEMory:RDIRectory <quoted directory name>
Default: not applicable.

Query: None

Rename File or Directory

This command renames a file or directory. Only directories and ".csv" files may be renamed using this command. Renaming a file requires that the ".csv" file name extension be specified for both the original file name and the new file name. An attempt to rename a file or directory that does not exist will raise error 201. An attempt to rename a file or directory to a file or directory that already exists will raise error 202 or 203, depending if the original file is a directory or a file. An attempt to rename a file being populated by the currently-active trend cycle will raise error 101. An attempt to rename a file open for file transfer will raise error 101. An attempt to rename a file or directory when the storage media is full will raise error -254.

Command: MMEMory:REName <quoted original file or directory name>,<quoted new file or directory name>
Default: not applicable.

Query: None

Copy File

This command copies a source file to a destination. The <quoted source> parameter indicates a relative or absolute source path to an existing file. The <quoted destination> parameter may indicate a relative or absolute path to a new non-existent destination file or an existing destination directory. The current working directory is assumed if the directory component of either source or destination path is omitted. A duplicate of the source file is created with the destination file name in the specified directory, if the destination parameter represents a file. A duplicate of the source file is created with the same source file name in the specified directory, if the destination parameter represents a directory. Copying a file requires that the ".CST" file name extension be specified for source files and destination file names (not destination directories). An attempt to copy a file that does not exist will raise error 201. An attempt to copy a file to a destination file that already exists will raise error 202 or 203, depending if the destination is a directory or a file. An attempt to copy a file when the storage media is full will raise error -254. An attempt to copy a source file that is currently in use will raise error 101.

Note that file copies may be lengthy operations and, for this reason, they are performed in the background. The result code returned by this command represents a “good faith” effort at predicting the results of the subsequent copy operation. If the background copy ultimately fails, error -200 is raised after the initial reply to this command has been returned. The system status word contains a bit to indicate that a host file copy is in progress. The host may check this bit to see if any copies are in progress.

Command:
MMEMory:COPY <quoted source>,<quoted destination>
Default: not applicable.

Query: None

Store Data to File

This command stores data generated from the last completed and unnamed trend cycle since the last power off/on cycle to a trend data file in mass storage. This command is ignored if a trend cycle is in progress. This command is ignored if no trend cycle has completed since the last power off/on cycle. An attempt to operate on a file being populated by the currently-active trend cycle will raise error 101. An attempt to store to a file open for file transfer will raise error 101.

Command: MMEMory:STORe <quoted file name>
Default: not applicable.

Query: None

File Transfer to Host

The host interface provides facility for transferring a trend data file in meter mass storage to the host computer via the host interface. The model for the facility will be:

1. Set file name
2. Open file
3. Fetch data record(s)
4. Close file

Only one file will be open at any time. Failing to follow the above order for file data access will raise error -200. The open/close state of a file will not persist across after a power off/on cycle. All files will be closed after a power off/on cycle.

Data records are defined as a single ASCII line in a comma-separated values data file. Data records are fetched in start-to-finish sequential order. Each data record is removed from the open file data stream as it is transmitted, until all data records have been read from the data stream.

Name File to Open

This command sets the name of the file that will apply when the next open command is sent. An attempt to set the name of a file while a previously opened file remains open will raise error 101

Command: MMEMory:NAME <quoted file name>
Default: not applicable.

Query: None

Open Named File

The command opens the previously-named file for transmission by placing all data records contained in the file in the record transmit queue. An attempt to open a file that has not been named will raise error 206. An attempt to open a file that does not exist will raise error 201. An attempt to open a file being populated by the currently active trend cycle will raise error 101.

Command: MMEMory:OPEN

Query: None

File Record Count Query

This query gets the number of unread data records available from the data stream of the currently-open trend data file. An attempt to issue this query while a file is not open will raise error 205.

Command: None

Query: MMEMory:FETCh:NRECords?
Reply: <count of records available>

Fetch Next Available Record(s)

The query gets the next unread and available data record(s) of the currently-open trend data file. An attempt to issue this query while a file is not open will raise error 205. An attempt to fetch more data records than are available will result in the exact number of data records available being transmitted.

As the meter transmits each data record:

- The data record is permanently removed from the record transmit queue

- The queued data record count decrements by one

Command: None

Query: MMEMory:FETCh:NEXT? [<record count>]
Reply: <next available record(s)>

Fetch All Available Records

This query gets all unread and available data records of the currently open trend data file.

After the completion of the reply transmission:

- The record transmit queue will be empty
- The queued data record count will be zero

Command: None

Query: MMEMory:FETCh:ALL?
Reply: <all available records>

Close Named File

This command closes the currently-open file. This command is ignored if a file is not open.

Command: MMEMory:CLOSE

Query: None

Measurement Data Format

The data format commands are used to configure the form in which the meter sends measurement data and statistical data to the host. Data records are sent to the host in ASCII text form. A data record is a set of one or more comma-delimited data values generated at the same instant, ending in "<CR><LF>".

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

Two types of data records are available to the host: Sample and Statistics. *Sample* data records that represent data from a single measurement pulse or sample are available anytime the meter has acquired data and sample data logging has been initialized. *Statistic* data records are available when statistics mode is active, and when one or more statistical batches have been completed and statistics data logging has been initialized.

Sample Data Record Format

The following information is available with each data record:

- Measurement value in "%.3E" format (when pyroelectric sensors are connected) and "%.4E" format (for any other sensor type)
- Quad Sensor X distance in MM in "%.1f" format (data is 0 if quad sensor is not used)
- Quad Sensor Y distance in MM in "%.1f" format (data is 0 if quad sensor is not used)
- Coded format ID indicating the exact format string used for meter measurement display—refer to Table 6-6 (p. 6-44) for coded format ID definitions.
- Coded engineering units scale multiplier ID—refer to Table 6-6 (p. 6-44) for coded scale multipler ID definitions.
- Encoded Units ID byte.
    - Bit 7 indicates the measurement value units, SET indicates Watts, CLEAR indicates Joules
    - Bit 6 indicates if units represent area, SET indicates units are in CM^2, CLEAR indicates no area
    - Bits 5-0 represent the following units:
        - Femto
        - Pico
        - Nano
        - Micro
        - Milli
        - Fundamental
        - Kilo
        - Mega
        - Giga
- Flags—defined in Table 6-7 (p. 6-46)).
- Pulse period in microseconds (valid if a pyroelectric sensor is attached)
- Sequence number

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

- With every pulse when a thermopile sensor is attached and Joules mode is selected
- 10 times per second when a thermopile or optical sensor is attached and Watts mode is selected
- With every pulse when a pyroelectric sensor is attached

The type of data that will be collected depends entirely on which mode is currently selected: Joules mode will collect only joules data and Watts mode will collect only watts data.

Since thermopile and optical power measurements are continuous in nature (not event-based as with pyroelectric sensors), the delivery of this data may be configured as a stream of sampled points or simply the last point recorded—see “Continuous Data Delivery Mode” (p. 6-48).

The host may configure the presentation of data in a record. Data ID tags and content are configurable. The host may control the expression of data ID tags that precede each data item in a batch record. The host may control the data contents and the expression of data ID tags that precede each data item—see “Sample Data Value Set Send” (p. 6-44) and “Data Value Headers” (p. 6-47).

Sample Data Value Set Send

This command—which takes effect at the next data measurement taken (but not already queued)—selects which values are sent when sample data are reported over the host interface. One or more of the selections from Table 6-6 may be selected.

