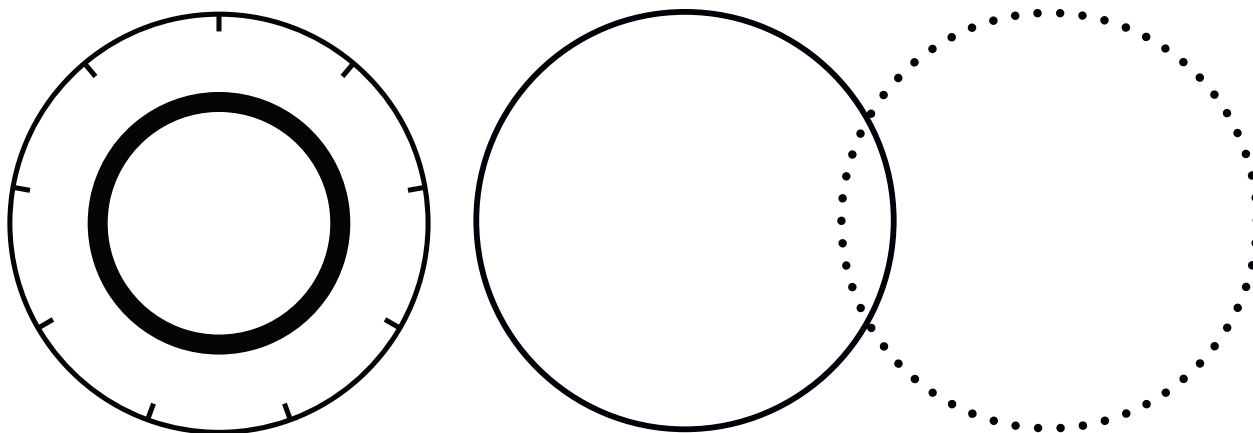


LabMax Touch / Touch Pro Meter

Operator's Manual



LabMax Touch/Touch Pro Meter™

Operator's Manual



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Table of Contents

1 Introduction	1
1.1 Safety Warnings	1
1.1.1 Signal Words.....	1
1.1.2 Symbols	2
1.2 Preface	3
1.3 Export Control Laws	4
1.4 The Operator's Manual.....	5
2 Description and Specifications.....	7
2.1 Introduction	7
2.2 Features	8
2.2.1 Models Available	9
2.2.2 Applications	9
2.2.3 Compatibility.....	10
2.2.3.1 Shipped with Meter.....	10
2.3 Product Description.....	11
2.3.1 Front Panel.....	12
2.3.1.1 Functional Control Buttons.....	12
2.3.1.2 LCD Display	13
2.3.1.3 Care and Handling of the Touchscreen	13
2.3.2 Back Panel	13
2.3.2.1 Kickstand.....	14
2.3.2.2 Battery.....	15
2.3.3 Side Panels and Ports	16
2.3.3.1 Top Panel and Connectors	19
2.3.3.2 Power and Status LED Indicator	20
2.4 Dimensions	21
2.4.1 Front and Back Panel Dimensions	21
2.4.2 Side Panel Dimensions	22
2.4.3 End Panel Dimensions	23
2.5 Specifications	23
2.5.1 Physical Characteristics.....	23
2.5.2 Temperature and Humidity.....	24
2.5.3 Measurement Ranges and Accuracy.....	24
3 Installation	27
3.1 Connect the Meter.....	27
3.1.1 Connect to a Sensor	28
3.1.2 Connect to an External Monitor.....	29
3.1.3 Connect to a PC	30

3.1.4 Apply Power to the Meter	30
3.2 Mount the Meter	31
3.3 Install PC Software	35
3.3.1 Software Features	35
3.3.2 Supported Products	36
3.3.3 System Requirements	36
3.3.4 Software Installation	37
3.4 Next Steps	38
4 Touchscreen User Interface	39
4.1 User Interface Description	39
4.1.1 Top Information Bar	40
4.1.1.1 Trigger Indicator Details	41
4.1.2 Quick Access Toolbar on the Main Window	42
4.1.3 Bottom Main Window Information Bar	43
4.2 Configure Settings	44
4.2.1 General Settings	47
4.2.2 Communication Settings	47
4.2.3 Acquisition Settings Menu	49
4.2.3.1 Acquisition Settings Tab	50
4.2.3.2 The fields are used to set the buffer capacity. The user sets 2 of the 3 settings and the other is calculated based on these. Acquisition Settings- Trigger Tab	52
4.2.3.3 Acquisition - Measurement Tab	53
4.2.4 Select Wavelength	54
4.2.5 Data Logging	56
4.2.6 Analysis Settings	57
4.2.6.1 Alarms and Limits Settings	57
4.2.6.2 Pulse Analysis Settings	58
4.2.7 Import/Export Utilities	60
4.2.7.1 Import Capture Data	61
4.2.7.2 Export Capture Data	62
4.2.7.3 Export Statistics Analysis	63
4.2.7.4 File Explorer Utility	64
4.2.8 View-Specific Settings	64
4.2.8.1 Trend View Settings	65
4.2.8.2 Tuning View Settings	68
4.2.8.3 Statistics Settings	68
4.2.8.4 Histogram Settings	69
4.2.9 System Utilities	69
4.2.9.1 Photonics Calculator	70
4.2.9.2 Power Limits Calculator	71
4.2.9.3 System Information	72
4.2.9.4 Firmware Update	73
4.2.9.5 Restore Default Settings	74

5 Operations Views in Touchscreen	75
5.1 Histogram View	75
5.2 Statistics View.....	76
5.3 Tuning View	77
5.4 Trend View.....	77
5.4.1 Trend Zoom View	78
5.4.2 Long-Pulse Energy Calculations	79
5.5 Measurement View	79
5.6 Beam Position/Stability View	81
5.7 Pyroelectric (Power) Watts Mode.....	81
5.8 Pulsed Thermopile Energy Joules Mode	83
5.9 Auto Range Setting.....	84
5.10 Indicators	85
5.10.1 Meter Must be Zeroed	86
5.11 Set Meter to Zero.....	87
5.12 Sensor Errors.....	89
5.13 Trigger States.....	89
5.13.1 External Trigger Input	89
5.13.2 External Trigger Output.....	91
5.13.3 User-Adjustable Internal Trigger	91
5.14 Analog Output Voltage Range	92
6 Operation - Touch Screen Interface	93
6.1 Overview	93
6.2 Take a Basic Power Measurement	94
6.2.1 Overview	95
6.2.2 Basic Measurement Procedure	95
6.3 Take a Variable High-speed Measurement with PowerMax Pro Meters.....	100
6.3.1 About PowerMax Pro Meter Measurements	100
6.3.2 Measurement Procedure	100
6.4 Perform a Pulse Analysis	105
6.4.1 Enable Pulse Analysis.....	105
6.4.2 View the Tending Chart	107
6.4.3 Capture Pulses	107
6.4.4 View and Save Results.....	110
6.5 Pyroelectric Energy Measurement.....	111
6.5.1 Set Up Basic Settings.....	111
6.5.2 Set a Trigger Level.....	112
6.5.3 Set Acquisition Measurement Settings.....	114
6.5.4 Start Measurement and View the Results	115
6.6 Display Statistics.....	116
6.7 Save a Log File.....	117
6.8 Export Capture Data to File.....	118
6.9 Export Log File to External Storage.....	118

7 Operation - Coherent Meter Connection	121
7.1 Overview	121
7.2 Graphical User Interface	122
7.2.1 Manage Display Cursors	122
7.2.1.1 Procedure	122
7.2.1.2 Selection Bounds Statistics.....	124
7.2.1.3 Energy Baseline	125
7.2.1.4 Snap To Triggers	125
7.2.1.5 Reset Cursors	126
7.2.1.6 Show Tracking Cursor.....	126
7.3 Take a Basic Power Measurement	126
7.3.1 Overview	127
7.3.2 Basic Measurement Procedure	127
7.3.3 Zoom Mode	131
7.4 Take a High-Speed Measurement	134
7.4.1 High-Speed Measurement Procedure	134
7.5 Take a Snapshot Measurement.....	138
7.5.1 Snapshot Sample Size	139
7.5.2 Overview of Process.....	140
7.5.3 Procedure: Define Settings	140
7.5.4 Procedure: Trial Measurement	143
7.5.5 Procedure: Take a Snapshot	144
7.6 Pulse Analysis	145
7.6.1 Enable Pulse Analysis.....	146
7.6.2 Display the Chart	147
7.6.3 Capture Pulses	148
7.6.4 Display Statistics	150
7.7 Pyroelectric Energy Measurement.....	152
7.7.1 Procedure	152
7.7.2 Set a Trigger Level.....	153
7.7.3 Display the Results	154
8 External Computer Control Host Commands	157
8.1 Communication Channels	157
8.2 Communication Protocol.....	158
8.3 External Control: Handshaking	170
8.4 Data Commands	170
8.4.1 READ.....	171
8.4.2 FETCH.....	171
8.5 Binary Data Transfer	172
8.6 Buffers and Data Flow.....	173
8.6.1 Valid File Paths	173
8.6.2 Valid File Types	174
8.7 Acquisition Commands	174

8.7.1 Duration	175
8.7.2 Buffer Size.....	176
8.7.3 Sample Rate	177
8.7.4 Decimation.....	177
8.8 Demo Source	177
8.8.1 Demo Source Frequency	178
8.8.2 Demo Source Function	178
8.8.3 Demo Source Pulse Rate	178
8.8.4 Horizontal Offset.....	178
8.8.5 Mode	179
8.8.6 State.....	179
8.9 Alarms and Limits Commands.....	179
8.9.1 Highlight Measurement Window	179
8.9.2 Stop on Fault	180
8.9.3 Fault Count.....	180
8.9.4 Maximum	180
8.9.5 Minimum.....	180
8.9.6 Pass Criteria.....	181
8.9.7 State.....	181
8.10 Configuration Commands.....	182
8.10.1 Analog Output Scale	182
8.10.2 Aperture Area	182
8.10.3 Area Correction	182
8.10.4 Auto Range.....	182
8.10.5 Data Headers	183
8.10.6 Data Item Select.....	183
8.10.7 Data Streaming Mode	185
8.10.8 Display Mode.....	185
8.10.9 Gain Compensation.....	185
8.10.10 Gain Factor.....	185
8.11 Measurement Source.....	186
8.11.1 Available Sources	186
8.11.2 Selected Source	186
8.11.3 Measurement Window (Integration Period)	186
8.11.4 Numeric Display Resolution	187
8.11.5 Operating Mode.....	187
8.11.6 Range List	187
8.11.7 Selected Range	187
8.11.8 Selected Wavelength.....	188
8.11.9 Smoothing (Pulse)	188
8.11.10 Smoothing (Time)	188
8.11.11 Statistics Display.....	188
8.11.12 Thermopile Speed-Up	189

8.11.13 Wavelength Correction	189
8.11.14 Wavelength List	189
8.11.15 Zero	189
8.12 Data Commands	190
8.12.1 Data Format	190
8.12.2 Data Gating	190
8.12.2.1 Abort	190
8.12.2.2 Initialize	190
8.13 Fetch	191
8.13.1 All	191
8.13.2 Missing	191
8.13.3 Next	191
8.13.4 Number of Records	192
8.13.5 Trend	192
8.13.6 Wait	192
8.13.7 Read Latest Measurement	193
8.13.8 Export Log Files and System Report	193
8.14 Display Commands	193
8.14.1 Backlight Enable	193
8.14.2 Backlight Intensity	194
8.14.3 Clear	194
8.14.4 Screenshot	194
8.14.5 Text	194
8.15 Logging Commands	195
8.15.1 Data Reduction	195
8.15.2 Condition	195
8.15.3 Count	195
8.15.4 Method	195
8.15.5 Time	196
8.15.6 Delimiter	196
8.15.7 Filename	196
8.15.8 Filename Conflict Resolution	197
8.15.9 State	197
8.16 Memory Commands	197
8.16.1 Catalog	197
8.16.2 Copy	198
8.16.3 Current Working Directory	198
8.16.4 Delete	198
8.16.5 Export Data File	198
8.17 File Transfer	199
8.17.1 File Close	199
8.17.2 File Data	199
8.17.3 File Open	200

8.17.4 Import Data File	200
8.17.5 Make Directory	200
8.17.6 Remove Directory Recursively	201
8.17.7 Rename File or Directory	201
8.18 State	201
8.18.1 Recall	201
8.18.2 Save	201
8.19 Miscellaneous Commands	201
8.19.1 Echo	201
8.19.2 Firmware Update	202
8.20 SCPI Common Commands	202
8.20.1 Identify	202
8.20.2 Reset	202
8.20.3 Self-Test	202
8.20.4 Wait	202
8.21 Statistics Commands	203
8.21.1 Clear	203
8.21.2 Limit	203
8.21.3 Mode	203
8.22 Results	204
8.22.1 1-Sigma	204
8.22.2 2-Sigma	204
8.22.3 3-Sigma	204
8.22.4 All	204
8.22.5 Count	205
8.22.6 Dose	205
8.22.7 Flags	205
8.22.8 Max	205
8.22.9 Mean	205
8.22.10 Min	206
8.22.11 Missed	206
8.22.12 Range	206
8.22.13 Standard Deviation	206
8.22.14 Wait	206
8.23 System Commands	207
8.23.1 Battery	207
8.23.1.1 Health	207
8.23.1.2 Percent Remaining	207
8.23.1.3 Status	207
8.23.2 Time	207
8.23.3 Time Format	207
8.24 Communication Settings	208
8.24.1 Ethernet	208

8.24.1.1 DHCP	208
8.24.1.2 Gateway	208
8.24.1.3 Hostname	208
8.24.1.4 IP Address	209
8.24.1.5 MAC Address	209
8.24.1.6 Port	209
8.24.1.7 Subnet Mask	209
8.24.2 Handshaking	209
8.24.3 RS-232	210
8.24.3.1 Baud Rate	210
8.24.3.2 Flow Control	210
8.24.3.3 Parity	210
8.24.3.4 Stop Bits	210
8.24.4 Date	211
8.25 Instrument Information	211
8.25.1 Board ID	211
8.25.2 CPU Temperature	211
8.25.3 Calibration Date	211
8.25.4 FPGA Firmware Version	211
8.25.5 FPGA Hardware Version	211
8.25.6 Firmware Version	212
8.25.7 Instrument Type	212
8.25.8 Manufacture Date	212
8.25.9 Part Number	212
8.25.10 Serial Number	212
8.26 Power Management	212
8.26.1 Restart	212
8.26.2 Shutdown	213
8.27 Probe Information	213
8.27.1 Calibration Date	213
8.27.2 Code	213
8.27.3 Diameter	213
8.27.4 Model	213
8.27.5 Responsivity	213
8.27.6 Serial Number	214
8.27.7 Temperature	214
8.27.8 Type	214
8.28 Remote Lockout	214
8.28.1 Local	214
8.28.2 Remote	214
8.28.3 Self-Test	214
8.29 Status	216
8.30 System Error Queue	217

8.30.1 All Errors	217
8.30.2 Clear	218
8.30.3 Error Count	218
8.30.4 Next Error	218
8.31 Trigger Commands	219
8.31.1 Force Trigger	219
8.31.2 Free-Run Mode	219
8.31.3 Pulsed Thermopile Joules Level	219
8.31.4 Trigger Delay	220
8.31.5 Trigger Level	220
8.31.6 Trigger Slope	220
8.32 Trigger Source	220
8.32.1 Trigger Status	221
9 Troubleshooting	223
9.1 Safe Mode	223
9.2 Measurement Errors	224
9.3 Zero the Meter	224
Appendix A: Parts and Accessories	225
A.1 Shipped with Meter	225
A.2 Optional Accessories	226
A.3 Shop.Coherent	226
Appendix B: Replace the Battery	227
B.1 Remove the Old Battery	227
B.2 Prepare the Replacement Battery	228
B.3 Insert the New Battery	229
B.4 Dispose of the Used Lithium Battery	230
Appendix C: Safety	231
C.1 Laser Safety Hazards	231
C.1.1 Optical Safety	232
C.1.1.1 Laser Safety Eyewear	232
C.1.1.2 Viewing Distance	233
C.1.1.3 Maximum Accessible Radiation Level	233
C.1.2 Laser Back Reflection	233
C.1.3 Precautions for Laser Safety	234
C.2 Electrical Safety	235
C.2.1 Electrical Safety Precautions	235
C.2.2 ESD Protection	236
C.3 Safety for Lithium Batteries	236
C.3.1 Battery Operating Temperature	237
C.3.2 Battery Safety Precautions	238
C.3.3 Battery Long-Term Storage	238

C.3.4 Packing or Recycling the Battery.....	238
C.3.5 Transportation.....	239
Appendix D: Compliance	241
D.1 CE Marking	241
D.2 Electromagnetic Compatibility	241
D.3 Coherent Corp. Global Product Environmental Compliance Statement	242
Appendix E: Service and Support	243
E.1 Technical Support.....	243
E.1.1 Support in the USA and North America.....	243
E.1.2 International Support.....	244
E.2 Obtain Service	244
E.3 Product Shipping Instructions	245
Appendix F: Warranty	247
F.1 Responsibilities of the Buyer	247
F.2 Limitations of Warranty	247
Appendix G: Extended Warranty	249
G.1 Extended Warranty	249

LIST OF FIGURES

2-1. LabMax Touch Pro Meter.....	8
2-2. Shipped with the Meter.....	11
2-3. LabMax Touch Meter – Front Panel	12
2-4. LabMax Touch Meter – Back Panel	14
2-5. Kickstand for the LabMax Touch Meter	14
2-6. Lithium-Ion Battery.....	15
2-7. Battery Dimensions	15
2-8. LabMax Touch Meter – Input/Output Ports	16
2-9. Trigger In Cable	17
2-10. Multi-Output Cable.....	18
2-11. Tri-Output Connectors	18
2-12. Connectors - Top	19
2-13. LabMax Touch Meter – Connector Ports	19
2-14. Power Button on the Meter.....	20
2-15. Dimensions – Front and Back Panel	22
2-16. Dimensions – Side Panels	22

2-17.	Dimensions – End Panels	23
3-1.	Connect the Meter to a Sensor	28
3-2.	Use HDMI to Attach External Monitor	29
3-3.	Use Mouse for Button Controls.....	29
3-4.	Connect the Meter to a PC	30
3-5.	Power Button on the Meter.....	31
3-6.	Meter Mount Accessory Kit	32
3-7.	Dimensions for the Mounting Brackets	33
3-8.	Brackets to Mount Meter	33
3-9.	Drill Holes to Mount Brackets.....	34
3-10.	Attach the Mounting Clips to DIN Rails	35
3-11.	Install CMC Software First	37
3-12.	Startup Splash Screen	38
4-1.	Touch Meter Main Screen– Example	39
4-2.	Touchscreen – Swipe to Change Views	40
4-3.	Top Information Bar – Meter/Sensor Information	40
4-4.	Top Information Bar – Live Measurement Value	40
4-5.	Top Information Bar – Status Information.....	41
4-6.	Main Window – Bottom Information Bar	43
4-7.	Configure Sample Rate - Dial	44
4-8.	Configure Sample Rate - Keypad	44
4-9.	Configure General, Acquisition, Analysis Settings.....	45
4-10.	Configure System Utilities, View Settings	46
4-11.	Configure General Settings	47
4-12.	Configure Communication Settings - Ethernet.....	47
4-13.	Configure Communication Settings - RS-232	48
4-14.	Acquisition Settings in Main Settings Window	49
4-15.	Configure General Acquisition Settings	50
4-16.	Screenshot Mode Selection Options	50
4-17.	Acquisition Settings - Trigger	52
4-18.	Configure Acquisition Settings for Measurement.....	53
4-19.	Select a Different Wavelength	54
4-20.	Configure – Add a New Wavelength	55
4-21.	Configure – Remove a Wavelength	55
4-22.	Configure Data Logging	56
4-23.	Analysis Settings in Main Settings Window	57

4-24.	Configure Alarms and Limits	58
4-25.	Pulse Analysis - Thresholds	58
4-26.	Pulse Analysis - Display Settings.....	59
4-27.	Pulse Analysis - Results of Data Collection	59
4-28.	Import/Export Utilities.....	60
4-29.	Configure Data Import Capture	61
4-30.	Configure Export Capture	62
4-31.	List of Local Log Files.....	63
4-32.	Export Statistical Analysis.....	63
4-33.	Configure File Explorer.....	64
4-34.	Trend View	65
4-35.	Trend View Settings	66
4-36.	Trend View Settings	67
4-37.	Trend View with Time in Seconds.....	67
4-38.	Tuning View Settings.....	68
4-39.	Configure Statistics Settings	68
4-40.	Configure Histogram	69
4-41.	Photonics Calculator Screens	70
4-42.	Power Limits Calculator Screen	71
4-43.	Start-Up Splash Screen	72
4-44.	System Information	72
4-45.	Firmware Update Settings.....	73
4-46.	Firmware Update Settings.....	74
5-1.	Touch Meter Histogram View	76
5-2.	Statistics View	76
5-3.	Touch Meter Tuning View.....	77
5-4.	Tuning Over Range.....	77
5-6.	Trend Zoom View	78
5-5.	Trend View	78
5-7.	Long Pulse Energy Calculation.....	79
5-8.	Touch Meter Power Measurement View	80
5-9.	Touch Meter Power Measurement View	80
5-10.	Touch Meter Beam Position View	81
5-11.	Bottom Information Bar - Watts Mode.....	81
5-12.	Sample Rate Setting.....	82
5-13.	Sample Count Setting Dial	83
5-14.	Bottom Information Bar - Energy Joules Mode	83

5-15.	Auto Range Mode Selection - via Settings Menu or via Bottom Button Panel.....	84
5-16.	Indicator Display Types	85
5-17.	Meter is not Zeroed Popup Message	86
5-18.	Meter is not Zeroed Warning Indicator	87
5-19.	Bad Zero Error	88
5-20.	External Trigger Input Circuitry	90
5-21.	Boost Source Current of Triggering Device	90
5-22.	Trigger Settings.....	91
5-23.	Trigger Level Setting	92
6-1.	Settings Main Menu	96
6-2.	Acquisition Settings	96
6-3.	Set Operating Range from Settings Menu or Bottom Button Bar	97
6-4.	Acquisition Settings - Measurement	97
6-5.	Select Wavelength.....	98
6-6.	Trend View	99
6-7.	Log File Button	99
6-8.	Acquisition Settings - Measurement	101
6-9.	Set Operating Range from Settings Menu or Bottom Button Bar	102
6-10.	Select Wavelength.....	103
6-11.	Log File Button	104
6-12.	Trend View (with zoom)	104
6-13.	Pulse Analysis Settings.....	106
6-14.	Trending Charts.....	107
6-15.	Display Trending View	108
6-16.	Trend Settings for Zoom	109
6-17.	Pulse Analysis Results	109
6-18.	Pulse Analysis Results	110
6-19.	Bottom Information Bar - Energy Joules Mode Selected	111
6-20.	Acquisition Settings	112
6-21.	Select Wavelength.....	112
6-22.	Acquisition Settings - Trigger	113
6-23.	Trigger Level Setting	114
6-24.	Configure Acquisition Measurement Settings.....	114
6-25.	Log File Button	115
6-26.	Statistics View	117
6-27.	Configure Data Logging	117
6-28.	Save to File Settings	118

6-29.	List of Local Log Files.....	119
6-30.	List of Local Log Files.....	120
7-1.	Trending Options	122
7-2.	Trending Window	123
7-3.	Zoom In/Out of the Pulse Display	124
7-4.	Selection Bounds	124
7-5.	Set Energy Baseline.....	125
7-6.	Snap to Trigger	125
7-7.	Show Tracking Cursor	126
7-10.	Data Buffer Settings.....	128
7-8.	Settings for a Power Measurement	128
7-9.	Zero to Set Baseline	128
7-13.	Display Trending Graphics Panel	129
7-11.	Measurement Tab Settings	129
7-12.	Select the Wavelength	129
7-15.	Stop Measurement.....	130
7-14.	Start Measurement	130
7-16.	Trending View.....	131
7-17.	Export or Clear the Capture	131
7-18.	Zoom Mode	132
7-19.	Select the Area to Zoom	133
7-20.	Zoom Options.....	133
7-21.	Example – High-Speed Mode	134
7-22.	Select Range	135
7-23.	Examples - High-speed Mode	136
7-24.	Loading Graphics View.....	137
7-25.	Example – Snapshot Mode	139
7-26.	Trigger Settings.....	142
7-27.	Show Trigger Markers	142
7-28.	Show Trigger Event	143
7-29.	Set Snapshot Mode	144
7-31.	Loading Snapshot.....	145
7-30.	Trigger Event Detected.....	145
7-32.	Select Pulse Analysis	146
7-33.	Optional Selection for Pulse Analysis	147
7-34.	Display Trending Chart.....	147
7-35.	Analysis Results	148

7-36.	No Pulse Detected	148
7-37.	Capture Pulses.....	149
7-38.	Pulse Analysis Results	149
7-39.	Compare Captures	150
7-40.	View Multiple Pulses.....	150
7-41.	Select Analysis Options.....	151
7-42.	Select Range	152
7-43.	Set Trigger	153
7-44.	View Data Collection.....	155
8-1.	Buffers and Data Flow.....	173
9-1.	Startup in Safe Mode	223
9-2.	Error Indicator Types.....	224
B-1.	Lift the Kickstand	228
B-2.	Unpack the Battery.....	228
B-3.	Connect Battery Cable	229
B-4.	Tuck In Battery Cable.....	229
B-5.	Label for Lithium Ion Battery	230
C-1.	Label for Lithium Ion Battery	239

LIST OF TABLES

2-1.	Compatible Sensors	10
2-2.	Functional Buttons on the Case.....	12
2-3.	Input/Output Ports on the LabMax Touch Meter.....	16
2-4.	Connector Ports Supported	19
2-5.	LED Status	21
2-6.	Physical Characteristics	24
2-7.	Temperature and Humidity	24
2-8.	Measurement Ranges.....	24

4-1.	Status Indicator Icons	41
4-2.	Trigger Status Icons.....	42
4-3.	Quick Access Toolbar.....	43
6-1.	Measurement Types.....	94
7-1.	Select Cursor	123
8-1.	Touch Meter Host Commands.....	158
8-2.	User-Accessible Data Locations	174
8-3.	File Types.....	174
8-4.	Duration for Fast Sensors (PMP)	175
8-5.	Duration for Slow Sensors (Thermopile, Optical).....	176
8-6.	Pass Criteria	181
8-7.	Data Items in FETCH Data.....	183
8-8.	Bits in the FLAG Field.....	184
8-9.	Mode to Open File	200
8-10.	Self-Test Procedure	215
8-11.	Status Bits.....	216
8-12.	System Error Codes	217
A-1.	Cables for the LabMax Touch Meter	225
A-2.	Accessories for the LabMax Touch Meter	226
C-1.	Lithium Ion Battery Operating Temperatures	237
C-2.	Lithium Ion Battery Storage Temperature	238

1 Introduction

This *Operator's Manual* introduces the LabMax Touch Meter:

- Learn about the LabMax Touch Meter (p. 7)
- Set up and connect the LabMax Touch Meter (p. 7)
- Learn about User Interface (p. 39)
- Try various Modes of Operations (p. 75)
- Follow the mini-tutorials to perform specific tasks (p. 121)

1.1 Safety Warnings

This section provides information about signal words and safety symbols that you need to know before you begin.

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

Anyone using the LabMax Touch Meter with lasers, meters, and sensors must first read and understand how safety information is presented prior to beginning any tasks.



NOTICE

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

1.1.1 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.

1.1.2

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 additional information.



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.

1.2

Preface

This manual contains user information for the product.



NOTICE

Read this manual carefully before operating the laser for the first time. Failure to follow the instructions and safety precautions in this manual can result in serious injury or death. Special attention must be given to the material in the Safety section, that describes the safety features built into the laser. Keep this manual with the product and in a safe location for future reference.



DANGER!

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

1.3 Export Control Laws

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

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

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

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

Declaration of Conformity certificates are available upon request.

1.4 The Operator's Manual

This Operator Manual is designed to familiarize the user with the LabMax Touch Meter and its designated use. It contains important information on how to install, operate, and troubleshoot the meter with a laser system safely, properly, and most efficiently. Observing these instructions helps to avoid danger, reduce repair costs, and downtimes and increase the reliability and lifetime of laser systems.

The screenshots in this manual are only examples and may show configurations or parameter settings which do not apply to the laser system. Changing parameter settings to correspond with screenshots may reduce laser performance or even damage the laser system!

2 Description and Specifications

2.1 Introduction

The Coherent LabMax Touch Meters represent the latest generation of high-performance instrumentation for laser power and energy measurement. The meter is designed to support the most demanding measurement applications in the lab while also offering reliability in the field.

These meters provide full compatibility with the full Coherent catalog of laser power and energy sensors. They can handle the full range of sampling rates provided by the sensors, including PowerMax Pro sensors.

- The standard LabMax Touch Meter samples up to 25 kHz with pyro-electric energy sensors and 10 Hz with thermopile, optical and PowerMax-Pro sensors.
- The LabMax Touch Pro Meter model increases sample rate to 1,000,000/sec with PowerMax-Pro sensors and adds advanced analytics like integrated energy and laser pulse width. The sampling rate is user-adjustable between 10 to 1,000,000 samples per second.

The all-new touchscreen interface provides easy access to measurement data and analytics including live display, statistics, trending, tuning, histogram, and beam position information.

This section introduces the LabMax Touch Meter, shown in Figure 2-1 It describes the components and features of the hardware and its connectivity, the dimensions and specifications.



Figure 2-1. LabMax Touch Pro Meter

2.2 Features

The LabMax Touch Meter offers several key features and performance factors:

- 25 kHz sample rate with pyroelectric sensors
- High-speed sampling up to 1,000,000/sec for with PowerMax-Pro and thermoelectric sensors (LabMax Touch Pro model only)
- 7-inch capacitive touchscreen LCD with LED backlight and wide viewing angles
- USB 2.0, RS-232, and Ethernet PC interfaces
- Two USB flash drive ports and HDMI output port
- Compatible with Coherent Meter Connection PC software
- Windows 10 compatible (32-bit and 64-bit)
- ISO 17025 accredited

Other features of the LabMax Touch Meter include:

- A rugged enclosure with an anti-slip grip
- A bumper on the edges of the case to provide shock/vibration protection

- A built-in heat sink for thermal protection

The remainder of this section provides a 'tour' of the LabMax Touch Meter. For information about Parts and Accessories - see 'Parts and Accessories' (p. 225)

Coherent Meter Connection PC Software and User Manuals are available for download from Coherent website.

2.2.1

Models Available

There are two models available for the LabMax Touch Meter:

- **LabMax Touch Pro Meter** — P/N 2256259
 - Larger on-board memory
 - Enhanced support for PowerMax-Pro sensors
 - PowerMax-Pro analytics including pulse shape analysis and pulse energy integration
 - High speed sampling of PowerMax-Pro measurement channel up to 1,000,000/sec
 - Measures energy with PowerMax-Pro sensors
- **LabMax Touch Meter (standard model)** — P/N 2256258
 - While the hardware is the same, the standard model offers a more simplified version of the User Interface.
 - The standard LabMax Touch Meter operates PowerMax-Pro sensors only in slow mode (10 Hz only)
 - The standard LabMax Touch Meter does not offer energy measurements for PowerMax-Pro sensors

Each meter is shipped with AC power adapter, power cord, USB cable, 2.5mm stereo AUX to DB9 RS-232 cable, 3.5mm AUX to BNC Trigger-in cable, Multi-Output cable (analog out, trigger out, flag out), and certificate of calibration.

The Cat5 Ethernet cable and an HDMI cable must be supplied by the customer.

2.2.2

Applications

The LabMax Touch Meter supports numerous applications, including:

- R&D and Laboratory

- Scientific
- Manufacturing
- Quality Assurance
- Field Service

2.2.3 Compatibility

the LabMax Touch Meter is compatible with a variety of sensors, including the PowerMax-Pro sensor, PM and LM-model thermopiles, OP-2/LM-2 optical sensors, EnergyMax DB25-model pyroelectric sensors, and Transverse Thermoelectric sensors.

Table 2-1 shows the compatible sensors and sample rates:

Table 2-1. Compatible Sensors

Type	Compatibility	Sample Rates
Pyroelectric	EnergyMax DB-25 pyroelectric sensors	<ul style="list-style-type: none">• Repetition Rate: Measure 25 kHz• Every pulse
Optical	LabMax and PowerMax optical sensor models (such as OP-2/LM-2)	<ul style="list-style-type: none">• Sample Rate: 10 Hz
Thermopile	LabMax and PowerMax thermopile models (such as LabMax-10 and PowerMax-10)	<ul style="list-style-type: none">• Supports quadrant beam position data when using LabMax-model thermopiles• Sample Rate: 10 Hz
Transverse Thermoelectric	PowerMax-Pro transverse thermoelectric models	<ul style="list-style-type: none">• 10 Hz (LabMax Touch)• Variable 10 Hz to 1 MHz (LabMax Touch Pro Model Only)

2.2.3.1 Shipped with Meter

The LabMax Touch Meter comes with the cables and accessories shown in Figure 2-2.

More details are given about these cables later in this section:

- USB A-to-USB B Mini cable (P/N 1108906)
- RS-232 cable with mini plug adapter (P/N 2237377)
- Trigger-Input cable (P/N 2237381)



Figure 2-2. Shipped with the Meter

- Multi-Output cable (P/N 2237382)

The Power Supply (P/N 1256370) is included with the LabMax Touch Meter.

2.3 Product Description

The LabMax Touch Meter can be viewed as follows:

- Front panel:
 - Functional control buttons
 - Display
- Back panel:
 - Battery
 - Meter stand
- Top of case — Communication Ports
- Edge of case — Input/Output Ports

2.3.1 Front Panel

The front panel of the LabMax Touch Meter is shown in Figure 2-3:



Figure 2-3. LabMax Touch Meter – Front Panel

2.3.1.1 Functional Control Buttons

The functional buttons on the front panel of the case for the LabMax Touch Meter are briefly described in Table 2-2. Also see 'Touchscreen User Interface' (p. 39) for details about how the user interface changes when these buttons are pressed.

Table 2-2. Functional Buttons on the Case

Button	Description
Back	Provides a quick way to cancel an operation, close a window and return to the previous view without accepting any changes
Menu	Displays the top-level menu with icons for the different function windows on the touchscreen.
Wavelength	Displays the wavelength selection dialog.
Zero	Cancels out any measurement offset caused by stray light, temperature, or sensor variations.
Run/Stop	Press RUN to begin capturing data into the trend buffer. Press STOP to stop capturing data to the buffer.

2.3.1.2

LCD Display

The front panel includes a display touchscreen with the following features:

- 1024 x 600 pixel color TFT LCD
- Active area 7" diagonal, capacitive touch-screen interface
- The LED backlight operates from either a power supply connected to the LabMax Touch Meter or the internal battery; the backlight level is user adjustable
- Display Rate
 - 3 Hz refresh rate for numeric display and static GUI elements
 - 15 Hz refresh rate for bar graph and needle tuning features



CAUTION!

Take necessary precautions or shielding to protect the display from electrostatic discharge to prevent damage or degradation of performance.

See 'Touchscreen User Interface' (p. 39) for details about the layout and functions of the User Interface.

2.3.1.3

Care and Handling of the Touchscreen

The display on the touchscreen is made of glass. Use normal precautions when handling so that you do not drop or apply excessive force on the glass.

If the display becomes dirty or contaminated, gently wipe with a clean, dry, soft cloth that will not scratch the surface. If the display remains dirty or contaminated, moisten the cloth with a small amount of either isopropyl alcohol or ethyl alcohol. Using water or any solvent other than those can contaminate the display; in particular, do not use Ketone or any aromatic solvents.

When storing the LabMax Touch Meter, do not leave in direct sunlight or prolong exposure to fluorescent lights.

2.3.2

Back Panel

The back of the LabMax Touch Pro Meter is shown in Figure 2-4:



Figure 2-4. LabMax Touch Meter – Back Panel

Note that, on the back panel of the case for the LabMax Touch Meter, there is a door over the battery compartment and air vents to provide thermal protection for the meter.



IMPORTANT NOTICE

Do not block the air flow over the vents on the back panel. This results in overheating and can distort measurements!

2.3.2.1

Kickstand

The case for the LabMax Touch Meter includes a kickstand that can be used to adjust viewing angles, as shown in Figure 2-5.



Figure 2-5. Kickstand for the LabMax Touch Meter

2.3.2.2

Battery

The battery in the LabMax Touch Meter is shipped with at least an hour of battery life, depending on the amount of charge already in the battery, time held in stock, calibration time, and shipping time. Connecting power to the meter automatically begins charging the battery; see 'Apply Power to the Meter' (p. 30).

The battery charges to full capacity while connected to power.

The LabMax Touch Meter includes a 7.2V 5.2Ah LI-ION (Lithium Ion) battery, shown in Figure 2-6.



Figure 2-6. Lithium-Ion Battery

The dimensions are shown in Figure 2-7:

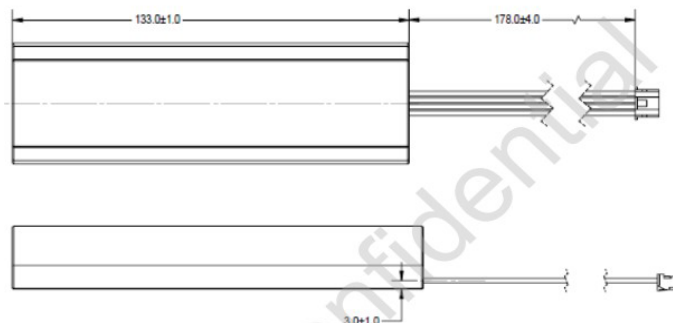


Figure 2-7. Battery Dimensions

The battery specifications are as follows:

- Peak usage: 2000mA
- Typical Usage: 1400mA

The battery life depends on the brightness of the touchscreen. For example, if you set backlight brightness at the following levels, the battery life while idle is approximately:

- With **0%** brightness: 7 hours
- With **20%** brightness: 6.5 hours
- With **100%** brightness: 4 hours

The time for operation between charges varies, as power consumption is dependent on what is running and if the unit is charging or not.

2.3.3 Side Panels and Ports

The right side panel of the LabMax Touch Meter provides connectivity to a sensor, as well as cable connections for trigger activities. The right side panel is shown in Figure 2-8. The left side panel has no connectors.



Figure 2-8. LabMax Touch Meter – Input/Output Ports

Descriptions for the ports on the side of the LabMax Touch Meter are shown in Table 2-3:

Table 2-3. Input/Output Ports on the LabMax Touch Meter

Port	Description
DB-25 (Sensor)	For connection to DB-25 PowerMax-Pro sensors and other devices
External Trigger Input Port	Trigger Input (3.5mm AUX Socket) TTL Compatible, 2-6 V @ 0.4 mA

Table 2-3. Input/Output Ports on the LabMax Touch Meter (Continued)

Port	Description	
Multi Output Port (Configurable to TTL) 3.5 mm AUX Socket	Analog Output	0 to 1, 2, or 4 VDC (user selectable) <ul style="list-style-type: none"> • 0.03% resolution • $\pm 0.2\%$ (of reading) $\pm 0.3\%$ (of full scale) accuracy • 50 ohms impedance
	TTL Outputs: <ul style="list-style-type: none"> • Trigger Output • Flag Output 	Configurable to TTL output 0V (low) or 5V (high)

Triggering is done with either an external trigger input or a user-adjustable internal trigger. See 'Trigger States' (p. 89) for details.

There is also an internal software trigger for pyroelectric sensors; 0% to 100%, 1.0% resolution (with a 5.0% default trigger level).

The Trigger In cable is shown in Figure 2-9:

**Figure 2-9. Trigger In Cable**

The Multi-Output Cable (P/N 2237382) is shown in Figure 2-10. This cable is shipped with the LabMax Touch Meter.