Table 6-6. Measurement Data Value Selections (Sheet 1 of 2)

Tokens	Data Description	Expressed In
PRI	Primary data value (includes Watts or Joules)	Scientific notation (for example, “2.88E-3”)
QUAD	Quad distance X/Y data in mm (valid only when an LM sensor is attached)	Two floating point values in X,Y order (for example, “-1.2,+1.5”)

Table 6-6. Measurement Data Value Selections (Sheet 2 of 2)

Tokens	Data Description	Expressed In
FMT	Primary data value display format	Coded print format ID followed by a "/" followed by a coded engineering units scale multiplier (for example, 5/3 represents a %6.2f print format string and a 1.0E-9 engineering units scake multipler). Coded IDs are as follows: Coded Print Format IDs 1. "%4.0f" 2. "%5.1f" 3. "%5.2f" 4. "%6.1f" 5. "%6.2f" 6. "%6.3f" 7. "%7.2f" 8. "%7.3f" 9. "%7.4f" 10. "%8.3f" 11. "%8.4f" 12. "%8.5f" Coded Scale Multiplier IDs 1. 1.0E-15 2. 1.0E-12 3. 1.0E-9 4. 1.0E-6 5. 1.0E-3 6. 1.0 7. 1.0E+3 8. 1.0E+6 9. 1.0E+9 10. 1.0E+12 11. 1.0E+15
UNIT	Primary data value display units	String format (for example, "mW/cm2")
PER	Pulse period in microseconds	32-bit unsigned integer form
FLAG	Flags	8-bit hexadecimal integer form
SEQ	Sequence ID	32-bit unsigned integer form

The data argument is a comma-separated list of one or more tokens shown below and in Table 6-6. At least one token must be specified. The tokens may be specified in any order. Duplicated tokens will be ignored. Error 101 will be raised if the list length exceeds 7 entries.

The presentation of the data items in a data record is: PRI, QUAD, FMT, UNIT, PER, FLAG, then SEQ order, depending on which tokens were specified.

The labels in the former list also serve as data header strings—see "Data Value Headers" (p. 6-47).

The query returns all selected tokens following the order stated in the reply list below.

Command: CONFigure:READings:SEND {DEFault|PRI,QUAD,FMT,UNIT,PER,FLAG,SEQ}
Default: PRI

Query: CONFigure:READings:SEND?
Reply: PRI,QUAD,FMT,UNIT,PER,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, uppercase hexadecimal number. Each bit has a qualification meaning as described in Table 6-7.

Table 6-7. FLAG Bit Definitions

Bit Position	Hex Bit Mask	Qualification Meaning	Data Error String
0	01	Minimum baseline error	BCLIP
1	02	Overrange error	OVR
2	04	Pulse sampled data	(none)
3	08	Negative power	(none)
6	40	Measurement is sped up	(none)
7	80	Sample included in TREND	(none)

Unspecified bits are reserved and will be 0.

The appropriate data error string indicated above will replace the PRI measurement value if a data record is generated with a data error. In situations where more than one flag condition is set, the lowest bit position condition will be indicated in the PRI measurement value.

As an example, indicating to send PRI and FLAG, the host interface could send the following data records:

PRI=1.449E-03,FLAG=00 (*this record shows a data value of 1.449 mJ and no flag bits set*)

PRI=OVR,FLAG=02 (*this record shows an invalid data value with the overrange bit set*)

Statistics Data Record Format

If statistics mode is active, the following data is available in a single data record at the completion of collection of a batch:

- AVG (mean of all pulses in batch, formatted as %.3E for pyroelectric sensors and %.4E for all other sensor types)

- DEV (standard deviation of the batch, formatted as %.3E)
- MIN (minimum measurement of the batch)
- MAX (maximum measurement of the batch, formatted as %.3E for pyroelectric sensors and %.4E for all other sensor types)
- DOSE (formatted as %.3E and only valid when a pyroelectric sensor is attached)
- MISSED (missed pulse count, formatted as a decimal integer—valid only when a pyroelectric sensor is attached with external triggering selected, or 0 otherwise)
- SEQ (batch sequence number, incremented once for each new set of batch results and formatted as a decimal integer)

The delivery of these data records may be configured as a buffered stream of batch results or simply the last batch result recorded—see “Continuous Data Delivery Mode” (p. 6-48).

The host may configure Data ID tags to be prepended to each data value in a record—see “Sample Data Value Set Send” (p. 6-44) and “Data Value Headers” (p. 6-47).

The presentation of the data items in a statistics data record is fixed in the following order: AVG, DEV, MIN, MAX, DOSE, MISSED, SEQ.

The labels in the former list will also serve as data header strings—see “Data Value Headers” (p. 6-47).

If an error (Over range, Baseline clip, etc.) occurs while a batch measurement sample is being taken, the batch may not be valid. This situation is indicated by a returned average value of 9.99E99.

Data Value Headers

This command selects whether or not data value identification strings will prefix data values reported over the host interface. Headers are in the form of “<header>=<value>”. The <header> is literally one of the ID tag strings used in the data value send command.

Command: CONFigure:READings:HEADers
{DEFault|ON|OFF}
Default: OFF

Query: CONFigure:READings:HEADers?
Reply: ON|OFF

For example, if headers is ON, a data record could look like "PRI=1.449E-03". If headers is OFF, a data record could look like "1.449E-03".

Continuous Data Delivery Mode

This command will select if measurement sample data records and statistical data records are buffered as a continuous stream of sampled data records or simply the last available data record. When this mode is set to LAST, each data record placed into the buffer will overwrite the previous data record.

If this command is issued while data collection is enabled, the setting will not take effect until data collection mode is ABORted and INITiated again—see "Data Gating" (p. 6-50).

Command: CONFigure:READings:CONTinuous {DEFault|LAST|STREam}
Default: LAST

Query: CONFigure:READings:CONTinuous?
Reply: LAST|STREam

Trigger Parameters

Trigger Source

This command selects the trigger source. Selecting external trigger source automatically results in internal trigger source selection when thermopile and optical sensors are attached.

Command: TRIGger:SOURce {DEFault|INTernal|EXTernal|BUS}
Default: INTernal

Query: TRIGger:SOURce?
Reply: INTernal|EXTernal|BUS

Internal Trigger

Level

This command sets the trigger level expressed as a percentage of full scale capability for pyroelectric sensors.

Command: TRIGger:LEVel {DEFault|2..20}
Default: 5

Query: TRIGger:LEVel?
Reply: 2..20

External Trigger

Edge Select

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

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

Query: TRIGger:SLOPe?
Reply: POSitive|NEGative

Delay

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

Command: TRIGger:DELay {DEFault|0..1000}
Default: 0

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

Numeric Display Resolution

Front panel numeric display resolution is configurable from among the following set of display digit counts: 3, 4, and 5.

Thermopile

This command sets the number of display digits used when a thermopile sensor is attached.

Command: CONFigure:RESolution:THERmopile
{DEFault|3|4|5}
Default: 3

Query: CONFigure:RESolution:THERmopile?
Reply: 3|4|5

Optical

This command sets the number of display digits used when an optical sensor is attached.

Command: CONFigure:RESolution:OPTical
{DEFault|3|4|5}
Default: 3

Query: CONFigure:RESolution:OPTical?
Reply: 3|4|5

Pyroelectric

This command sets the number of display digits used when an optical sensor is attached.