Figure 2-11 shows the different outputs:



Figure 2-10. Multi-Output Cable

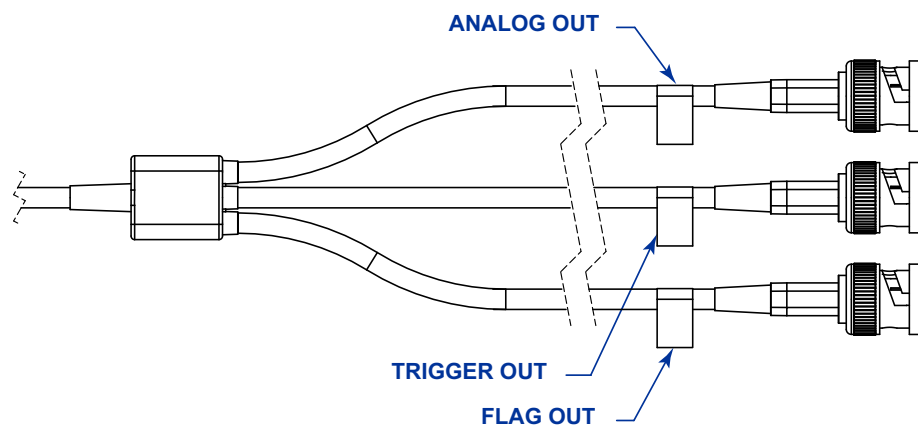


Figure 2-11. Tri-Output Connectors

2.3.3.1 Top Panel and Connectors

The connectors on the top panel of the LabMax Touch Meter are shown in Figure 2-12:



Figure 2-12. Connectors - Top

The various connector labels are shown in the illustration in Figure 2-13:

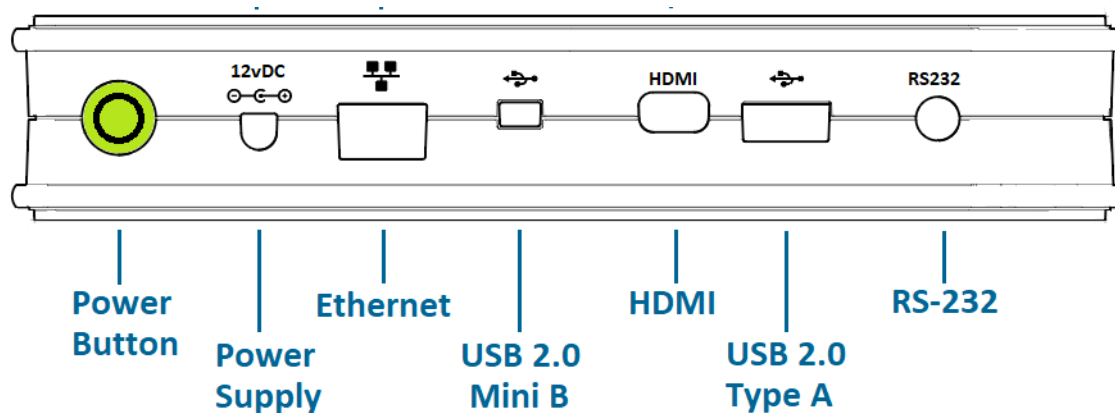


Figure 2-13. LabMax Touch Meter – Connector Ports

The various top panel connectors are described in Table 2-4:

Table 2-4. Connector Ports Supported

Port	Notes
Power button	Toggles power ON and OFF. Displays when set to ON.
Power Supply Input	Connects a 12 VDC power supply (P/N 1256370).
Ethernet RJ-45	Allows remote access through a network.

Table 2-4. Connector Ports Supported (Continued)

Port	Notes
USB 2.0 Mini-B	Miniature USB PC Interface port. Allows user to configure, send, and receive data for operation with the LabMax Touch Meter.
HDMI Output	Connects to an external monitor with a mini-HDMI cable.
USB 2.0 Type A	Allows access to an external USB flash drive for data logging or software upgrades.
RS-232	Operates as RS-232 with use of a special cable adapter (maximum baud rate of 115200). 2.5 mm stereo AUX socket. (not supplied)

The Power button is located at the end of the Connector panel on top of the meter. This button sets the meter ON and OFF, and displays in green when turned ON, as shown in Figure 2-14:



Figure 2-14. Power Button on the Meter

See 'Installation' (p. 27) for details about use of the Power button either with dedicated power (the power supply plugged in) or when using the battery.

2.3.3.2 Power and Status LED Indicator

The Power button LED on the LabMax Touch Meter displays the current status of the system and the battery.

There are four (4) colors that the Power button displays, depending on whether the device is powered on or off:

- **GREEN:** Power is ON (either from the battery or when plugged in).

- **YELLOW**: The battery is charging.
- **BLUE**: The battery is fully charged and a power supply is attached.
- **RED**: Failed to charge or a fault condition exists.

Table 2-5 lists the different LED states:

Table 2-5. LED Status

LED	State	
	ON	OFF
Charging	Green	Yellow
Fully Charged	Green	Blue
Fault Condition	Red	Red

Two other cables that can be used with the LabMax Touch Meter are customer supplied and are not included with the product. Contact your local vendor to purchase these cables.

- CAT5 Ethernet cable
- Mini HDMI cable

See 'Parts and Accessories' (p. 225) for additional information and part numbers for items associated with the LabMax Touch Meter.

2.4 Dimensions

Both models of the LabMax Touch Meter are the same size. The additional features and functions of the LabMax Touch Pro Meter version are accessed through the software.

2.4.1 Front and Back Panel Dimensions

The dimensions for the front and back panels are shown in Figure 2-15:

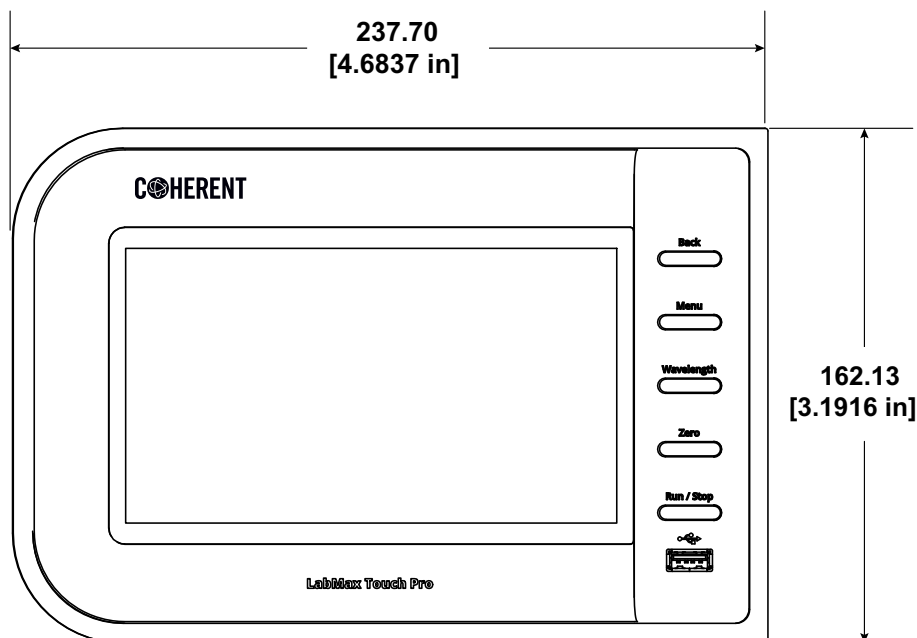


Figure 2-15. Dimensions – Front and Back Panel

2.4.2 Side Panel Dimensions

The dimensions for the side panels are shown in Figure 2-16:

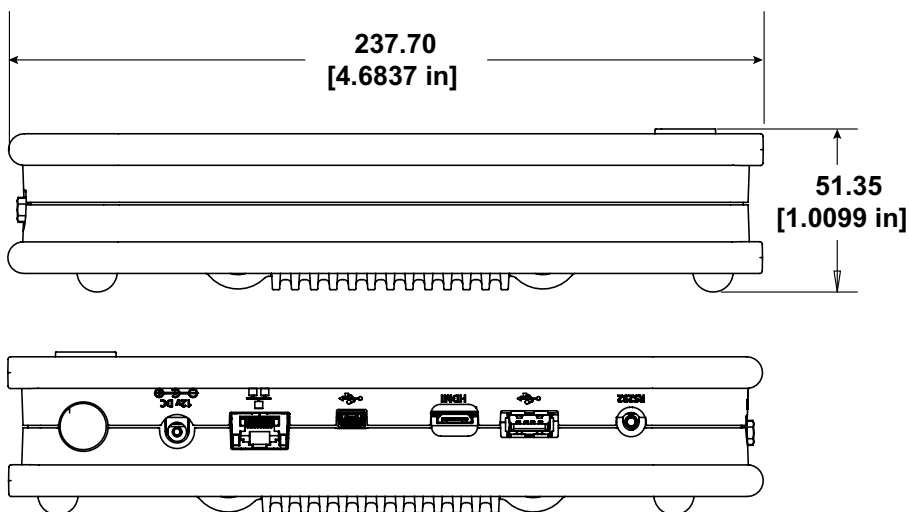


Figure 2-16. Dimensions – Side Panels

2.4.3 End Panel Dimensions

The dimensions for the end panels are shown in Figure 2-17:

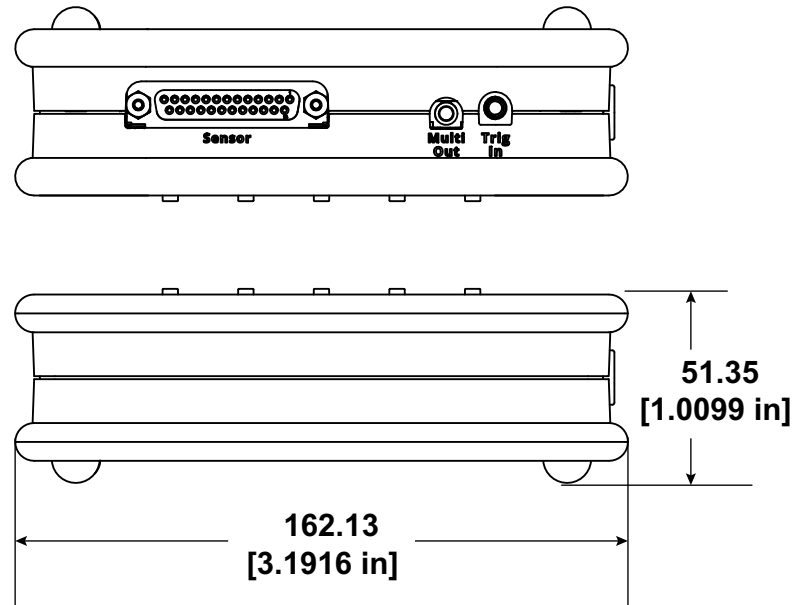


Figure 2-17. Dimensions — End Panels

2.5 Specifications

This section describes the specifications for the LabMax Touch Meter, including:

- Physical Characteristics
- Temperature and Humidity
- Measurement Ranges and Accuracy

2.5.1 Physical Characteristics

Table 2-6 shows the ranges and accuracy for measurements taken with the LabMax Touch Meter.

Table 2-6. Physical Characteristics

Measurement	Notes
LCD Display	1024 x 600 pixel color TFT LCD, 7" diagonal, capacitive touch-screen, LED backlight
Display Resolution	3 to 5 digits (user selectable)
Computer Interface	Ethernet, USB and RS-232
Dimensions	23.8 cm x 16.2 cm x 5.1 cm (9.37 in. x 6.37 in. x 2.0 inches)
Weight	1190 g (2.62 pounds)
Compliance	CE, UKCA, RoHS, WEEE, ISO 17025

2.5.2 Temperature and Humidity

Table 2-7 shows the temperature and humidity ranges for operation and storage of the LabMax Touch Meter.

Table 2-7. Temperature and Humidity

Operations	Temperature	Humidity
Battery Operating Temperature Range	0 to 40°C	0 to 95% RH, non-condensing
Power Adapter Operating Temperature Range	0 to 50°C	0 to 95% RH, non-condensing
Storage	-20 to 60°C	0 to 95% RH, non-condensing

2.5.3 Measurement Ranges and Accuracy

Table 2-8 shows the ranges and accuracy for measurements taken with the LabMax Touch Meter.

Table 2-8. Measurement Ranges

Measurement	Notes
Meter Accuracy	±1%
System Accuracy	Meter accuracy + sensor accuracy

Table 2-8. Measurement Ranges (Continued)

Measurement	Notes
Analog Output Accuracy	$\pm 0.04\%$ (25% to full scale) $\pm 0.26\%$ (5% to 25% of full scale) $\pm 1\%$ (min to 5% of full scale)
Analog Output Update Rate	500 Hz
Calibration Uncertainty (k=2)	$\pm 1\%$
Measurement Resolution	0.1% of full-scale
Frequency Measurement	<ul style="list-style-type: none"> 0-10000 Hz: 0.1% accuracy 10000-20000 Hz: 0.5% accuracy
Measurement Range	<ul style="list-style-type: none"> 1 μW to 30 kW, with 100 nW resolution in the lowest range using corresponding thermopiles. 100 pW to 5 W with 10 pW resolution in the lowest range using corresponding optical sensors. 10 nJ to 100 J with 1 nJ resolution in the lowest range using corresponding pyroelectric detectors. 1 mW to 3 kW, with 100 μW resolution in the lowest range using corresponding transverse thermoelectric sensors
Measurement Analysis	LabMax Touch Meter: Trending, tuning, histogram, data logging, statistics (minimum, maximum., mean, range, standard deviation, dose, stability)
	LabMax Touch Pro Meter: LabMax Touch features + Pulse analysis, Pulse shape, and high speed analytics with PowerMax-Pro Sensors
Thermopile Channel Sampling Rate (Hz)	LabMax Touch Meter: 10 Hz LabMax Touch Pro Meter: 1 to 10 Hz
Optical Channel Sampling Rate (Hz)	LabMax Touch Meter: 10 Hz LabMax Touch Pro Meter: 1 to 10 Hz
Pyroelectric Channel Sampling Rate (Hz)	25,000 Hz
PowerMax Pro (Hz)	LabMax Touch Meter: 10 Hz LabMax Touch Pro Meter: 10 to 1,000,000 Hz
Analog Output (VDC)	0.02 to 1, 2, or 4 VDC (selectable)
Analog Output Resolution (mV)	0.1 mV

3 Installation

- This section provides instructions about how to set up and connect the LabMax Touch Meter. It also shows how to install the measurement software.

Optionally, to put the meter in a fixed location, the meter can be mounted on DIN rails; see 'Mount the Meter' (p. 31).



CAUTION!

Before connecting devices, follow all laser safety procedures; see 'Safety' (p. 231). The laser must be blocked or switched OFF before starting any activity involving laser measurement.

3.1 Connect the Meter

Refer to 'Safety' (p. 231) for required safety precautions when using lasers.



CAUTION!

Take precautions to avoid Electrostatic Discharge (ESD) when setting up equipment.

To set up the LabMax Touch Meter:

- Connect a sensor to the LabMax Touch Meter
- (Optional) Connect the LabMax Touch Meter to a PC
- Connect the power supply to the LabMax Touch Meter
- Set the power to the meter to ON

Each of these steps are described in the subsections that follow.

3.1.1 Connect to a Sensor

To connect the meter to a sensor:

1. Attach a PowerMax-Pro sensor to the LabMax Touch Meter with the DB-25 connector, as shown in Figure 3-1:



Figure 3-1. Connect the Meter to a Sensor

- If no sensor is present, then the default view will be the MAIN MENU view after power is applied to the meter.
- Any time the meter is set to ON and no sensor is detected, a warning message is displayed. See the section, 'Troubleshooting' (p. 223), for information about errors displayed.
- If a sensor is connected, the meter defaults to the last mode used with that sensor type (thermopile, optical, pyroelectric, transverse thermoelectric or PowerMax Pro). The modes used include MEASURE, TUNE, TREND, STATISTICS, and BEAM POSITION.

Wavelength settings persist rather than being changed when a new sensor is attached. If the wavelength is out of range, it will switch to the calibration wavelength for that sensor.

3.1.2 Connect to an External Monitor

To view measurements in a larger format, connect the meter to an external monitor using a mini HDMI cable, as shown in Figure 3-2:

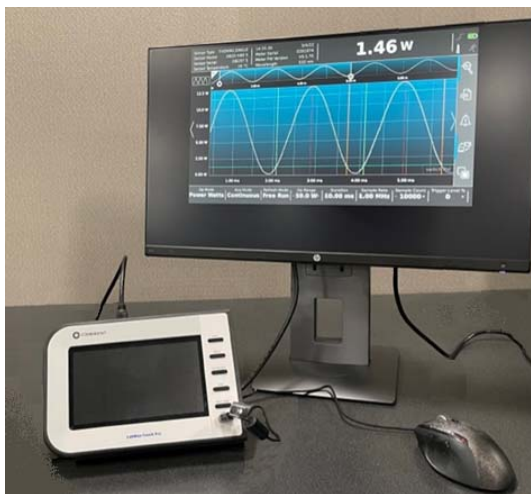


Figure 3-2. Use HDMI to Attach External Monitor

A mouse is required to change the controls. A left-click becomes the new finger touch. A right-click opens a small menu that has five buttons. Refer to Figure 3-3. These five buttons provide the same functions as the actual physical buttons on the meter.

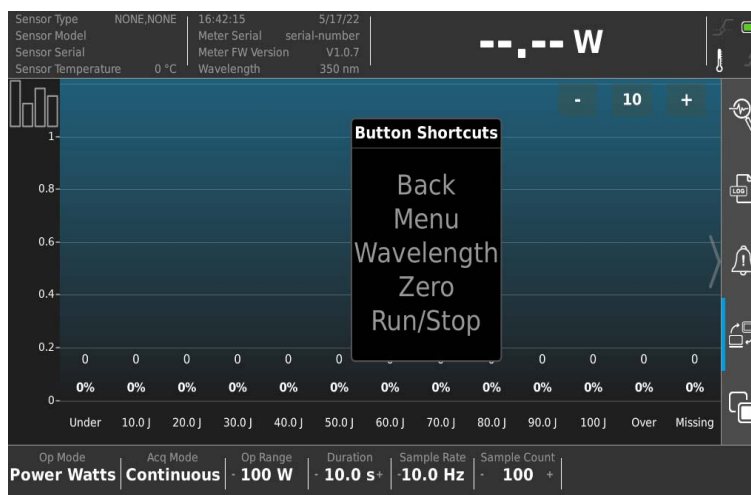


Figure 3-3. Use Mouse for Button Controls

3.1.3 Connect to a PC

To use remote commands with the LabMax Touch Meter, connect the meter to a personal computer (PC) or laptop. This is an optional step when using host commands. Remote communications must be enabled on the meter. Refer to 'Quick Access Toolbar on the Main Window' (p. 42).



NOTICE

When connecting the LabMax Touch Meter to a PC, wait to apply power to the meter.

1. Attach a USB 2.0 cable from the meter's high-speed mini-B port to the PC, as shown in Figure 3-4.



Figure 3-4. Connect the Meter to a PC

2. Press the Enable Remote Communications button on the quick access toolbar. Refer to 'Quick Access Toolbar on the Main Window' (p. 42). Note that the default setting for Remote Communications is Enabled (On).

3.1.4 Apply Power to the Meter

To connect the power supply to the LabMax Touch Meter:

1. Attach the power supply to the meter, and the power cord to the power supply.
2. Plug the power cord into an electrical outlet. This applies power to the meter, as well as automatically charging the battery in the meter.
3. The Power button is located at the end of the connector panel on top of the meter.
To set **Power ON**: Press the Power button, which illuminates in **green**, as shown in Figure 3-5:



Figure 3-5. Power Button on the Meter

- A start-up screen displays for 2 to 3 seconds that shows the Coherent logo.
- To set **Power OFF**: Press and hold 2-3 seconds; the Power button color changes. When no external power is connected, there is no light.
- When external power (12VDC) is plugged into the meter, it automatically turns ON. There is no need to press the ON/OFF button.
- When used with battery power, the ON/OFF button must be pressed to set the meter to ON or OFF.