Command: CONFigure:RESolution:PYRoelectric {DEFault|3|4}
Default: 3

Query: CONFigure:RESolution:PYRoelectric?
Reply: 3|4

Sample Measurement Data Collection

Measurement data records is placed in the measurement data transmission queue as the meter generates measurement data while data collection is enabled. The queue storage capacity is 200,000 records. A missing data count increments by one for every data record that is generated but not added to the queue due to a full queue condition.

Data Gating

The host has control over when measurement data is queued for reading from the host interface. Data collection is enabled and disabled using the INITiate and ABORt commands, respectively. Data collection is enabled after an INITiate command. Data collection is disabled after an ABORt command. Measurement data records are queued for transmission as the meter generates measurement data while data collection is enabled.

For more information, refer to “Continuous Data Delivery Mode” (p. 6-48).

The host gating commands does not affect front panel operation.

Initiate Command

This command enables measurement data collection. It automatically resets the measurement data buffer to empty and clears the missing data count. This command is ignored if data collection is enabled.

Command: INITiate

Query: none

Abort Command

This command disables measurement data collection. This command is ignored if data collection is disabled.

Command: ABORt

Query: none

Data Query

The host must query for measurement data in two steps. First, query for the number of data records available (N) and second, query N times for the data records—see “Measurement Data Format” (p. 6-42) and “Pulsed Thermopile Joules Mode” (p. 4-6).

Data record queries are destructive reads. The data record count decrements by one automatically as the host reads each data record.

Fetch Available Record Count

This query gets the number of unread data records available at the time of the query.

Command: none

Query: FETCh:NRECords?
Reply: <count of records available>

Fetch Next Available Record(s)

The query gets the next unread available measurement data record(s) at the time of the query. More than one data record may be queried using the optional <record count> parameter, which must be an integer value. If <record count> is not specified, a single data record is returned. No reply is transmitted if there are no measurement data records available.

Command: none

Query: FETCh:NEXT? [<record count>]
Default: not applicable

Reply: <next available record(s)>

Fetch All Available Records

This query gets all unread available measurement data records at the time of the query. No reply is transmitted if there are no measurement data records available.

Command: none

Query: FETCh:ALL?
Reply: <all available records>

Fetch Missing Data Count

This query gets the missing data count due to a measurement data transmission queue full condition.

Command: none

Query: FETCh:MISSing?
Reply: <integer count of missing data records>

Statistics Data Collection

Statistics Data Gating

The host has control over when statistics data is queued for reading from the host interface. Statistical data collection is available only when statistics is active on the meter, at which time statistics data collection can be enabled or disabled using the STATistics:INITiate and STATistics:ABORt commands, respectively. Data collection is enabled after a STATistics:INITiate command. Data collection is disabled after a STATistics:ABORt command. Statistical data records are queued for transmission as the meter generates statistics data while statistics is active and data collection is enabled.

For more information, refer to "Continuous Data Delivery Mode" (p. 6-48).

The host gating commands do not affect front panel operation.

Statistics Initiate Command

This command enables statistical data collection. It automatically resets the statistics data buffer to empty and clears the missing data count. This command is ignored if statistics data collection is already enabled. Note that this command only enables queuing of statistical results for transmission to the host; it does not enable statistics mode on the meter.

Command: STATistics:INITiate

Query: none

Statistics Abort Command

This command disables statistics data collection. This command is ignored if statistics data collection is disabled. Note that this command disables queuing of statistical results for transmission to the host; it does not disable statistics mode on the meter.

Command: STATistics:ABORt

Query: none

Statistics Data Query

The host must query for statistics data in two steps. First, query for the number of statistics data records available (N) and second, query N statistics data records. See "Statistics Data Record Format" (p. 6-46) for detailed information on the definition of statistics data records.

Statistics data record queries are destructive reads. The statistics data record count automatically decrements by one as the host reads each data record.

Fetch Available Statistics Record Count

This query gets the number of unread statistics data records available at the time of the query.

Command: none

Query: STATistics:FETCh:NRECords?
Reply: <count of records available>

Fetch Next Available Statistics Record(s)

The query gets the next unread available statistics data record(s) at the time of the query. More than one data record may be queried using the optional <record count> parameter, which must be an integer value. If <record count> is not specified, a single statistics data record is returned. No reply is transmitted if there are no statistics data records available.

Command: none

Query: STATistics:FETCh:NEXT? [<record count>]
Reply: <next available record(s)>

Fetch All Available Statistics Records

This query gets all unread available statistics data records at the time of the query. No reply is transmitted if there are no statistics data records available.

Command: none

Query: STATistics:FETCh:ALL?
Reply: <all available records>

Fetch Missing Statistics Data Count

This query is the missing record count due to a statistics data transmission queue full condition.

Command: none

Query: STATistics:FETCh:MISSing?
Reply: <integer count of missing statistics records>

Display

Contrast

This command sets the display contrast between no contrast and maximum contrast as displayed. The parameter ranges in value from 0.00 to 1.00. 0.00 indicates no contrast and 1.00 indicates maximum contrast. On input the contrast value is rounded to two decimal places.

Command: DISPlay:CONTrast {DEFault|0.00..1.00}
Default: 0.50

Query: DISPlay:CONTrast?
Reply: <contrast value>

Display Text

This command sets the display text in the measurement display area. When text is displayed through the host interface, it remains until it is cleared from the front panel, changed again from the host interface, or until a display clear (DISP:CLE) is sent. The string is displayed centered. Oversized strings are left and right truncated. All text within the quoted string is displayed.

The characters acceptable for the <quoted display text> are from the set of all 7-bit ASCII characters, starting with and including the space character (20 hex), and up to and including the tilde character (7E hex), except for the double quote character (22 hex). The double quote character is reserved to close the quote of the <quoted display text>. Any characters that follow the closing double quote are not displayed and are discarded.

Command: DISPlay:TEXT <quoted display text>

Query: none

Text Clear

This command clears the display text and enables measurement data to be displayed live. This command should also be used to clear dismissible error displays on the LCD.

Command: DISPlay:CLEar

Query: none

Meter and Sensor Device Information

The meter and any compatible sensors can be queried for device information for the purposes of unit identification and quality control.

Meter

Date and Time

Current Time

The command sets the time maintained within the meter. The query gets the time maintained within the meter.

Command: SYSTem:TIME <hour>,<minute>,<second>
Default: not applicable.

Query: SYSTem:TIME?
Reply: <hour>,<minute>,<second>

<hour> ranges from 0 to 23. <minute> ranges from 0 to 59. <second> ranges from 0 to 59.

Current Date

The command sets the date maintained within the meter. The query gets the date maintained within the meter.

Command: SYSTem:DATE <year>,<month>,<day>
Default: not applicable.

Query: SYSTem:DATE?
Reply: <year>,<month>,<day >

<year> is indicated by the four-digit year number. <month> ranges from 1 to 12. <day> ranges from 1 to 31.

Date Format

This command sets the panel display date format used by the meter.

Command: SYSTem:DATE:FORMat
{DEFault|MDY|DMY}
Default: MDY

Query: SYSTem:DATE:FORMat?
Reply: MDY|DMY

MDY indicates month-day-year format. DMY indicates day-month-year format.

Serial Number

This query gets the meter serial number.

Command: none

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

Calibration Date

This query gets the calibration date of the meter.

Command: none

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

Meter Type

This command gets the meter type.

Command: SYSTem:INFormation:INSTrument:TYPE
Default: not applicable.

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

Sensor

Type

This query gets the currently-connected sensor type.

Command: none

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

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

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

NONE,NONE is returned when a valid sensor is not attached. THERMO,QUAD or THERMO,SINGLE is returned when a valid thermopile sensor is attached. PYRO,NOSPEC is returned when a valid pyroelectric sensor is attached. OPT,NOSPEC is returned when a valid optical sensor is attached.

Model

This query gets the currently-connected sensor model.

Command: none

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

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

The following naming rules apply in order:

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

Serial Number

This query gets the serial number of the sensor.

Command: none

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

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

Responsivity

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

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

0.0 is returned if a valid sensor is not attached.

Calibration Date

This query gets the calibration date of the sensor.

Command: none

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

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

Head Temperature

This query gets the head temperature of the sensor.

Command: none

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

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

Diameter

This query gets the sensor diameter.

Command: none

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

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

Host Interface Glossary

Power off/on cycle - The action of turning off the meter using the panel Power button and then turning it back on again using the same button. The state of the meter electronics is sleep mode at a significantly reduced level of power consumption between the power off and power on events. The power off/on cycle transitions across this sleep mode.

Valid probe - A sensor attached to the meter with all of the following characteristics:

- Either a fully-functional Molectron PowerMAX sensor, Molectron SmartProbe, or Coherent LM sensor all having an EEPROM for sensor calibration data storage
- Valid EEPROM checksum(s) that validates the data stored within

Front panel idle period - The period of time during which neither front panel button press/release events or data wheel movement events have happened. The following events are not included as events that will end a front panel idle period:

- Sensor attach and remove events
- USB flash drive attach and remove events
- Host port cable attach and remove events
- Host interface commands and queries
- Any data measurement events

Dose - The sum of pulse energies of all pulses contained within a batch of pulses.

Minimum baseline error - A pulse measurement error condition during which the meter and sensor system is in a state which is driving the analog-to-digital converter to a voltage less than it can measure. Also known as *baseline clipping error.*

Baseline clipping error - See *Minimum baseline error.*

Overrange error - A measurement error condition during which the measurement exceeds the full scale range setting.

Pulse sampling - A measurement situation in which pulse energy measurements are subsampled (every Nth pulse, N > 1) due to meter pulse processing capacity limits.

Sequence ID - The identification number used to synchronize data from multiple meters that share the same trigger signal. The sequence ID increments by one and accompanies each measurement data record transmitted. It is unique in a stream of data transmissions until it wraps around from 2147483647 to 0 or until it is set by the TRIG:SEQ command.

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

Directory - The pathname component of the fully qualified file-name. For example, “greenbuster” is one of three directories in the fully qualified filename “usb:\data\greenbuster\config\file.txt”. The other directories are “data” and “config”.

Dirty batch - A batch that contains indeterminate data. Indeterminate data is characterized as having errors associated with it (for example: overranged, baseline clipped, or missing data). Batch results from a dirty batch cannot be computed due to the indeterminate data it contains.

ActiveX Control Interface

Document Overview

This section specifies the ActiveX control interface for the Coherent LabMax single-channel meter. The purpose is to detail the properties, events, and methods of the control so that it can easily integrate into a variety of containers such as LabVIEW, Visual Basic, VB.Net, and C#.

Scope

This section defines the interface for the LabMax low-level ActiveX control. The actual high-level commands, responses, and behavior that you can expect from the meter resulting from these interface calls are in the *Host Interface* section of the user manual.

Installation

The ActiveX control and low-level DDL are automatically installed—along with the LabMax PC Applications software—when you run the CD that is supplied with the meter.

LabMax Low Level Control

Overview

The LabMax Low Level Control (LabMaxLowLevCtl.ocx) provides a simple interface that enables a container to access all interfacing capabilities available through the host interface. This control hides the differences relating to specific details when communicating with the meter through USB, RS-232 or GPIB. Only one instance of the control is allowed per process and only a single mode of communication (USB, RS-232 or GPIB) is allowed per control. In other words, the communication modes are not mixed per process.

Before using any methods or properties in the control, you must call the Initialize() method. This method sets up the necessary member variables to enable proper connection to the meter(s). Likewise, when the connection is no longer needed, you must call the DeInitialize() method. The DeInitialize disconnects from any attached meters and enables the caller to call Initialize() again without destroying the control. Note that calling DeInitialize() to disconnect

meters will not cause the MeterRemoved event to fire. If you want to receive this event, call DisconnectFromMeter() before calling DeInitialize().

The command set is based on the SCPI Standard. A major deficiency of SCPI is that commands and queries do not have defined replies and illegal commands and queries are silently ignored, except for standard error queuing. To have a more robust method of communication, this control establishes a command/query handshaking protocol, which allows it to immediately identify an illegal command/query and reflect this through the interface. For more information, see the specification for "SendCommandOrQuery" (p. 6-65).

To support the command/query and reply handshaking protocol, a queue is implemented that contains strings received from the meter after a command/query has been sent. This queue is flushed if you send another command/query to the meter. It is up to you to know how many calls to GetNextString are needed to retrieve the strings in the queue, and that the data in the queue is lost if you initiate another command/query without retrieving the data from the previous query.

Quick Reference

Below is a summary of the properties, methods, and events exposed in the control.

	Purpose	Page
Properties		
CommunicationMode(…)	Specifies whether USB, RS-232 or GPIB is used	6-62
RS232Settings(…)	Specifies port settings for a specific meter	6-63
GPIBSettings(…)	Specifies board index for the GPIB board	6-64
SerialNumber(…)	Retrieves serial number for a specific meter	6-64
METHODS		
Initialize()	Initialize the control	6-65
DeInitialize()	Deinitializes the control; disconnects all meters	6-65
SendCommandOrQuery(…)	Sends specified SCPI command or query to meter	6-65
GetNextString(…)	Returns string received from meter	6-66
ConnectToMeter(…)	Connects to a specific meter	6-66
DisconnectFromMeter(…)	Disconnects from a specific meter	6-67
EVENTS		
MeterAdded(…)	Meter has established a communication channel	6-67
MeterRemoved(…)	Meter has broken a communication channel	6-68
AsynchronousNotification(…)	An asynchronous notification event is transmitted from the meter	6-68
USBStreamingPacket(…)	A streaming measurement data packet is available	6-68

Detailed Reference

Below is detailed information on the properties, methods and events exposed in the control. Some of the properties and all of the methods and events have a parameter called *iMeterIndex*. The *iMeterIndex* parameter contains a value specific to the communication mode setup by the **CommunicationMode** property. The following values are valid for the *iMeterIndex* parameter:

USB CommunicationMode

Valid inputs are 0 to 127. The control automatically detects any USB devices, either when the communication mode is set to COM_MODE_USB, or when a device is plugged in. The *iMeterIndex* is assigned by the control and is sent to the MeterAdded () event. Thereafter, this parameter should be used in the calls to the methods and properties of the control.

GPIB CommunicationMode

Valid inputs are 1 to 31. Address 0 is reserved for the GPIB controller-in-charge board. The assigned number must match whatever is currently set in the meter hardware.

RS232 CommunicationMode

Valid inputs are 1 to 9, depending on which COM port the meter is connected.

Properties

CommunicationMode

The *CommunicationMode* property defines the single mode of communication for this instance of the ActiveX control. If a communication channel is connected and you try to reset this mode, the call is ignored. The control is inactive until this property is set. The property is defined by the enumerated type *LabMaxCommunicationMode*, defined as follows:

```
typedef enum {
        COM_MODE_NONE,      // 0
        COM_MODE_USB,       // 1
        COM_MODE_GPIB,      // 2
        COM_MODE_RS2322     // 3
} LabMaxCommunicationMode;
```

The initial value for the property is COM_MODE_NONE.