3.2 Mount the Meter

The LabMax Touch Meter can be mounted so that it is positioned in an easily-accessible location. For example, you might want to put the meter on a DIN rail above a workbench in a lab where measurements are typically taken to save space, or to set up the display panel at eye level.

To mount the meter, the **Meter Mounting Accessory Kit** (P/N 2269910) is needed, which can be ordered on the [Shop.coherent.com](https://shop.coherent.com) website.

SHOP COHERENT

Shop.coherent is the official e-commerce website for Coherent lasers, energy meters and sensors, fiber optics, and accessories. This e-commerce service offers product-specific filtering, fast-and-easy checkout, and prompt shipping confirmations.

As shown in Figure 3-6, the Kit includes:

- Two mounting brackets (quantity 2)
- Screws (quantity 4, 2 for each bracket) to attach the LabMax Touch Meter

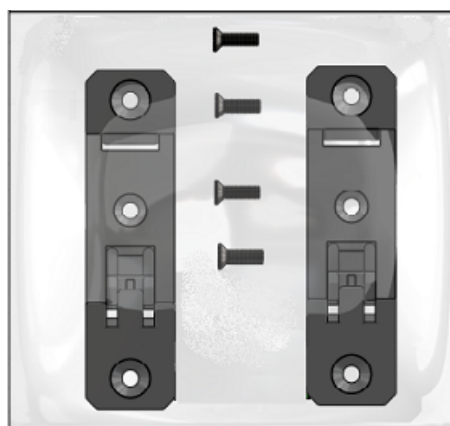


Figure 3-6. Meter Mount Accessory Kit

The customer must provide the DIN rail (not included in the Kit). The mounting brackets for the LabMax Touch Meter fit a standard 35 mm x 7.5 mm DIN rail. The DIN rail can be secured to the wall or other support in any preferred way, using the slots in the middle of the rail.

The dimensions for the mounting brackets are shown in Figure 3-7:

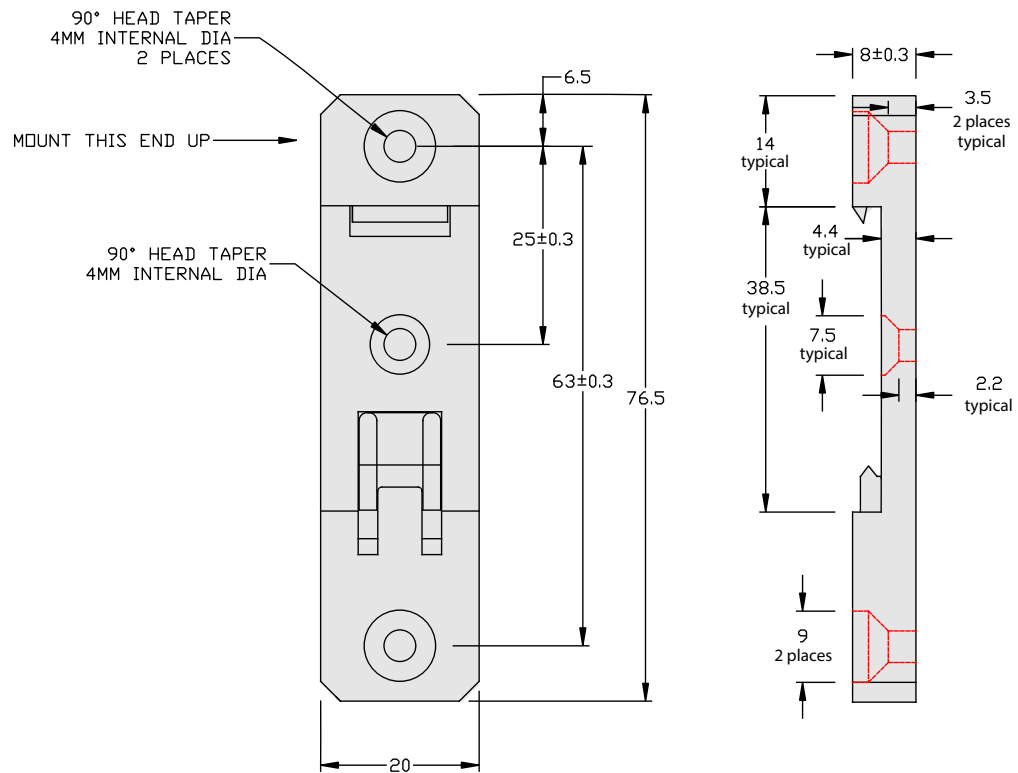


Figure 3-7. Dimensions for the Mounting Brackets

Figure 3-8 shows the position of the brackets on the meter:



Figure 3-8. Brackets to Mount Meter

To mount the meter:

1. Put the LabMax Touch Meter face down on a solid surface. Be sure to first clear the surface so that no objects might scratch the display on meter.
2. Attach the two brackets to the meter using two screws each. Figure 3-9 shows the location of the holes on the back of the meter where attach the screws are attached.

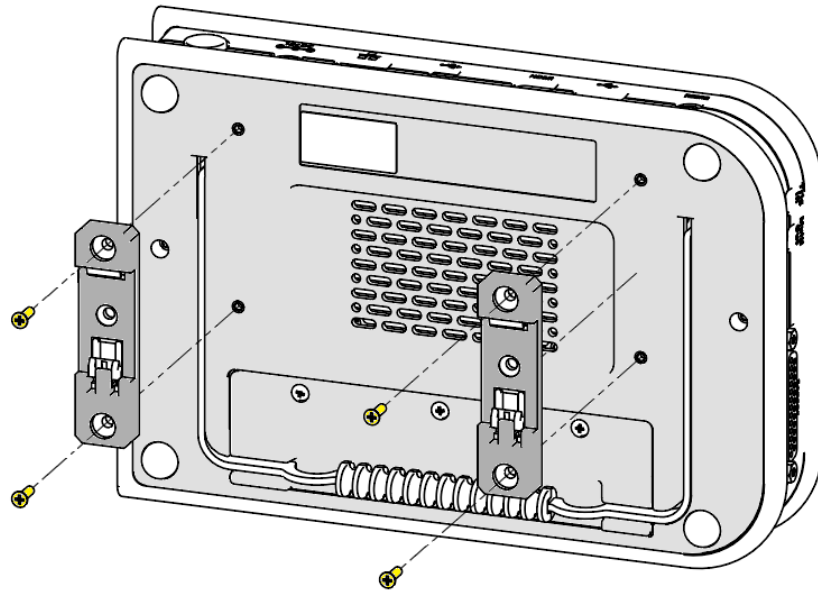


Figure 3-9. Drill Holes to Mount Brackets

3. Tighten the screws until snug, then tighten an additional 1/4 turn.
4. Identify the necessary facility location to mount the meter. Securely attach the DIN rail to the desired location to attach the meter.

5. To install, slide the lower edge of the brackets onto the lower edge of the DIN rail, and snap the meter up to engage the top of the brackets, as shown in Figure 3-10.

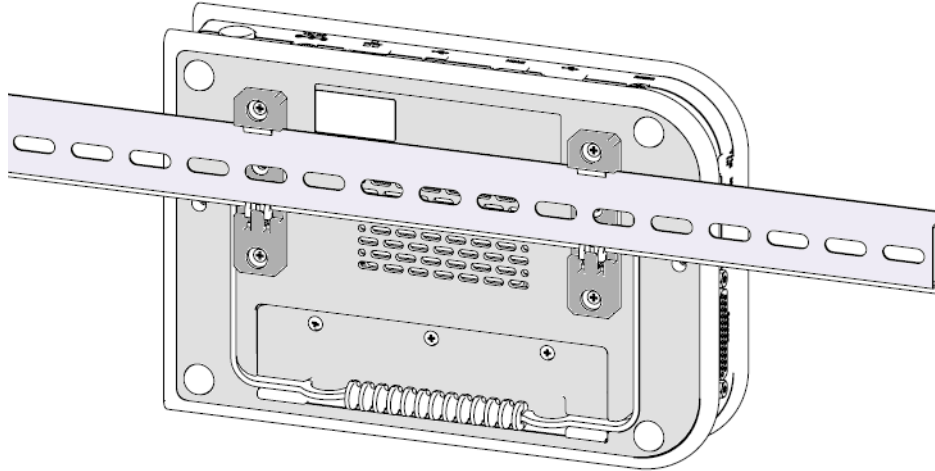


Figure 3-10. Attach the Mounting Clips to DIN Rails



NOTICE

Because the touchscreen will be accessed frequently, remember to occasionally check that the meter is tightly clipped to the DIN rail.

3.3

Install PC Software

This section introduces the Coherent Meter Connection (CMC) software and describes how to install the application on a personal computer (PC) or laptop.

For information about the features and functions of the software, see the *Coherent Meter Connection User Manual* (P/N 1343658).

3.3.1

Software Features

The Coherent Meter Connection software offers an easy-to use Windows-based interface to perform a wide range of analysis functions for instrument control and measurement. This includes:

- High-speed sampling modes up to 1MHz

- Trending with Time and Power cursors
- Energy integration
- Tuning
- Data logging
- Statistics
- Histogram

3.3.2 Supported Products

The Coherent Meter Connection software supports a variety of Coherent sensors and meters. These devices offer a wide range of analytical functions, although some software functions may be limited by the capability of the sensor. Supported devices include:

- LabMax Touch Meter and the LabMax Touch Meter Pro
- LabMax-Pro SSIM Laser Power and Energy Meter
- PowerMax[®]-Pro USB/RS power sensors
- PowerMax USB/RS power sensors
- EnergyMax USB/RS energy sensors

3.3.3 System Requirements

It is recommended that you use the most current and robust systems possible. Support is provided for the following minimum requirements:

- Windows v10 (32- and 64-bit) operating system
- 4 GB of RAM
- 100 MB of available hard disk space
- 2.5 GHz or faster processor
- 1024x768 screen resolution

- Microsoft .NET Framework 4.0 or higher. If no version (or an older version) is found on the workstation, then the installation program installs a version of Microsoft .NET Framework.

3.3.4

Software Installation

Before you begin, remember to save any data and close all other applications. The installation displays the message shown in Figure 3-11.



Figure 3-11. Install CMC Software First

1. Download the software and the *Coherent Meter Connection User Manual* (Part Number 1343658) from the Coherent website.

Coherent product information and related software is available in one easily accessible location on the Coherent website:

<https://www.coherent.com/resources>



NOTICE

The Coherent Meter Connection software is available in English only.

2. Run the set-up file, where the last two digits represent the current software build:
`Coherent Meter Connection v1.4.x.x Release Setup.exe`
3. Refer to the *Coherent Meter Connection User Manual* for detailed installation instructions

When installation completes and the software is started, the following splash screen displays. Refer to the User Manual to learn about the features and functions of the User Interface.



Figure 3-12. Startup Splash Screen

3.4 Next Steps

Go to the next section to learn more about the touchscreen user interface and settings.

Go to the 'Operation - Coherent Meter Connection' (p. 121) to learn about the PC Software User Interface and to perform measurement tasks.

Go to 'External Computer Control Host Commands' (p. 157) to learn about host commands.



CAUTION!

Before connecting devices, follow all laser safety procedures; see 'Safety' (p. 231). The laser must be blocked or switched OFF before starting any activity involving laser measurement.

4 Touchscreen User Interface

This section gives the procedures for how to set up and use controls in the User Interface for the LabMax Touch Meter screen.

The User Interface for the LabMax Touch Meter supports a 7-inch, full-color touchscreen. Main Window.

4.1 User Interface Description

An example of the Main screen for the LabMax Touch Meter is shown in Figure 4-1:

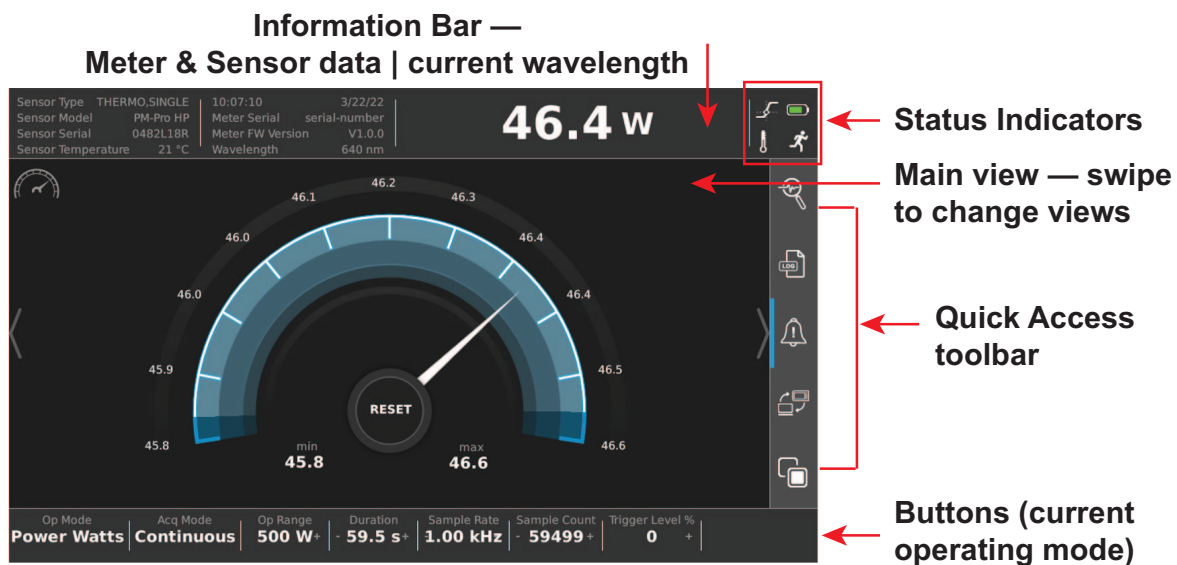


Figure 4-1. Touch Meter Main Screen— Example

The screen includes these functional areas:

- Information bar
- Status indicators
- Main view — swipe to switch between major views
- Quick-access toolbar — click to toggle on/off, or press and hold to pop up settings

- Button bar for operating mode configuration— options relevant to the current operating mode — press to toggle on/off, use (+/-) to increase/decrease settings, or press and hold to pop up settings

To change the view, simply swipe the touchscreen to the left or to the right. This slides the next view to the main window, as shown in Figure 4-2:

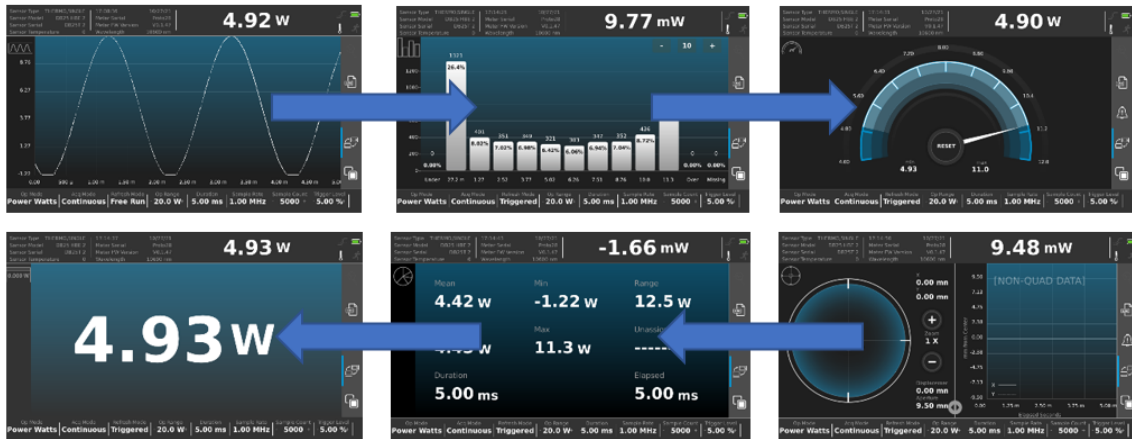


Figure 4-2. Touchscreen – Swipe to Change Views

4.1.1

Top Information Bar

At the top of the window, the information bar shown in Figure 4-3 displays important sensor and meter information, along with the selected Wavelength.

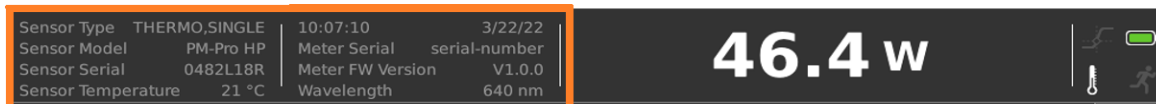


Figure 4-3. Top Information Bar – Meter/Sensor Information

The space in the information bar shown in Figure 4-4 that displays a live measurement value. This value is updated several times per second, and is useful to check the current reading of the sensor even when the meter is not running.

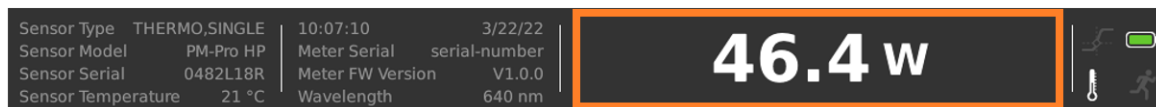


Figure 4-4. Top Information Bar – Live Measurement Value

The box shown in Figure 4-5 in the top right corner of the display shows additional information about the meter.

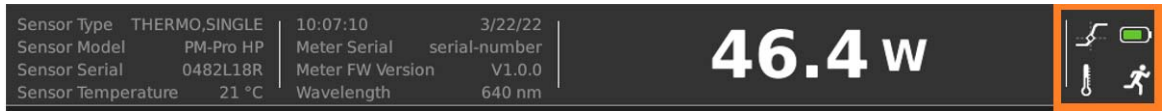


Figure 4-5. Top Information Bar – Status Information

These icons for the status of the meter are described briefly in Table 4-1:

Table 4-1. Status Indicator Icons

Icon	Name	Description
	Trigger indicator	Identifies whether a trigger threshold has been crossed or a trigger has been received.
	Battery	The charge status of the battery is displayed.
	Temperature Alarm	Reports when the sensor is too hot.
	Run/Stop	The 'running person' icon is: <ul style="list-style-type: none"> Highlighted when data is being captured to the buffer. Grayed out when data is not being captured to the buffer.

4.1.1.1

Trigger Indicator Details

Certain operating modes rely on triggers. Triggers cause acquisition to wait until measurements meeting certain criteria occur.

Triggers and their indicators only apply to certain sensors and operating modes:

- PowerMax Pro sensors - in high-speed Power and Energy modes, but not slow speed
- Pyroelectric sensors
- They do not apply to legacy LM thermopile and PowerMax sensors

The indicator reflects the state of acquisition hardware, via the Trigger Status Indicator. The Trigger Indicator can display four possible states. Refer to Table 4-2:

Table 4-2. Trigger Status Icons

Trigger Icon	Status Description
	Triggers are not available or not in use.
	Triggers are in use, and the acquisition hardware has recently seen at least one occur
	Indicates hardware is actively waiting for a trigger and that a force trigger is allowed. For higher sampling rates, force-trigger is activated by tapping anywhere in the indicator region of the title bar Note that force-trigger only applies to Snapshot mode.
	A forced trigger is in use and the acquisition hardware is actively waiting for one to occur. Sometimes, the meter waits indefinitely in this state, because there is no signal or if trigger levels or other parameters are set incorrectly.

4.1.2

Quick Access Toolbar on the Main Window

The Quick Access tool bar that is vertical on the right side of the main window provides quick access to special meter functions.

- A blue bar displays next to the icon when the function is enabled. (No blue bar is shown when the backlight is turned off.)
- **Tap or click** an icon to toggle settings (generally ON or OFF).
- **Press and hold** the icon (instead of tapping the icon) to bring up configuration dialogs for these functions.

See Table 4-3 for a brief description of functions in the Quick Access toolbar:

When the modes are toggled ON or OFF, a brief pop-up message announces the activity.