HRESULT CommunicationMode
([in] LabMaxCommunicationMode
iCommunicationMode)

Inputs:

iCommunicationMode—value in the enumerated type *LabMax-CommunicationMode*, specified above.

HRESULT CommunicationMode
([out, retval] LabMaxCommunicationMode
***oCommunicationMode)**

Outputs:

oCommunicationMode—value in the enumerated type *LabMax-CommunicationMode*, specified above.

RS232Settings

The *RS232Settings* property specifies the serial port settings of the addressed meter. It uses the same specification format as the MSCOMM32 control settings property. Basically, it is a string composed of four settings and has the following format: "B,P,D,S" where B is the baud rate, P is the parity, D is the number of data bits, and S is the number of stop bits. The default value is "19200,N,8,1".

- Valid baud rates are: 9600, 19200(default), 38400, 57600, and 115200.
- Valid parity values are: E (even), N (none—default), and O (odd).
- Valid data bit value is: 8(default)
- Valid stop bits values are: 1(default), and 2.

HRESULT RS232Settings
([in] SHORT iMeterIndex,
[out,retval] BSTR* oRS232Settings)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

Outputs:

oRS232Settings—a BSTR holding the serial port settings string, as defined above.

HRESULT RS232Settings
([in] SHORT iMeterIndex,
[in] BSTR iRS232Settings)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

iRS232Settings—a BSTR holding the serial port settings string, as defined above.

Because this property takes an input parameter, it can appear differently when used by VB.Net and LabVIEW. For example, in VB.Net, the property is accessed by *set_RS232Settings(…)* and *get_RS232Settings(…)*. For LabVIEW, the property appears under the Methods menu as *RS232Settings(put)* and *RS232Settings(get)*.

GPIBSettings

The *GPIBSettings* property specifies the board index for the GPIB board. The default value is "0". Only one board index is supported for this instance of the ActiveX control. All referenced meters must be attached to this board.

HRESULT GPIBSettings
([out,retval] BSTR* oGPIBSettings)

Outputs:

oGPIBSettings—a BSTR holding the GPIB board index string.

HRESULT GPIBSettings
([in] BSTR iGPIBSettings)

Inputs:

iGPIBSettings—a BSTR holding the GPIB board index string.

SerialNumber

The *SerialNumber* property indicates the serial number of the addressed meter.

HRESULT SerialNumber
(in] SHORT iMeterIndex,
[out,retval] BSTR* oSerialNumber)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

Outputs:

oSerialNumber—a BSTR holding the serial number of the addressed meter. It will be an empty string if an invalid meter is addressed.

Because this property takes an input parameter, it can appear differently when used by VB.Net and LabVIEW. For example, in VB.Net, the property is accessed by *get_SerialNumber(…)*. In LabVIEW, the property appears under the Methods menu as *SerialNumber.*

Methods

Initialize

You must call the *Initialize* method before calling any other methods. This is equivalent to a C++ constructor and is used to initialize the control variables.

HRESULT Initialize
([out, retval] SHORT* oResult)

Outputs:

oResult—the method returns 1 if the initialization was successful; otherwise, 0.

DeInitialize

You must call the *DeInitialize* method when communication with the control is no longer needed. This is equivalent to a C++ destructor. It ensures that all meters are properly disconnected and allocated memory is freed. If you use this method—as opposed to *DisconnectFromMeter*—to handle disconnecting from all connected meters, the *MeterRemoved* event will not be fired.

HRESULT DeInitialize
([out, retval] SHORT* oResult)

Outputs:

oResult—the method returns 1 if the initialization was successful; otherwise, 0.

SendCommandOrQuery

The *SendCommandOrQuery* method allows the container to send a specified SCPI command or query to the addressed meter specified by the parameter **iMeterIndex**. This method waits for a response from the meter to state whether the command/query is valid or not. The timeout value for this response is 3 seconds. After issuing the command/query, it is expected that you call *GetNextString()* to retrieve the string(s) in response to this action.

HRESULT SendCommandOrQuer
([in] SHORT iMeterIndex,
[in] BSTR iCommandOrQuery,
[out,retval] SHORT* oResult)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

iCommandOrQuery—contains a user-specified SCPI command or query string.

Outputs:

oResult—the method returns a 1 if the string is successfully transmitted and the validation of the command/query from the meter is received before the timeout period. A 0 is returned if the timeout expires, the command/query is invalid, an invalid meter is specified as an input parameter, or the *CommunicationMode* property is not set.

GetNextString

The *GetNextString* method allows the caller to retrieve the next available string in the string queue of the addressed meter. This queue is filled according to the specific command/query sent to the meter in the *SendCommandOrQuery()* method. Refer to the “SendCommandOrQuary” heading, above, for more information.

HRESULT GetNextString
([in] SHORT iMeterIndex,
[out,retval] BSTR* oString)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

Outputs:

oString—the method returns the next available string in the string queue of the addressed meter. An empty string is returned if there is no string available in the queue, if an invalid meter is addressed, or if the CommunicationMode property is not set.

ConnectToMeter

The *ConnectToMeter* method connects to the addressed meter if the communication mode is RS-232 or GPIB. If the communication mode is RS-232, it uses the settings as defined by the *RS232Settings* property. If the communication mode is USB, this method does nothing.

HRESULT ConnectToMeter
([in] SHORT iMeterIndex,
[out,retval] SHORT* oResult)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

Outputs:

oResult—this method returns 1 if the communication mode is RS-232 or GPIB, and a successful connection is established. If the communication mode is USB, the method returns 1; otherwise, it returns a 0.

DisconnectFromMeter

The *DisconnectFromMeter* method disconnects from the addressed meter if the communication mode is RS-232 or GPIB. If the communication mode is USB, this method does nothing.

HRESULT DisconnectFromMeter
([in] SHORT iMeterIndex,
[out,retval] SHORT* oResult)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

oResult—this method returns 1 if the communication mode is RS-232 or GPIB, and connection is successfully broken. If the communication mode is USB, the method return 1; otherwise, it returns a 0.

Events

MeterAdded

The *MeterAdded* event fires when a meter establishes a connection. If the communication mode is RS-232 or GPIB, this event occurs after a successful call to *ConnectToMeter()*. If the communication mode is USB and a meter is already plugged in a USB port, this event will occur immediately after setting the control in communication mode to USB. If the communication mode is USB and a meter is plugged in after the communication mode is configured, this event will occur when the plug-in is detected. For USB, the **iMeterIndex** is assigned by the control and should be used in further calls to

methods and properties relating to this device. For RS-232 and GPIB, the **iMeterIndex** is the index that is sent in the *ConnectToMeter()* function call.

void MeterAdded
([in] SHORT iMeterIndex)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

MeterRemoved

The *MeterRemoved* event fires when the connection with the configured meter is broker. If the communication mode is RS-232 or GPIB, this event occurs after a successful call to *DisconnectToMeter()*. If the communication mode is USB, this event occurs when a meter is unplugged from the USB port.

void MeterRemoved
([in] SHORT iMeterIndex)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

AsynchronousNotification

The AsynchronousNotification event fires when an asynchronous event is received from the meter. The communication mode determines when this event happens. For USB, it occurs when an attention packet is transmitted. For GPIB, it occurs when a service request is generated. For RS-232, it occurs when a service request is transmitted.

void AsynchronousNotification
([in] SHORT iMeterIndex)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

USBStreamingPacket

The *USBStreamingPacket* event fires when a streaming measurement data packet is generated by the meter. This event only occurs if the communication mode is USB.

void USBStreamingPacket
([in] SHORT iMeterIndex,
[in] VARIANT iStreamingPacket)

Inputs:

iMeterIndex—valid parameter values depend on the communication mode. For more information, refer to “Detailed Reference” (p. 6-62).

iStreamingPacket—the VARIANT data type is an array of VARIANTS. Each array element is a VARIANT, and maps to the data type and value of each structure element.