Table 4-3. Quick Access Toolbar

Icon	Name	Description
	Pulse Analysis	Toggles Pulse Analysis ON to Activate and OFF to Deactivate. (LabMax Touch Pro only)
	Data Logging	Logs data to a file. Toggles to 'Done Logging to file'.
	Alarms and Limits	Toggles Alarms and Limits ON to Activate and OFF to Deactivate.
	Remote Communication	Toggles Remote Communications ON to Allow and OFF to Lock Out. The default setting is ON.
	Screen light	Toggles the screen ON or OFF. Turning the screen off when not in use saves battery life. Tap anywhere on the touchscreen to exit Blanking Mode (which then displays the regular touchscreen).

4.1.3

Bottom Main Window Information Bar

The information bar at the bottom of the main window, shown in Figure 4-6, shows information related to the current operating mode. These touch-sensitive buttons can be configured. What is displayed and available changes based on the type of sensor used and the measurement being performed.

Op Mode	Acq Mode	Op Range	Duration	Sample Rate	Sample Count	Trigger Level %
Power Watts	Continuous	500 W ⁺	- 59.5 s ⁺	1.00 kHz	- 59499 ⁺	0 ⁺

Figure 4-6. Main Window – Bottom Information Bar

Tapping or holding the various buttons allows changes to the different configuration parameters. The buttons that are visible change depending on factors such as the selected Operating Mode or the attached sensor.

Some of these on screen buttons act as toggle switches, switching between two different options such as the Operating Mode and the Acquisitions Mode buttons.

Other buttons allow changes to the settings by clicking:

- (-) at left side of the button to decrease the value of the parameter.
- (+) at right side to increase the value of the parameter.

Holding these configurable buttons displays a configuration dial used to speed up the value selection by spinning the dial, as shown in the example in Figure 4-7:

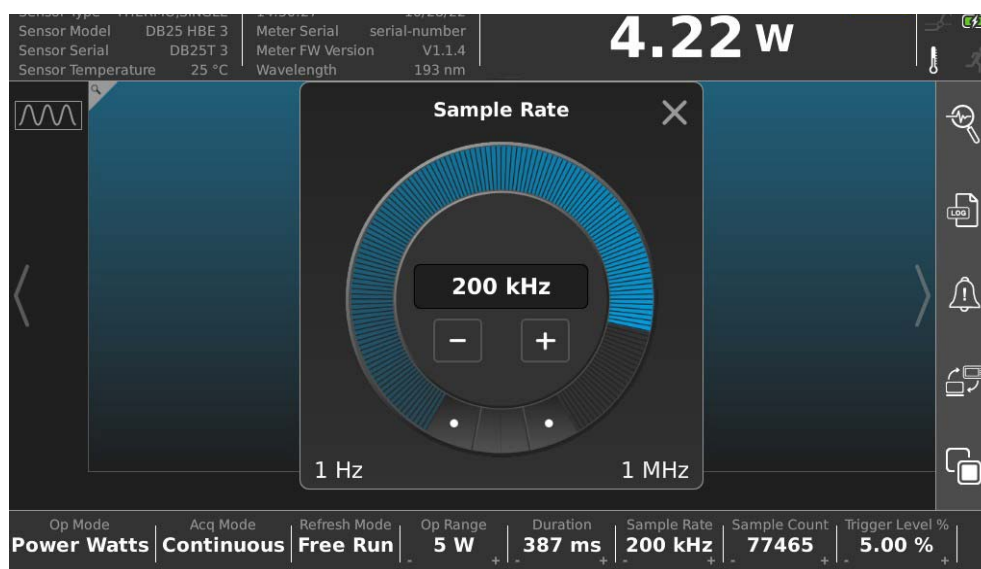


Figure 4-7. Configure Sample Rate - Dial

The value field in the middle of the dial can be tapped to display a keypad to type in the necessary value. Refer to Figure 4-8:

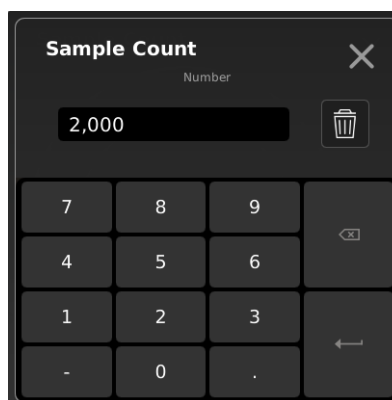


Figure 4-8. Configure Sample Rate - Keypad

The less common configuration parameters can be accessed through the Acquisition Settings Dialog. Press the Menu button to the right of the LCD display.

4.2 Configure Settings

Many of the operating settings are restored at start-up from settings saved for the type of sensor attached the last time the attached sensor was used. However, note the following:

- The selections in the information button bar (at the bottom of the touchscreen), in the settings menus, and tables may change, depending on the type of sensor being used.
- The Toggle button states (icons in the Quick Access toolbar) are NOT saved or restored.

Pressing the physical MENU function button displays the Settings menu. This Settings screen displays several categories of settings (shown in Figure 4-9 and Figure 4-10) to configure the LabMax Touch Meter.

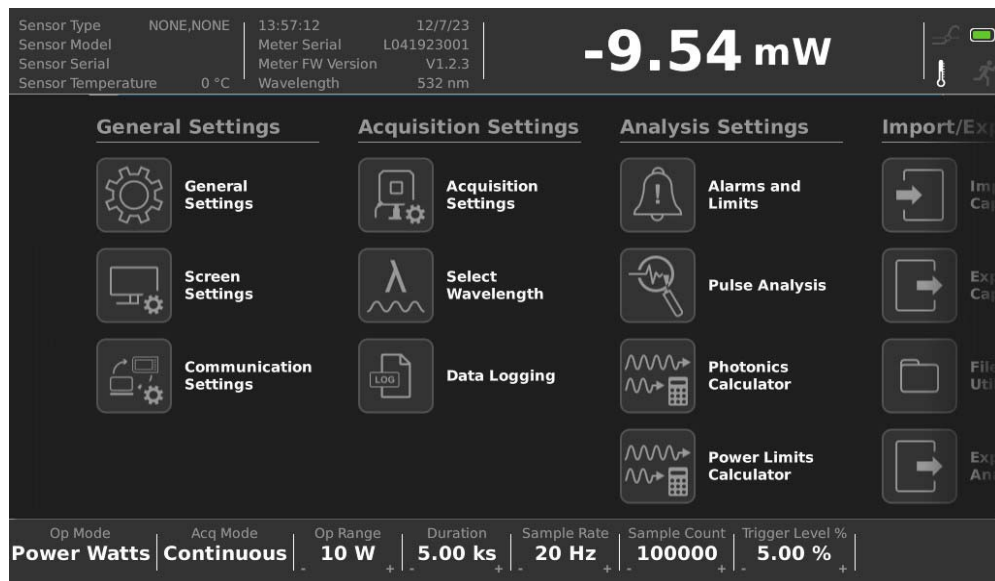


Figure 4-9. Configure General, Acquisition, Analysis Settings

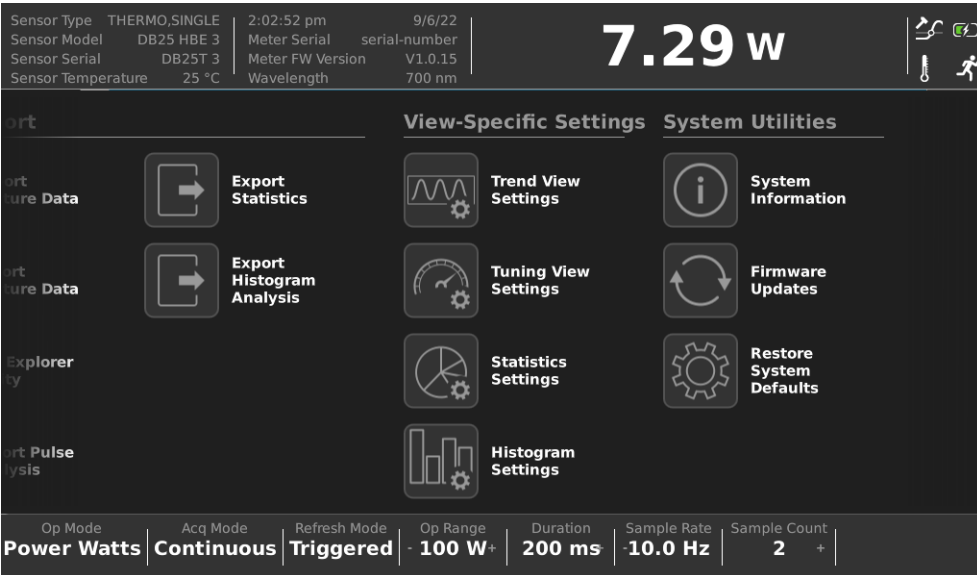


Figure 4-10. Configure System Utilities, View Settings

Each group can be accessed by swiping to the left or right in the window, and then tapping the name of the necessary group. Some functions are also selectable by pressing and holding the associated icon in the quick menu. Refer to 'Quick Access Toolbar on the Main Window' (p. 42).

The next sections describe the configuration settings in more detail.

4.2.1 General Settings

Figure 4-11 shows the options that can be configured for General settings:

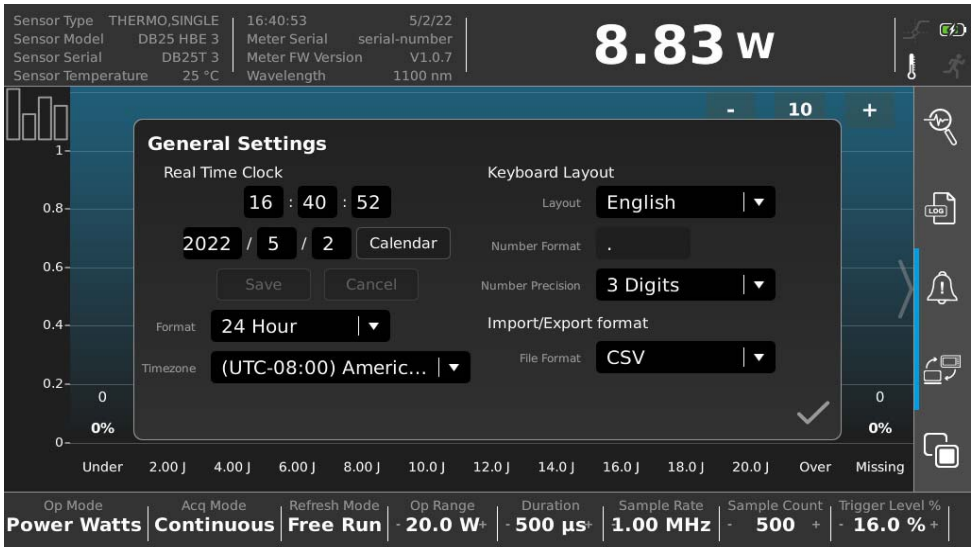


Figure 4-11. Configure General Settings

4.2.2 Communication Settings

Figure 4-12 shows the configurable settings for remote communication via a PC for Ethernet. Remote communication is enabled/disabled via the button in the Quick Menu, at right.

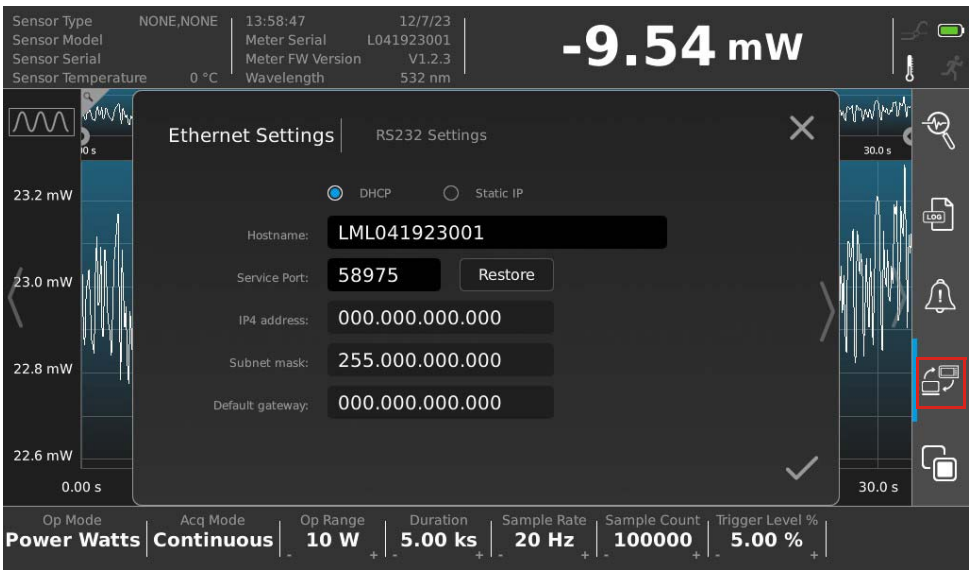


Figure 4-12. Configure Communication Settings - Ethernet

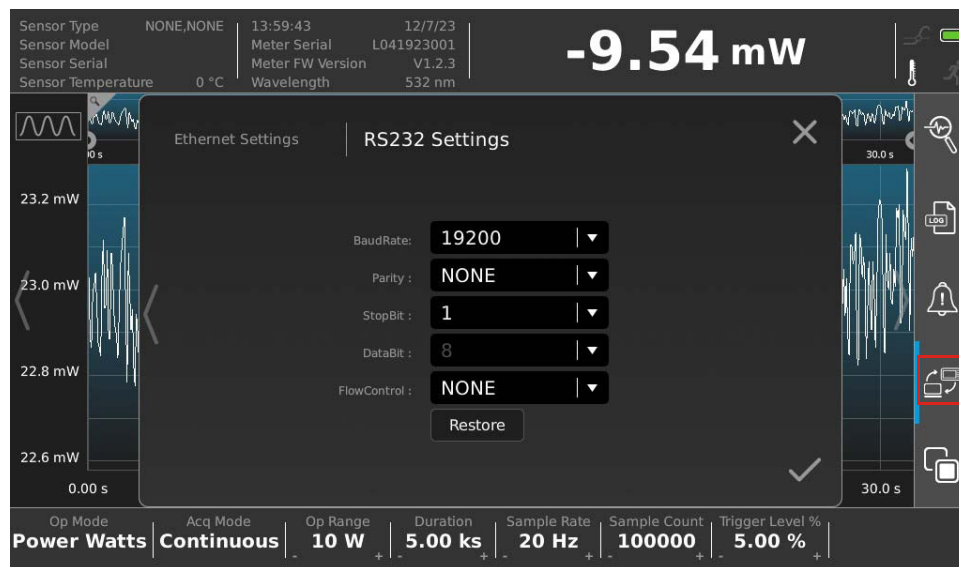


Figure 4-13. Configure Communication Settings - RS-232

4.2.3 Acquisition Settings Menu

The Acquisition Settings dialog can be accessed from the Main Menu. It includes three sub-tabs, or sub-menus:

- 'Acquisition Settings Tab' (p. 50) submenu
- 'Select Wavelength' (p. 54) submenu
- 'Data Logging' (p. 56) submenu

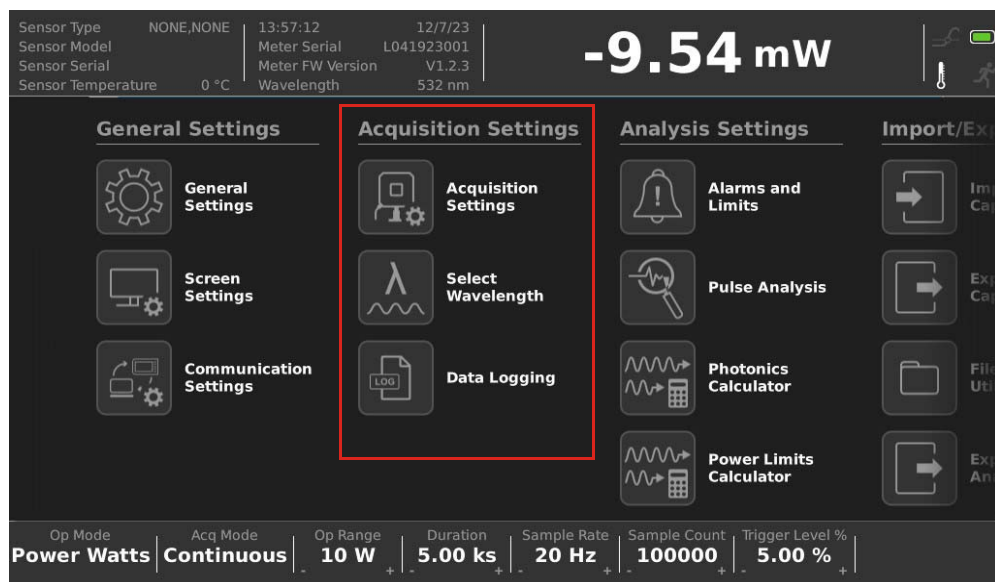


Figure 4-14. Acquisition Settings in Main Settings Window

4.2.3.1 Acquisition Settings Tab

From this dialog, change and adjust the acquisition parameters, as necessary. Figure 4-15 shows the configurable options for general Acquisition settings in Power Watts Operating Mode:

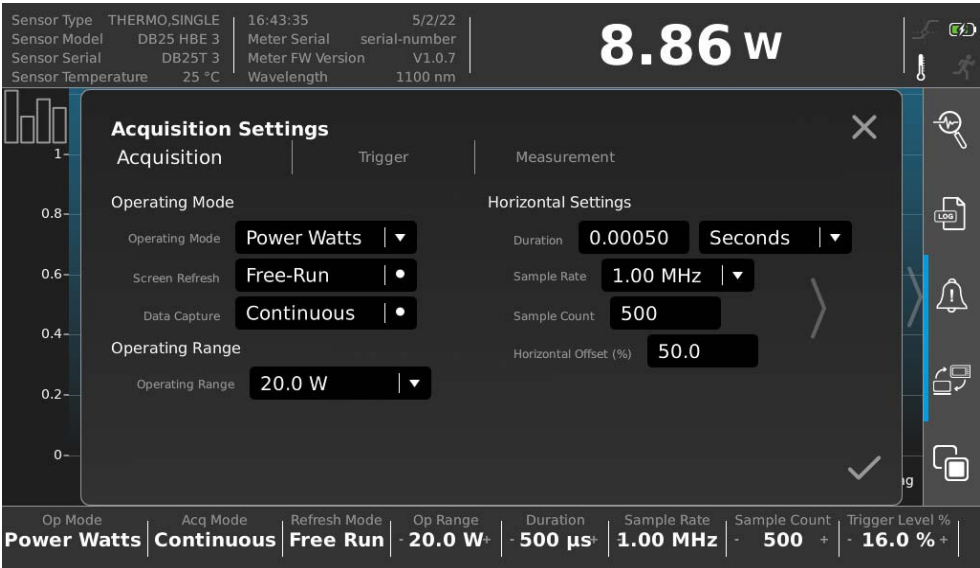


Figure 4-15. Configure General Acquisition Settings

NOTICE
What is displayed and available changes based on the type of sensor used and the measurement being performed.

Note the selections available for Snapshot Mode in Figure 4-16. Snapshot mode is only available with PowerMax Pro sensors.

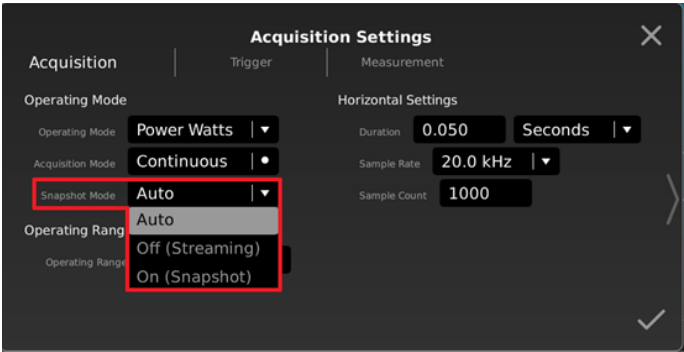


Figure 4-16. Screenshot Mode Selection Options

Operating Mode Group

Power Watts: Collects and displays measurements in power units. For PowerMax/PowerMax Pro sensors, this is a direct power measurement. For EnergyMax sensors, this is calculated using the measured pulse energy and the measured pulse repetition rate.

Energy Joules: Collects and displays measurements in energy units.