The C data structure is:

```
typedef struct LMHostMsg {
        float measurement;
        float quadDistanceMMX;
        float quadDistanceMMY;
        unsigned char displayFormatId;
        unsigned char scaleMultiplierId;
        unsigned char unitsId;
        unsigned char flags;
        unsigned int pulsePeriodUS;
        unsigned int sequenceNumber;
};
```

The corresponding VARIANT array is:

array [0]—4-byte float (in Labview, "Single Precision")
array [1]—4-byte float
array [2]—4-byte float
array [3]—1-byte unsigned (in Labview, "Unsigned Byte")
array [4]—1-byte unsigned
array [5]—1-byte unsigned
array [6]—1-byte unsigned
array [7]—4-byte unsigned (in Labview, "Unsigned Long")
array [8]—4-byte unsigned

SECTION SEVEN: CALIBRATION AND WARRANTY

In this section:

- Calibration (this page)
- Coherent calibration facilities and capabilities (this page)
- Limited warranty (page 7-2)
- Extended warranty (page 7-2)
- Warranty limitations (page 7-3)
- Obtaining service (page 7-3)
- Product shipping instructions (page 7-4)

Calibration

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

Coherent Calibration Facilities and Capabilities

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

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

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

Limited Warranty

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

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

Extended Warranty

Coherent, Inc. (the "Company") offers original purchasers (the "Customer") purchasing laser power and energy meters and sensors products ("Products") an extended twelve (12) month warranty program, which includes all parts and labor. In order to qualify for this warranty, a Customer must return the Product to the Company for recalibration and recertification. The Company will recertify 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 recertified due to damage beyond repair, parts obsolescence, or other reasons, the Customer may be informed that an Extended Warranty program is not available for the Product.

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

Warranty Limitations

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

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

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

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

Obtaining Service

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

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

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

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

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

Table 7-1. Coherent Service Centers

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

Product Shipping Instructions

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service (refer to Table 7-1, above) for a Return Material Authorization number.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Coherent Customer Service.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. If the original packing material and carton are not available, obtain a corrugated cardboard shipping carton with inside dimensions that are at least 6 in. (15 cm) taller, wider, and deeper than the product. The shipping carton must be constructed of cardboard with a minimum of 375 lb. (170 kg) test strength. Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the product. Allow 3 in. (7.5 cm) on all sides, top, and bottom.
5. Seat the shipping carton with shipping tape or an industrial stapler.
6. Ship the product to:

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

APPENDIX A: SPECIFICATIONS

This appendix lists specifications for the LabMax meter.

Table A-1. Specifications[a] (Sheet 1 of 2)

Parameter	Description
Maximum Sensor Input	
Thermopile Sensors (LM models)	2V
Thermopile Sensors (PM models)	2V
Optical Sensors	20 mA
Pyroelectric Sensors	16V
Minimum Sensor Input	
Thermopile Sensors (LM models)	50 µV
Thermopile Sensors (PM models)	20 µV
Optical Sensors	1 nA
Pyroelectric Sensors	1 mV
Noise	
Thermopile Sensors (LM models)	1.2 µV
Thermopile Sensors (PM models)	500 nV
Optical Sensors	4.6 pA
Pyroelectric Sensors	20 µV
Measurement Resolution (% of full scale)	0.1[b]
Positional Resolution (mm)	0.1
Repetition Rate Error	< 1%
Maximum Repetition Rate (Hz)	10,000 sampling (1,000 Hz every pulse)
Pulse Triggering	Internal and external (selectable)
External Trigger Pulse Width	1.3 µS (min.)
External Trigger Pulse Amplitude	2 to 7V
Power Sampling Rate (Hz)	10
Uncertainty (k=2, 95% confidence interval)	
Instrument - Pyroelectric Channel	± 1.5%
Instrument - Thermopile Channel	± 1.1%
Instrument - Optical Channel	± 0.9%
System	meter channel + sensor
Analog Output Accuracy	± 2%
Display	112 x 78 mm backlight graphic LCD 480 x 320 pixels Adjustable contrast and viewing angle
Measurement Analysis	Min., max., mean, range, standard deviation, energy dose, and stability Trend charting, tuning, positional display, and analysis of beam stability
Computer Interface	USB, RS-232, and GPIB (LabMax-TOP w/GPIB model only)

Table A-1. Specifications[a] (Sheet 2 of 2)

Parameter	Description
Analog Output (VDC)	0 to 1, 2, or 4 VDC (selectable)
Analog Output Update Rate	10 Hz for thermopile and optical Up to 1,000 Hz for pyroelectric
Instrument AC Power Adapter (incl.)	100 to 240 VAC, 50/60 Hz Output: + 12 VDC (center-positive), 1.25A, 15W (max.)
Instrument Batteries	4400 mAH Li-ion battery (included)
Battery Life 4400 mAH	 8 hr., backlight off 7 hr., backlight on
Temperature Operating Storage	 5 to 40°C (41 to 104°F) -20 to 70°C (-4 to 158°F)
Regulations Met Instrument AC Adapter and Cord	 CE, RoHS, WEEE PSE and UL
Size (H x W x D)	152 x 229 x 53 mm (6.0 x 9.0 x 2.1 in.)
Weight (including 4400 mAH battery)	1.04 kg (2.3 lb.)
LabMax-TOP Meter Part Number	1104622
LabMax-TOP w/GPIB Meter Part Number	1104620

a. Meter supplied with 4400 mAH Li-ion battery, AC power adapter, power cord, 6-ft. USB cable, RS-232 adapter, 2 GB USB flash drive, 3 RCA-to-BNC adapters, user manual, software and driver CD, soft carrying case, and certificate of calibration. (A GPIB cable is provided with the LabMax-TOP w/GPIB model.)

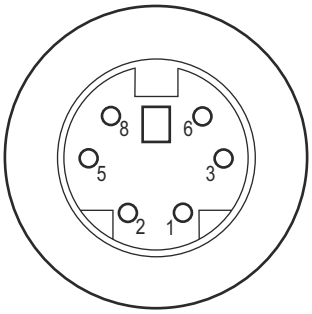
b. User-selectable display resolution (3, 4, or 5 digits).

RS-232 Pinouts

Table A-2 shows the LabMax RS-232 connector pinouts.

Table A-2. RS-232 Pinouts

Pin	Assignment
1	GND
2	Receive (from computer to LabMax)
3	Transmit (from LabMax to computer)
5	
6	
8	



Persistent Parameters

Table A-3 lists the LabMax persistent parameters.