- For PowerMax thermopile sensors, this activates Long Pulse Joules mode.
- For LabMax Touch Pro with PowerMax Pro sensors, this activates pulse acquisition and analysis mode.
- For EnergyMax sensors, this measures pulse energy and pulse repetition rate.

Acquisition Mode

Continuous: The meter keeps collecting measurements even when the user-specified buffer capacity is filled, operating as FIFO.

One Shot: Once the user-specified buffer capacity is reached, acquisition stops.

Snapshot Mode:

Auto - The meter selects snapshots or streaming automatically. Snapshot mode is selected when the selected sample rate is greater than 100 kHz, in Power Watts operating mode, and a PowerMax Pro sensor is selected. Otherwise, streaming mode is enabled.

On (Snapshot) - Forces snapshot mode if it is allowed (a PowerMax Pro sensor is connected and Power Watts mode is selected)

Off (Streaming) - Forces streaming mode. This reduces the maximum sample rate to 100 kHz.

Operating Range Group

Operating Range: Sets the desired operating range for the sensor.

Horizontal Settings Group

4.2.3.2 Acquisition Settings- Trigger Tab

The fields are used to set the buffer capacity. The user sets 2 of the 3 settings and the other is calculated based on these.

NOTICE

This functionality only applies to the LabMax Touch Pro model.

Press the **Trigger** tab to display Trigger settings sub-menu. Refer to Figure 4-17.

Trigger Level %: Sets the trigger level as a % of the current range setting.

Trigger Source: Toggle the trigger source between internal auto trigger using the % trigger level, or external trigger.

Trigger Edge: Toggle between rising edge or falling edge trigger logic.

Trigger Delay: Sets the delay between trigger input signal and measurement acquisition. External trigger only.

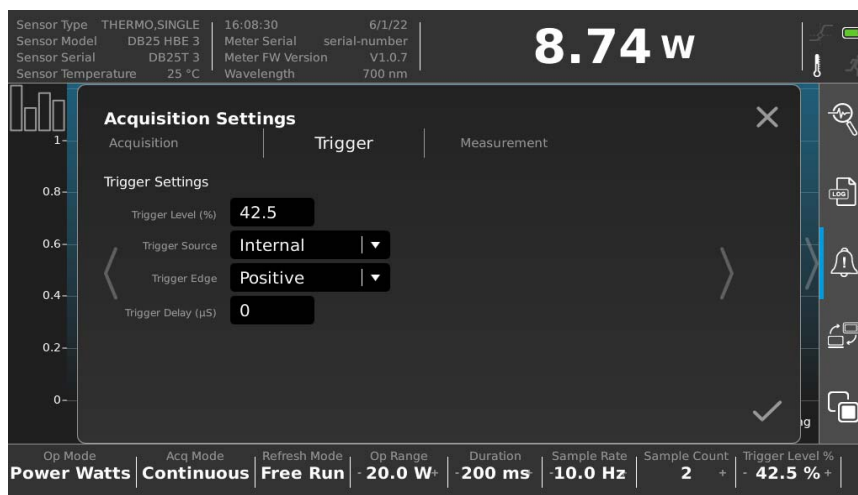


Figure 4-17. Acquisition Settings - Trigger

4.2.3.3 Acquisition - Measurement Tab

Figure 4-18 shows the options to configure acquisition Measurement sub-tab settings in Energy (Joules) mode:

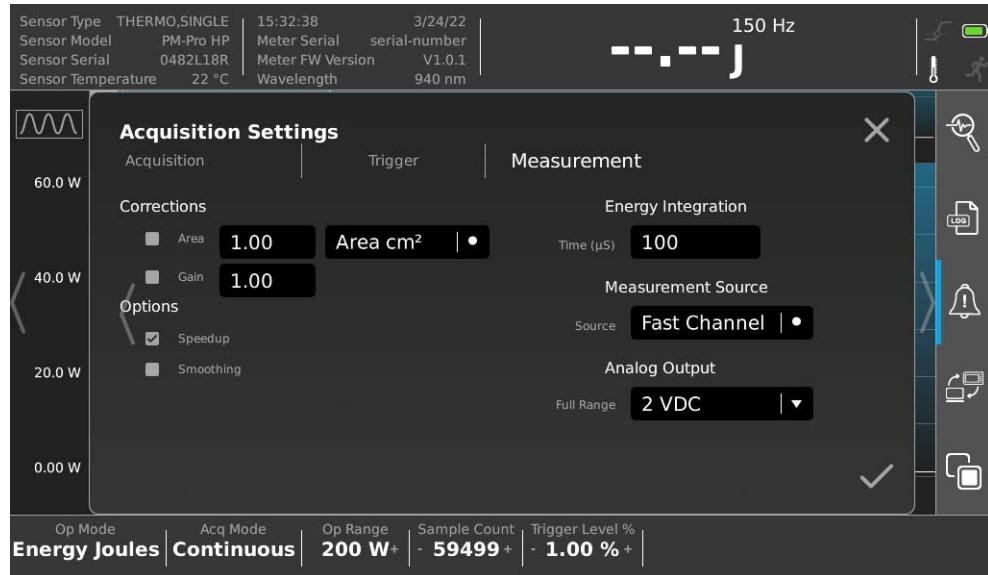


Figure 4-18. Configure Acquisition Settings for Measurement

Corrections Group

Area - Changes the displayed units from Power/Energy to Power Density / Energy Density. Input your known beam area into the field after enabling this setting.

Gain - Adjusts the displayed measurement values by a specified gain factor. Input the factor for the measurement to be multiplied by.

Options Group

Speedup - Activates the Speedup algorithm. This provides a faster response for Thermopile power sensors. Note - this can cause some small amount of overshoot on the power reading before stabilization.

Smoothing - suppresses large and rapid variations in the output reading. This is implemented by performing an average of every 32 samples. Used in the following conditions:

- A PowerMax/PowerMax Pro sensor is connected and Watts mode is selected
- A pyroelectric sensor is connected and Joules mode is selected

Energy Integration

Time - Sets the energy integration time for pulse measurements using PowerMax Pro sensors (LabMax Touch Pro only). Used in the following conditions:

- Meter is a LabMax Touch Pro model
- A PowerMax Pro sensor is connected
- Measurement source is set to Fast
- Operating mode is set to Joules

Measurement Source

Source - Changes the measurement source channel for PowerMax Pro sensors (LabMax Touch Pro only). Options are Slow (0-10 Hz sample rate) and Fast (10 Hz - 1 MHz).

Analog Output

Full range - Changes the full scale value of the analog output signal. Default is 2 VDC, options are 1, 2 and 4 VDC.

4.2.4

Select Wavelength

Figure 4-19 shows the options to select a different wavelength when the WAVELENGTH select button is pressed:



Figure 4-19. Select a Different Wavelength

Figure 4-20 shows the options to add a new Wavelength:

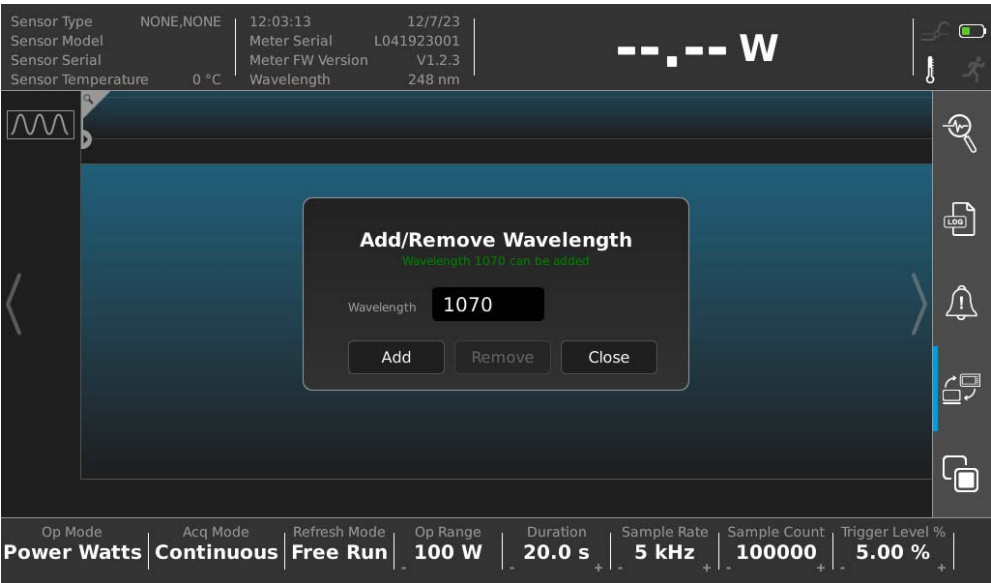


Figure 4-20. Configure – Add a New Wavelength

Figure 4-21 shows the options to remove a Wavelength:

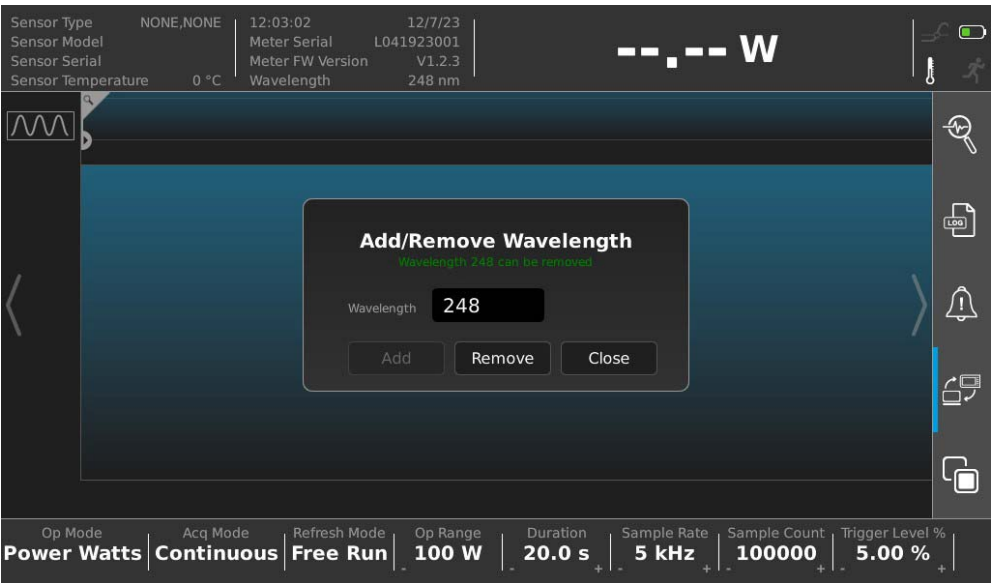


Figure 4-21. Configure – Remove a Wavelength

4.2.5 Data Logging

Figure 4-22 shows the options to identify a destination for in the Log File submenu, on the Destination tab:

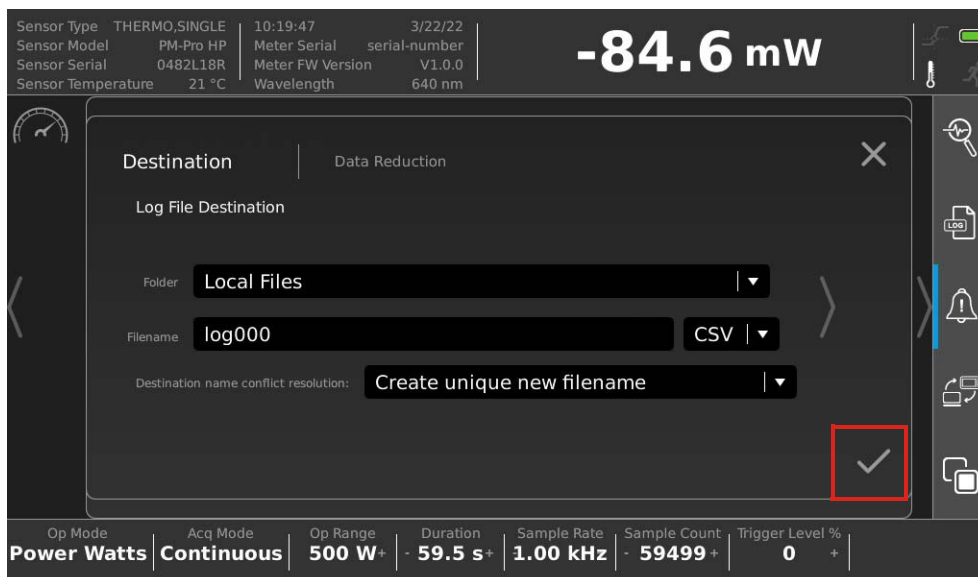


Figure 4-22. Configure Data Logging

Enabling data logging requires a USB flash drive inserted into the USB-A port on the top of the meter.

In the Destination tab, use the **Folder** and **Filename** fields to name the log file and choose the save destination.

Press the Data Reduction tab to change how many samples are preserved in the log. The default is All Samples.

Once settings are completed, press the check mark (highlighted, Figure 4-22) to enable data logging. Press the Run/Stop physical button to start data acquisition and begin writing the log file to the USB flash drive.

To save a log file to a USB flash drive, refer to 'Export Capture Data to File' (p. 118).

4.2.6 Analysis Settings

The Analysis Settings options can be accessed from another group the main Settings Menu.

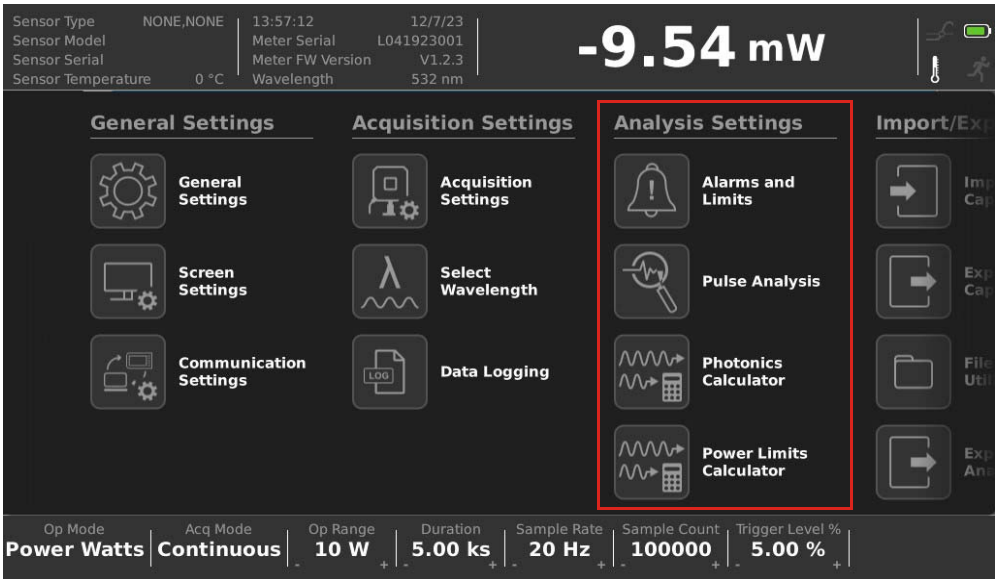


Figure 4-23. Analysis Settings in Main Settings Window

4.2.6.1 Alarms and Limits Settings

NOTICE
This functionality only applies to the LabMax Touch Pro model.

Figure 4-24 shows the configurable options settings for Alarms and Limits. Alarms and Limits allows the option to set a Pass/Fail window based on minimum/maximum measurement values accepted by the user.

When measurement values are recorded that fall outside of this window, Fault Actions can be assigned. This can either stop Acquisition of data, highlight where the out of range data falls, or both.

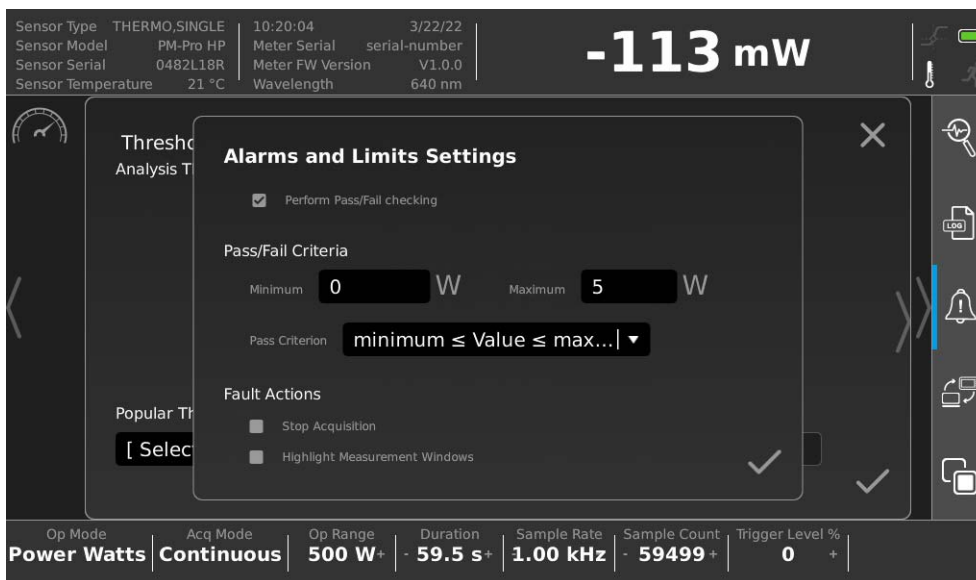


Figure 4-24. Configure Alarms and Limits

4.2.6.2

Pulse Analysis Settings

Figure 4-25, Figure 4-26, and Figure 4-27 show subtabs for categories of pulse analysis settings.



Figure 4-25. Pulse Analysis - Thresholds

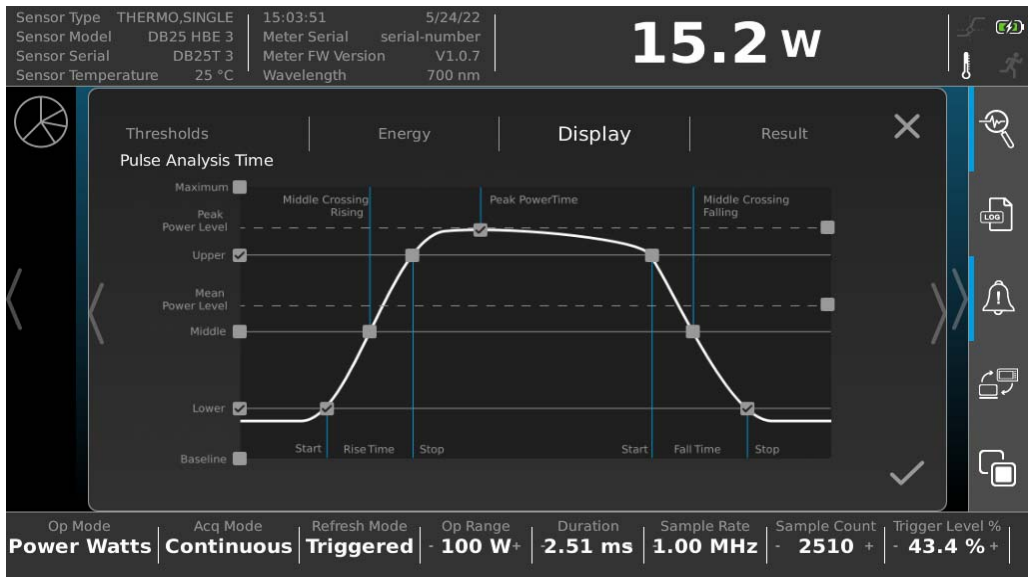


Figure 4-26. Pulse Analysis - Display Settings

Pulse Analysis features are only applicable to power measurements when used with PowerMax Pro meters. This feature is applicable to LabMax Touch Pro model only.

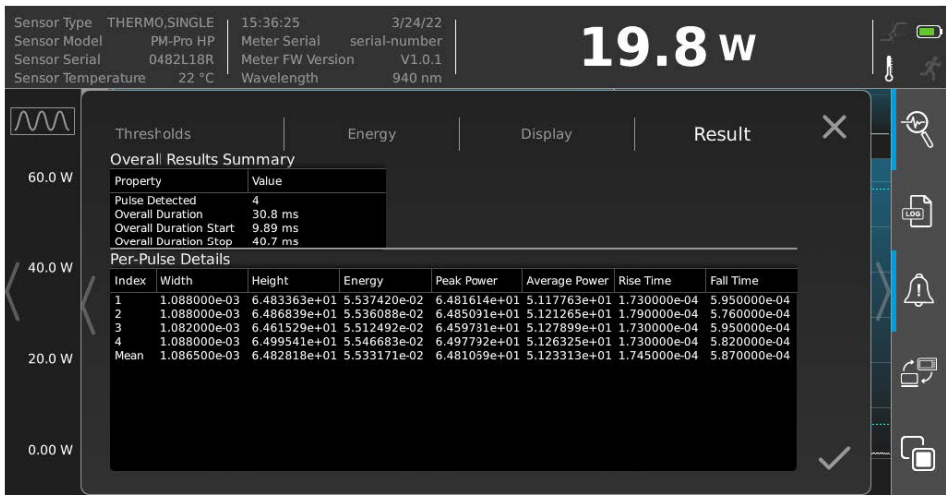


Figure 4-27. Pulse Analysis - Results of Data Collection

4.2.7 Import/Export Utilities

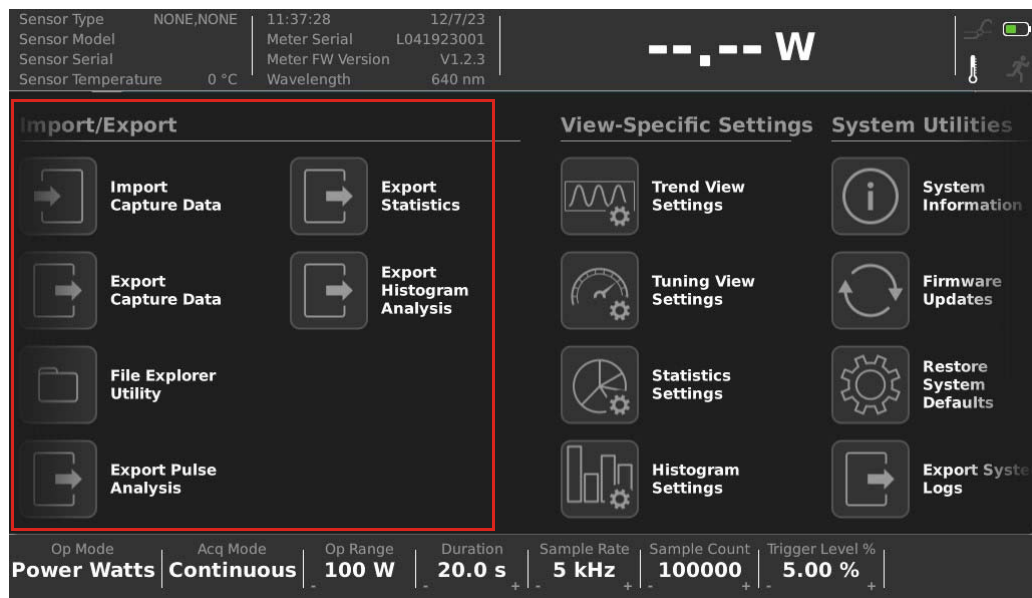


Figure 4-28. Import/Export Utilities

Each of the system utilities settings are described next:

- 'Import Capture Data' (p. 61)
- 'Export Capture Data' (p. 62)
- 'Export Statistics Analysis' (p. 63)
- 'File Explorer Utility' (p. 64)

4.2.7.1 Import Capture Data

Figure 4-29 shows the options to configure settings to import data:

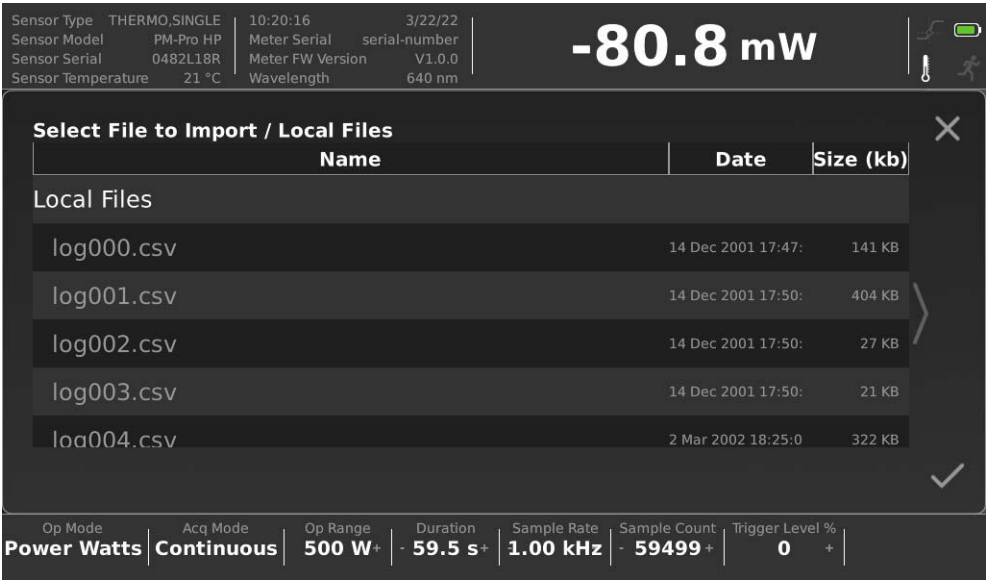


Figure 4-29. Configure Data Import Capture

4.2.7.2 Export Capture Data

Figure 4-30 shows the dialog to configure to export data:

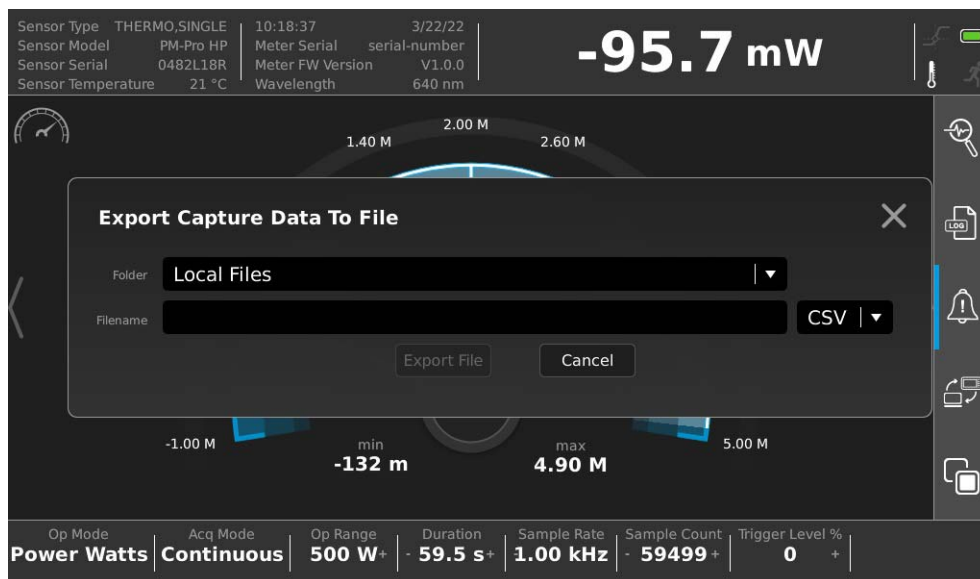


Figure 4-30. Configure Export Capture

For more information, refer to 'Save a Log File' (p. 117).

Figure 4-31 shows a list of log files in the File Explorer utility accessed from the menu:

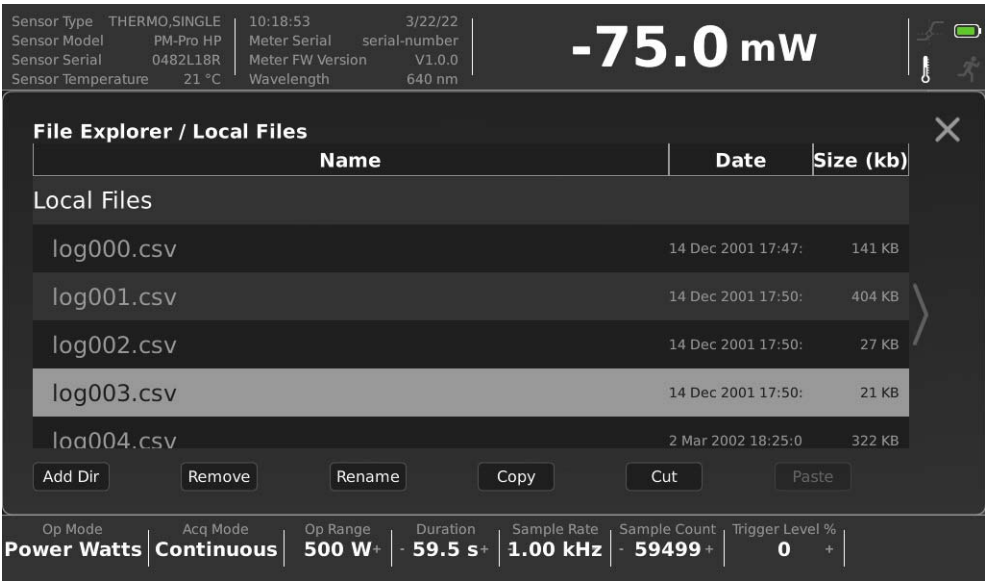


Figure 4-31. List of Local Log Files

4.2.7.3 Export Statistics Analysis

Figure 4-32 shows the Export Statistics Analysis dialog to configure and export statistics calculations to a USB drive.



Figure 4-32. Export Statistical Analysis

4.2.7.4 File Explorer Utility

Figure 4-33 shows the options to configure for File Explorer:

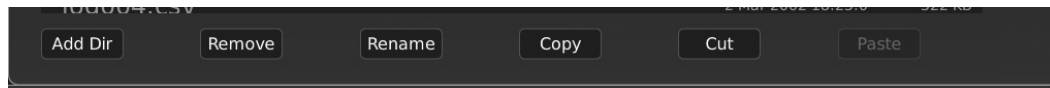


Figure 4-33. Configure File Explorer

4.2.8 View-Specific Settings

The view-specific settings that can be configured include:

- 'Trend View Settings' (p. 65)
- 'Tuning View Settings' (p. 68)
- 'Statistics Settings' (p. 68)
- 'Histogram Settings' (p. 69)

Each of these are described in the sections that follow.

4.2.8.1 Trend View Settings

Figure 4-34 shows the window for the Trend view. The upper left icon can also be pressed to display the Trend Settings for zoom window.

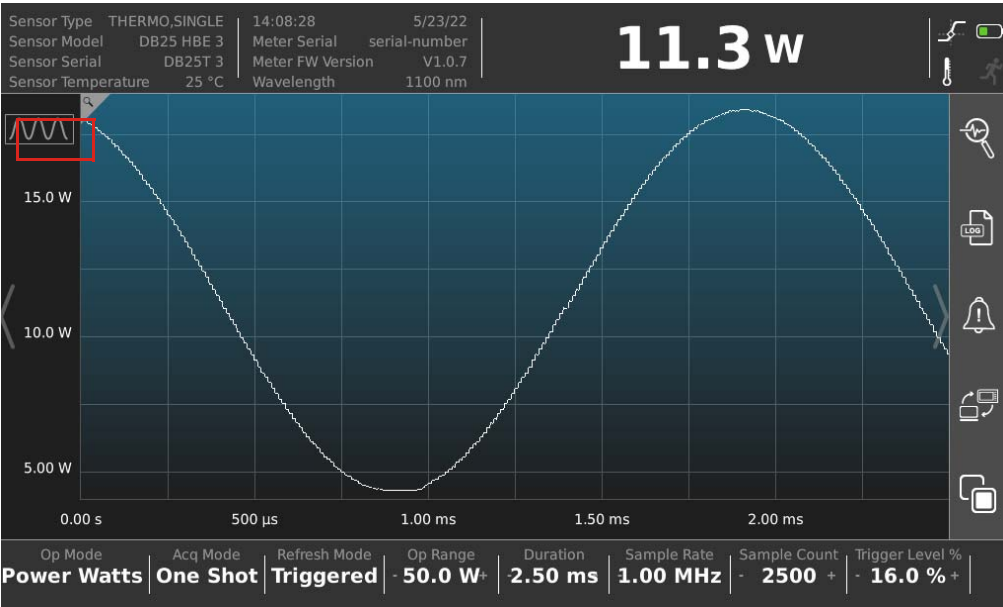


Figure 4-34. Trend View

Figure 4-35 shows examples of the Trend Settings window for zoom:

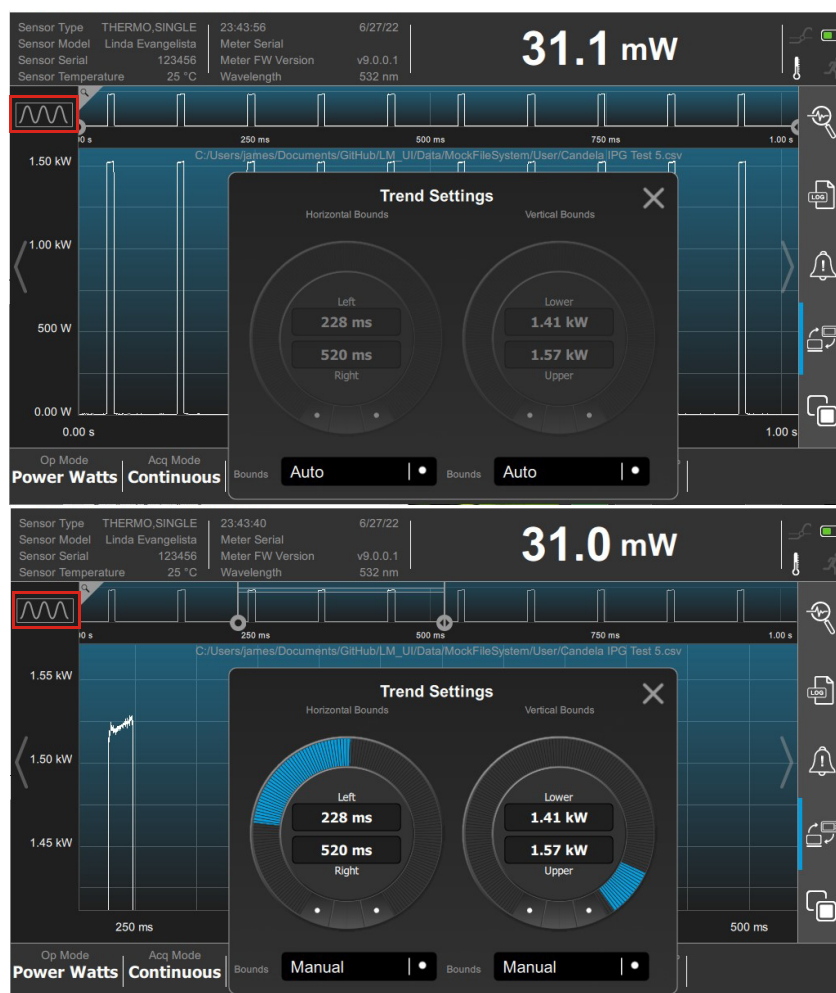


Figure 4-35. Trend View Settings

The Bounds fields are used as follows:

Auto: The H or V axis is scaled to match the actual min/max range of the data present.

Manual: The H or V axis is expanded to show a specific subset of the entire view. The dials are used to select the pair of values.

Note that the horizontal cursors can be moved by touch in the zoom window. The vertical cursors are small and can only be changed with use of the dial in the Trend Settings window.

Users can use touchscreen 'pinch' to zoom in and out on the cursors.

For energy measurements, an additional view setting for additional x-axis

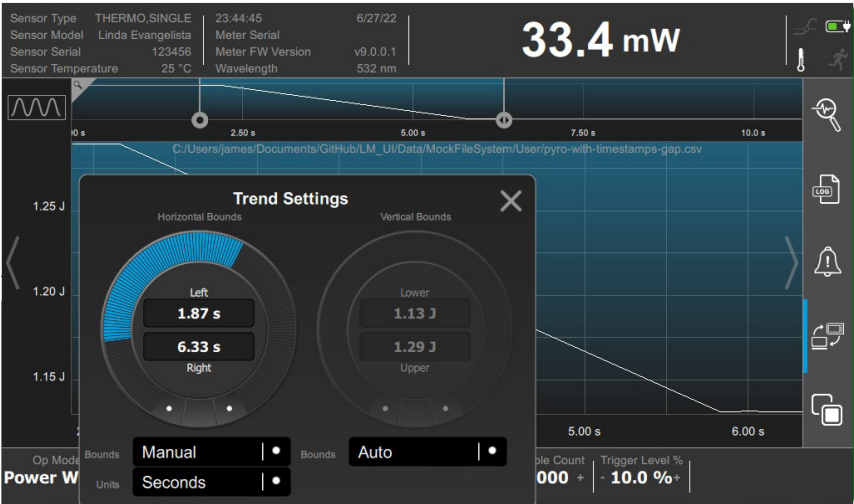


Figure 4-36. Trend View Settings

is available for Units. Refer to Figure 4-36. It is only visible when energy data is viewed and has the following options:

Pulses: Simple measurement sequence numbers, also known as Pulse IDs.

Seconds: Measurement timestamps show the time that the sample was received.

The trend view with Seconds selected and timestamp axis is shown in Figure 4-37.

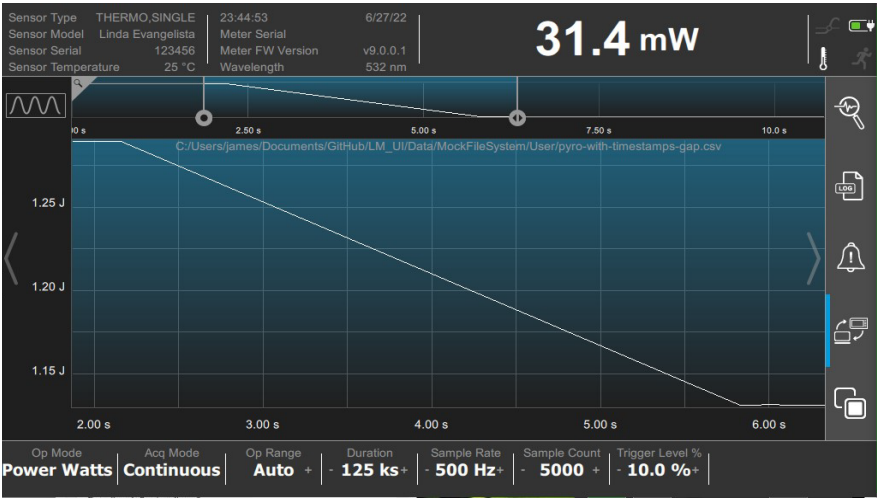


Figure 4-37. Trend View with Time in Seconds

4.2.8.2 Tuning View Settings

Figure 4-38 shows the window for the Tuning view settings. The settings can also be adjusted, in Tuning view, by clicking the **Tuning Settings** button in the upper left.

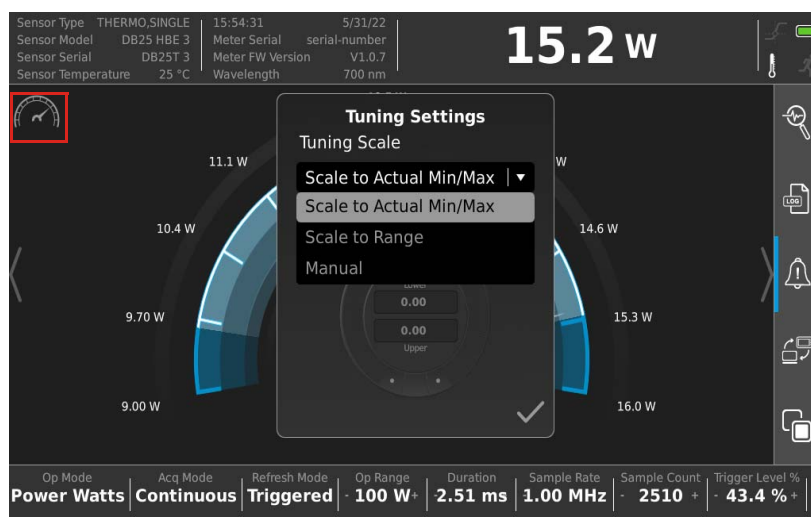


Figure 4-38. Tuning View Settings

4.2.8.3 Statistics Settings

Figure 4-39 shows the options that can be configured for Statistics to display. The settings can also be adjusted, in Statistics view, by clicking the Statistics Selection button in the upper left.