Table A-3. Persistent Parameters (Sheet 1 of 2)

Parameter Description	Data Argument Range	Factory Default
Backlight auto off time under AC power	OFF | 1..60	OFF
Backlight auto off time under battery power	OFF | 1..60	OFF
Meter power auto off time	OFF | 1..60	OFF
Selected host interface *	RS232 | GPIB | USB	USB
Host serial port baud rate *	9600 | 19200 | 38400 | 57600 | 115200	19200
Host serial port parity *	Even | Odd | None	N
Host serial port stop bits *	1 | 2	1
Host serial port data pacing *	XON | None	None
Host GPIB port data address *	1..30	1
Display date format	MDY | DMY	MDY
Measurement mode	J | W	J if a valid pyroelectric sensor is attached; otherwise, W
Display power units	W | DBM	W
Display mode	Pri | Stat | Pstab | Tune | Trend	Pri
Display sub mode for statistics	Numbers	Numbers
Display sub mode for trend	Chart	Chart
Display view mode for position stability	Scroll | Fit-to-screen	Scroll
Display view mode for tune	Strip-chart | Bar-chart	Strip-chart
Display view mode for trend	Scroll | Fit-to-screen	Scroll
Area correction state	ON | OFF	OFF
Area correction aperture	0.01..500.00	1.0
Analog output full scale voltage	1 | 2 | 5	2
Speedup applied to host data store	OFF | ON	ON
Speedup applied to analog output	OFF | ON	ON
Speedup applied to measure display	OFF | ON	ON
Speedup applied to tune display	OFF | ON	ON
Numeric display smoothing window size for pulses	OFF | AUTO | 2..999	AUTO
Numeric display smoothing window size for time	OFF | AUTO | 1..60	AUTO
Wavelength correction state *	OFF | ON	ON
Wavelength of operation *	1..99999	193
Wavelength selection list *	Comma-separated list of wavelengths ranging from 1 to 99999 nm	193, 248, 266, 337, 532, 1064, 2100, 10600

Table A-3. Persistent Parameters (Sheet 2 of 2)

Parameter Description	Data Argument Range	Factory Default
Gain compensation state	OFF | ON	OFF
Gain compensation factor	0.001..100000.0	1.0
Selected range	The maximum measurement expected	3.0
Auto ranging state	ON | OFF	ON
Statistics mode display output selection	Comma-separated list of Mean, Min, Max, Stdv, 1sig, 2sig, 3sig, Range, Dose, Missed	Mean, Min, Max, Stdv
Statistics mode batch size for pulses	2..99999	10
Statistics mode batch size for time	00:00:01..24:00:00	00:00:10
Statistics mode sample rate for pulses	1..99999	1
Statistics mode sample rate for time	1.157E-5..1.0E1	1.0
Statistics mode restart mode	Manual | Automatic	Manual
Position stability mode duration	00:00:01..24:00:00	00:01:00
Tune mode strip chart view vertical zoom level	AUTO | 1 | 2 | 5 | 10 | 20	AUTO
Tune mode strip chart view horizontal zoom level	1 | 2 | 5 | 10 | 20	1
Tune mode bar chart view zoom level	1 | 2 | 5 | 10 | 20	1
Trend mode scroll view vertical zoom level	1 | 2 | 5 | 10 | 20	1
Trend mode batch size for pulses	2..99999	10
Trend mode batch size for time	00:00:01..24:00:00	00:00:10
Trend mode sample rate for pulses	1..99999	1
Trend mode sample rate for time	1.157E-5..1.0E1	1.0
Numeric display resolution for thermopile sensors	3 | 4 | 5	3
Numeric display resolution for optical sensors	3 | 4 | 5	3
Numeric display resolution for pyroelectric sensors	3 | 4	3
Trigger source	Internal | External	Internal
Trigger level	2..20	5
Trigger slope	Positive | Negative	Positive
Trigger delay	0..1000	0
Trigger bus direction	Host | Guest | Independent	Independent
Display contrast	0.0..1.0	0.5

* = parameter is not included when restoring the configuration from the last sensor used

APPENDIX B: ERRORS

Measurement Errors

Table B-1. Measurement Errors

When the meter detects:	Measurement values are replaced by:
An overrange condition	OVER RANGE
A sensor saturation condition (optical sensor only)	SATURATED

Pressing the HELP button when an error is displayed will explain what caused the error and what to do about it.

Meter and Sensor Errors

Table B-2. Meter and Sensor Errors

Symptom	Cause	Corrective Action
Searching for sensor	Sensor not connected	Connect a sensor to the meter
Sensor over temp	The sensor has overheated	Turn the laser off immediately and let the sensor cool down
NVRAM communication failure	A failure occurred while reading the internal EEPROM	Contact a Coherent Service Center
Sensor checksum error	The sensor internal EEPROM checksum check failed, causing the meter to give non-calibrated readings.	Contact a Coherent Service Center
Sensor communication failure	Sensor and/or meter communication has failed	Disconnect and reconnect the sensor. If problem persists, contact a Coherent Service Center.
Sensor/firmware mismatch	The meter does not recognize the EEPROM format of the sensor	Contact a Coherent Service Center for a firmware upgrade
Sensor NVRAM corrupt	The sensor EEPROM is corrupted	Contact a Coherent Service Center
Unrecognized sensor	The meter does not recognize this sensor	The sensor is either incompatible, or does not have a functioning EEPROM. If the problem persists, contact a Coherent Service Center.
Fatal initialization error		Contact a Coherent Service Center

APPENDIX C: ONSCREEN INDICATORS

This section presents a summary of all the onscreen indicators.

Table C-1. Onscreen Indicators (Sheet 1 of 3)

Battery Life Appears on:All screens when meter is running on battery Onscreen location:Upper left corner Onscreen label:Icon Range of values:5 bars = 81to 100% of remaining battery life 4 bars = 61 to 80% 3 bars = 41 to 60% 2 bars = 21 to 40% 1 bar = 11-20% 0 bars = 0 to 10% Behavior:Displays currently remaining battery life Updates as battery life decreases Blinks when remaining battery life is 10% or less Edited in:N/A
Wavelength Appears on:All MEASURE screens Onscreen location:Lower left corner Onscreen label:Wavelength: Range of values:Sensor-dependent Behavior:Displays current value Edited in:SETUP
Gain Appears on:All MEASURE screens Onscreen location:Lower left corner Onscreen label:Gain: Range of values:OFF, .001 to 999.999 Behavior:Displays ON or OFF Edited in:SETUP
Display Smoothing Appears on:All MEASURE screens Onscreen location:Lower right corner Onscreen label:Smoothing: Range of values:ON/OFF Behavior:Displays current value Edited in:SETUP

Table C-1. Onscreen Indicators (Sheet 2 of 3)

Bull's-Eye Appears on:MEASURE POWER Onscreen location:Upper right corner Onscreen label:Icon Range of values:Presence/absence of dot Behavior:N/A Edited in:N/A
Elapsed Appears on:STATS Onscreen location:Upper right corner Onscreen label:Elapsed: Range of values:N/A Behavior:Starts at 0 Begins countup when you press START Edited in:STATS & TREND: Setup
Duration Appears on:STATS Onscreen location:Upper right corner, below "Elapsed:" Onscreen label:Batch: Range of values:N/A Behavior:Displays the value indicated in the STATS Setup screen Edited in:STATS & TREND: Setup
Trigger/Trigger? Appears on:MEASURE STATS TREND Whenever a pyroelectric sensor is connected Onscreen location:Upper left above measurement value but below stats and trend "Remaining:" indicator Onscreen label:TRIGGER TRIGGER? Range of values:N/A Behavior:TRIGGER appears when a pulse is received If no other pulse is received after two (2) seconds, TRIGGER is replaced by TRIGGER? Edited in:N/A

Table C-1. Onscreen Indicators (Sheet 3 of 3)

Ready/Calculating for Thermopile Joules Appears on:MEASURE STATS TREND Whenever a thermopile is in use and Joules is selected Onscreen location:Upper left above measurement value but below stats and trend “Remaining:” indicator Onscreen label:READY CALCULATING Range of values:N/A Behavior:CALCULATING appears when a pulse is received and is replaced by READY when the measurement value appears Edited in:N/A
Old Data Appears on:MEASURE STATS TREND Whenever Joules is selected Onscreen location:Just to the upper right of the measurement value Onscreen label:OLD Range of values:N/A Behavior:Appears when the measurement value is stale Appears simultaneously with READY (for thermopile sensors) and TRIGGER? (for pyroelectric sensors). Edited in:N/A
Zero for Optical Sensors Appears on:MEASURE screen when optical sensor is in use Onscreen location:Just to the upper right of the measurement value Onscreen label:ZERO Range of values:N/A Behavior:Appears when you press the ZERO button while using an optical sensor Edited in:N/A

INDEX

A
AC adapter 3-12
Adding a wavelength 4-55
Analog
    Out connector 3-8
    Output 4-58
Area correction 4-49

B
BACKLIGHT button 4-74
Bar charts 4-26
Battery
    Charge indicator 3-8
    Pack replacement 3-11
Buttons 3-4
    BACKLIGHT 4-74
    HELP 4-73
    MEASURE 4-1
    SETUP 4-45
    TREND 4-28
    TUNE 4-25
    ZERO 4-44

C
Calibration 7-1
Charts
    Bar 4-26
    Strip 4-25
Coherent calibration facilities and capabilities 7-1
Commands and queries, host 6-13
Communications 4-61, 6-17
Compliance
    Export control laws xi
    RoHS xi
Connectors
    Analog out 3-8
    Ext trig 3-8
    Mini-USB 3-6
    Power jack 3-7
    RS-232 3-6
    Sensor 3-7
    USB flash drive 3-6
Context-sensitive help 4-73
Correction, area 4-49

D
Date/time 4-63
Declaration of conformity 1-2
Deleting a wavelength 4-56
Display
    Host interface command 6-54
    Smoothing 4-46

E
Energy savings 4-65
Errors
    Measurement B-1
    Record reporting and collection 6-20
Export control laws compliance xi
Ext trig connector 3-8
Extended warranty 7-2

F
Features, product 3-2
Firmware
    Updates xiv
    Version 4-68
Flash drive, USB 3-6
Front panel 3-4
    Buttons 3-4
    Power on/off button 3-5
    Selection knob 3-5
    Soft keys 3-5

G
Gain compensation 4-51
General help 4-74

H
HELP
    Button 4-73
    Context-sensitive 4-73
    General 4-74
Host command quick reference 6-5
Host interface
    Commands and queries 6-13
        Communications 6-17
        Display 6-54
        Error record reporting and collection 6-20
        Measurement data collection 6-50
        Measurement setup and control 6-22
        Meter and sensor device information 6-55
        SCPI common commands 6-13
        System options 6-13
    Glossary 6-58
    Host command quick reference 6-5
    Notation conventions 6-3
    Persistent parameters A-3
    RS-232 interface, using 6-2
    Special considerations 6-1

Syntax 6-4
USB interface, using 6-3

I

Indicators, onscreen C-1
Instructions, product shipping 7-4
Internal triggering mode 4-12

L

Limited warranty 7-2

M

Manage configs 4-71
MEASURE
Button 4-1
Detailed procedures 4-23
POSITION STABILITY 4-23
Energy, pyroelectric sensors 4-10
Power 4-2
Optical sensors 4-5
Thermopile quad sensors 4-4
Thermopile sensors 4-2
Statistics 4-15
Measure
Energy 4-6
Power 4-2
Measurement
Data collection 6-50
Setup and control 6-22
Measuring
Energy with a pyroelectric sensor (Quick Start) 2-3
Power with a thermopile or optical sensor (Quick Start) 2-2
Meter and sensor device information 6-55
Mini-USB connector 3-6
Mode, internal triggering 4-12
Moving a file to the USB flash drive (Quick Start) 2-5

O

Onscreen indicators C-1
Optical sensors 4-5
Over-temperature condition 4-3
Overview, product 3-1

P

Panel
Front 3-4
Rear 3-7
Side 3-6
Persistent parameters A-3
Positiion stability 4-23
Power
Jack connector 3-7
Measure units 4-56
On/off button 3-5
Preface xi
Product
Compliance
Export control laws xi
RoHS xi
Features 3-2
Overview 3-1
Shipping instructions 7-4
Specifications A-1
Publication updates xiv
Pulse sampling 4-14
Pyroelectric sensors 4-10

Q

Quick Start
Measuring energy with a pyroelectric sensor 2-3
Measuring power with a thermopile or optical sensor 2-2
Moving a file to the USB flash drive 2-5
Saving data to a file on the local drive 2-4

R

Rear panel 3-7
Analog out connector 3-8
Ext trig connector 3-8
Replacement, battery pack 3-11
Resolution 4-57
RoHS compliance xi
RS-232
Connector 3-6
Pinouts A-2

S

Safety 1-1
Declaration of conformity 1-2
Signal words and symbols in this manual xi
Waste electrical and electronic equipment (WEEE, 2002) 1-2
Sampling, pulse 4-14
Save current config 4-69
Saving data to a file on the local drive (Quick Start) 2-4
SCPI common commands 6-13
Screen contrast 4-66
Selection knob 3-5
Sensor
Connector 3-7
Over-temperature condition 4-3
Sensors
Optical 4-5
Pyroelectric 4-10
Thermopile 4-2
Thermopile quad 4-4
Serial number 4-68
Service 7-3
SETUP
Analog output 4-58
Area correction 4-49

Button 4-45
Communications 4-61
Date/time 4-63
Detailed procedures 4-69
Manage configs 4-71
Save current config 4-69
Display smoothing 4-46
Energy savings 4-65
Gain compensation 4-51
Power measure units 4-56
Resolution 4-57
Screen contrast 4-66
Serial number 4-68
Soft keys 4-68
Speedup 4-48
Trigger 4-58
Version 4-68
Wavelength
Correction 4-53
Table edit 4-54
Side panel 3-6
Mini-USB connector 3-6
Power jack connector 3-7
RS-232 connector 3-6
Sensor connector 3-7
USB flash drive connector 3-6
Signal words and symbols in this manual xi
Soft keys 3-5
Specifications A-1
Speedup 4-48
Statistics soft key 4-15
Strip charts 4-25
System options 6-13

T

Thermopile
Quad sensors 4-4
sensors 4-2
TREND
After data collection 4-32
Button 4-28
Detailed procedures 4-34
File manager 4-36
Name log file 4-34
TREND setup 4-41
During data collection 4-30
Trigger 4-58
Boosting source current of triggering device 5-2
External circuit 5-1, 5-2
States and the trigger annunciator 4-14
TUNE
Bar charts 4-26
Button 4-25
Strip charts 4-25

U

Updates
Firmware xiv
Publication xiv
USB flash drive connector 3-6

V

Version, firmware 4-68

W

Warranty
Extended 7-2
Limitations 7-3
Limited 7-2
Waste electrical and electronic equipment (WEEE, 2002) 1-2
Wavelength
Adding 4-55
Correction 4-53
Deleting 4-56
Table edit 4-54

Z

ZERO button 4-44

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