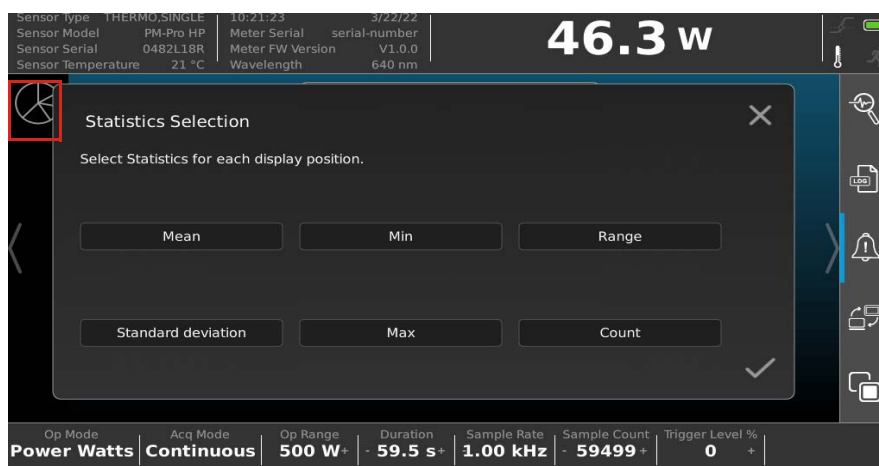


Figure 4-39. Configure Statistics Settings

4.2.8.4 Histogram Settings

Figure 4-40 shows the options that can be configured for a histogram. The button in the upper left can also be pressed, in Histogram view, to display the histogram settings.

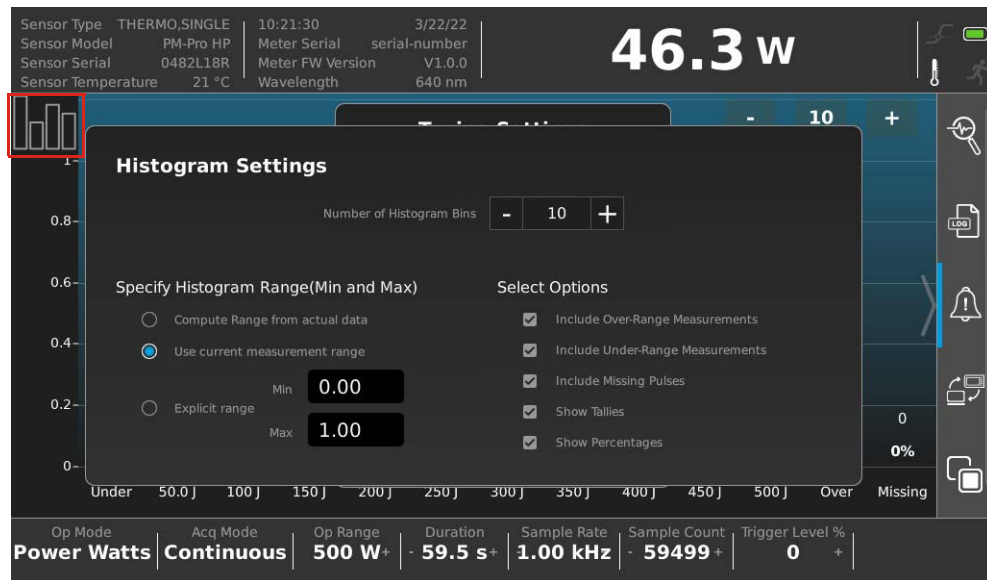


Figure 4-40. Configure Histogram

4.2.9 System Utilities

System information and update utilities include:

- 'System Information' (p. 72)
- 'Firmware Update' (p. 73)
- 'Restore Default Settings' (p. 74)

Each of these are described in the sections that follow.

4.2.9.1 Photonics Calculator

The Photonics Calculator functionality is shown in Figure 4-43. It has tabs for units converter and for standard laser-related parameters. It provides common units conversions for laser parameters.

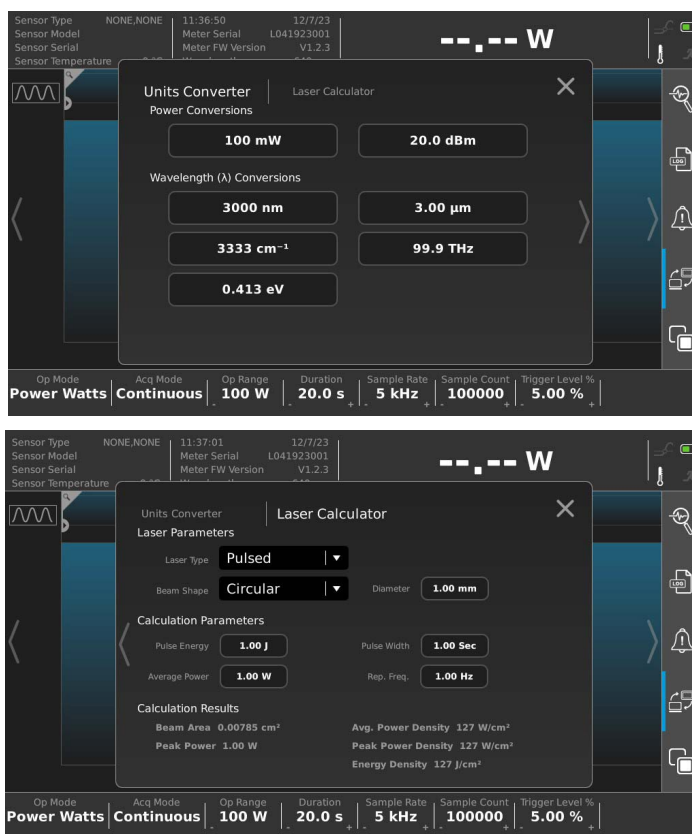


Figure 4-41. Photonics Calculator Screens

4.2.9.2 Power Limits Calculator

The Power Limits Calculator functionality is shown in Figure 4-43.



Figure 4-42. Power Limits Calculator Screen

4.2.9.3 System Information

The following figure shows information about the meter and operating system when System Information is pressed. An example About LabMax Touch Pro is shown in Figure 4-43. Figure 4-44 shows the system



Figure 4-43. Start-Up Splash Screen

information, including properties for the meter and sensor. Swipe to the right or left to reveal more information.

Meter Properties		Sensor Properties	
Property	Value	Property	Value
System Type	THERMO	Sensor Type	THERMO, SIN
Meter Type	TOP	Sensor Model	PM-Pro HP
Serial Number	serial-number	Probe Serial Number	0482L18R
Calibration Date	May 1, 2020	Head Temperature	21 °C
Pyro Support	False	Responsivity	4.4683e-05
Firmware Version	V1.0.0		
FPGA FW Version	20210910		
FPGA HW Version	20210723		
Operating Mode Group			
Operating Mode	Power Watts		
Selected Range	500		
High Speed Mode Selected	true		
Continuous Mode Selected	false		
Wait Trigger Mode Selected	0		
Trigger Level%	0.00		

Figure 4-44. System Information

4.2.9.4

Firmware Update

A firmware update can be done via a USB flash drive. To install a firmware update, do the following:

1. Download the latest firmware update file from www.Coherent.com. The filename must be *LabMax-Touch.img*.
2. Put the file in the root directory of a USB drive and insert the drive into one of the USB sockets on the LabMax Touch Meter.
3. Press the MENU button on the LabMax Touch Meter, and then press the **Firmware Update** button in the Settings menu. The Firmware Update dialog displays.



Figure 4-45. Firmware Update Settings

4. Make sure that the LabMax Touch Meter is connected to wall power and that it remains plugged in and powered on until the operation completes.
5. Press the **Start Update** button on the Firmware Update screen to begin the update.
6. When the update is done, the LabMax Touch Meter restarts.
7. Remove the flash drive.

4.2.9.5 Restore Default Settings

The meter can be reset to the default values for the current sensor, to the default values for all sensors, or for the user data to be erased.

1. In the main settings menu, press the **Restore System Defaults** button in the System Utilities group.
2. In the Restore Default Settings dialog, press the button for the needed reset type. Refer to Figure 4-46. The reset is immediate, without confirmation.

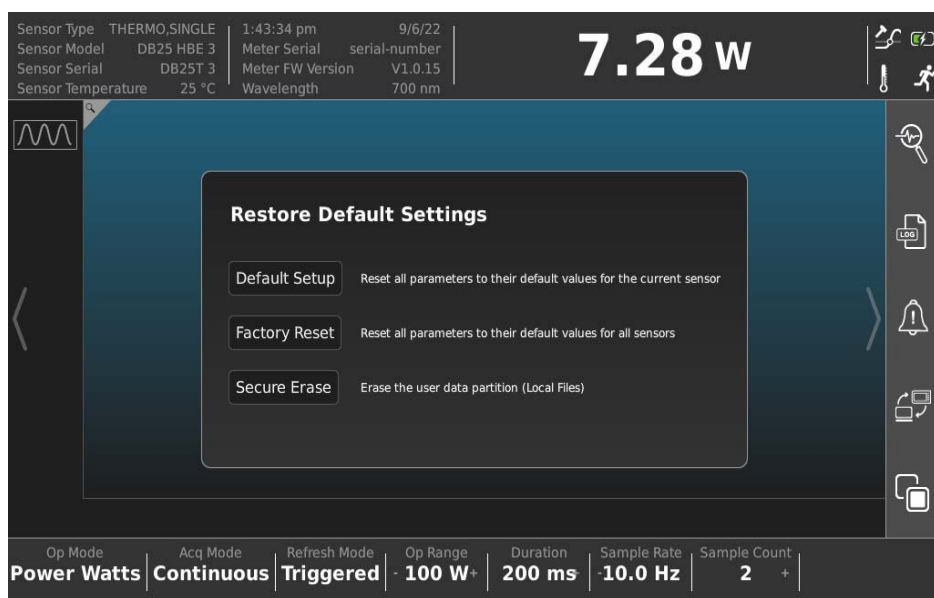


Figure 4-46. Firmware Update Settings

Note the following:

- *Default Setup*: Does not change communications settings.
- *Factory Reset*: Resets all communications settings, and sets comm to ON
- *Secure Erase*: Resets all communications settings, and sets communications to ON.

5

Operations Views in Touchscreen

This chapter describes the different functional views available when operating the LabMax Touch Meter:

- Histogram View
- Statistics View
- Trend View
- Tuning View
- Power Measurement View
- Position Stability View
- Pulsed Thermopile Joules
- Pyroelectric Watts

This chapter also describes key operating functions including trigger setting, zero setting, and analog output range setting.

5.1 Histogram View

The Histogram View is shown in Figure 5-1.

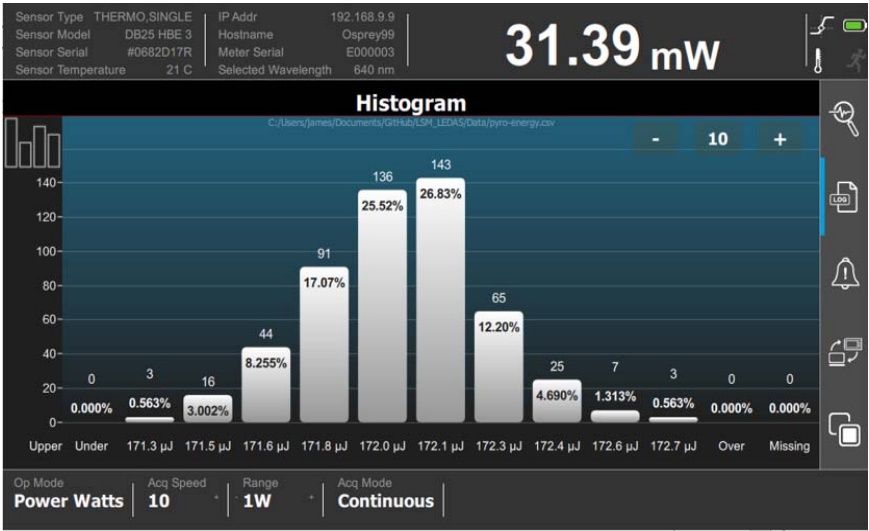


Figure 5-1. Touch Meter Histogram View

5.2 Statistics View

The Statistics Mode view mode is shown in Figure 5-2.

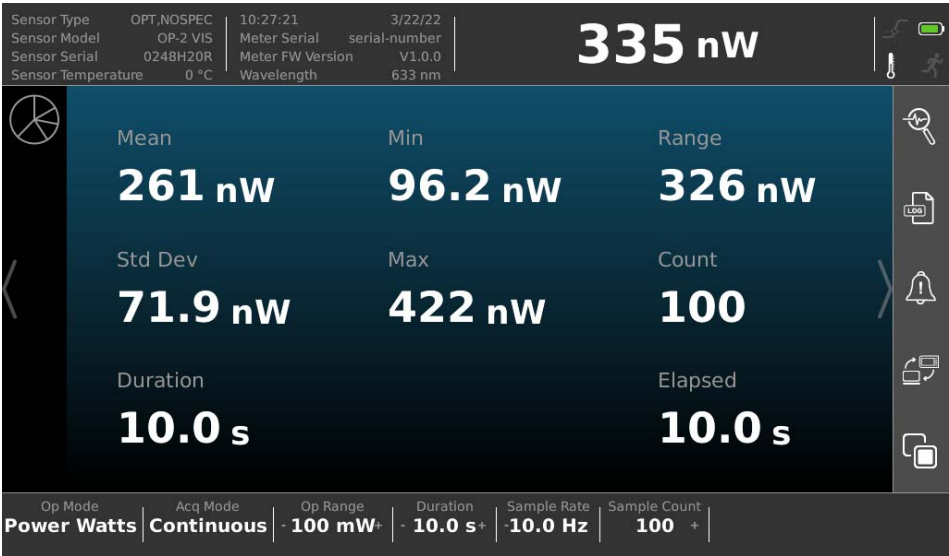


Figure 5-2. Statistics View

5.3 Tuning View

The Tuning View is shown in Figure 5-3.

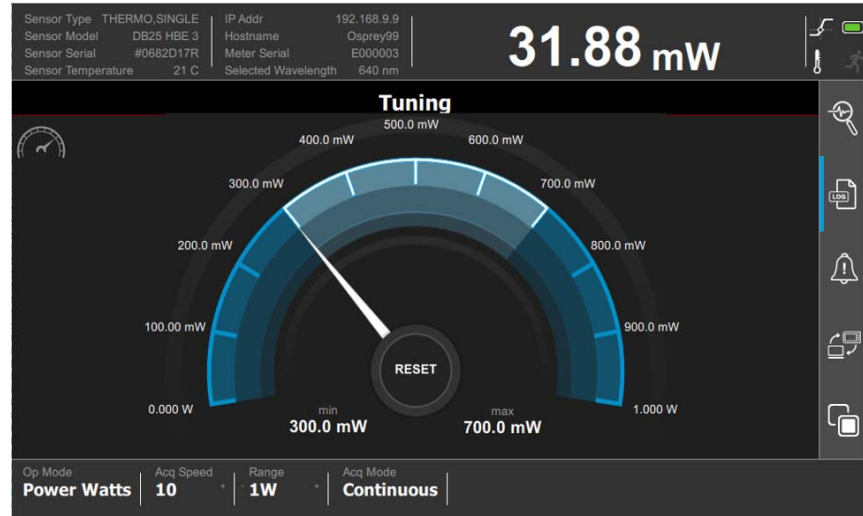


Figure 5-3. Touch Meter Tuning View

When this is over range, the red indicator shown in Figure 5-4 displays:

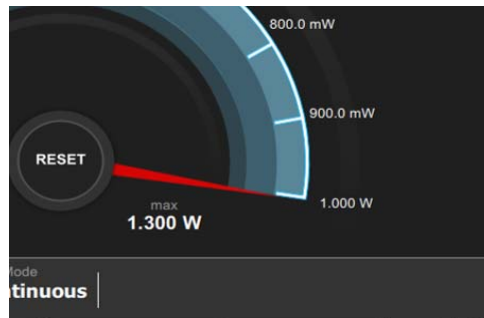


Figure 5-4. Tuning Over Range

5.4 Trend View

The Trend View is shown in the example in Figure 5-5.

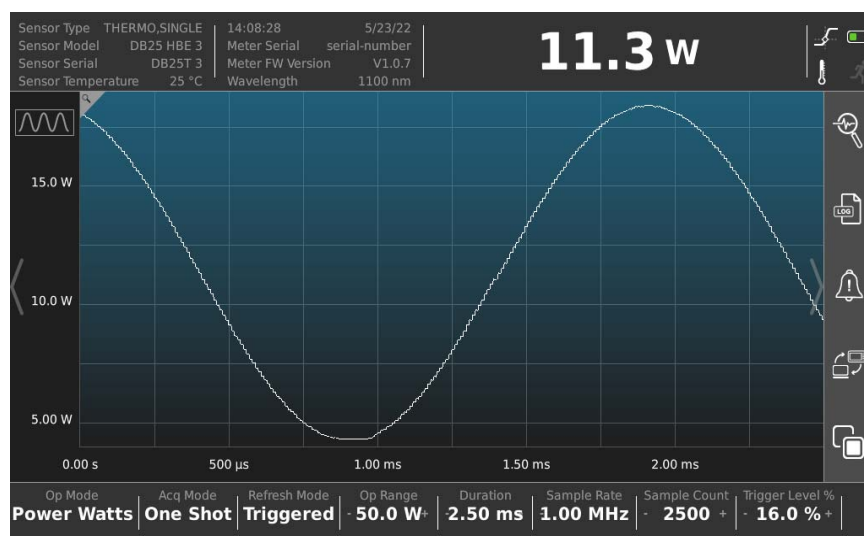


Figure 5-5. Trend View

5.4.1 Trend Zoom View

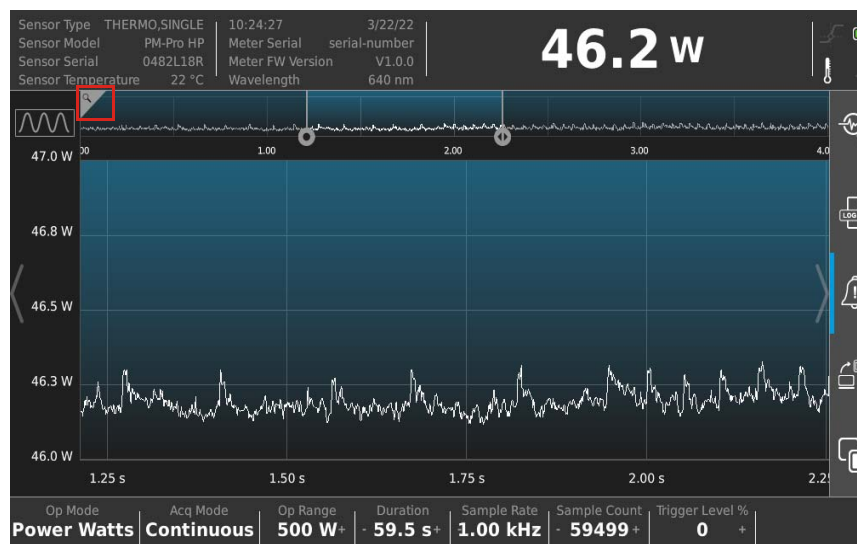


Figure 5-6. Trend Zoom View

A Trend zoom feature is displayed by clicking the small Zoom icon in the top left. Use the sliding handles to increase or decrease the zoom region horizontally.

The trend view zoom settings are adjustable. Refer to 'Trend View Settings' (p. 65).

5.4.2 Long-Pulse Energy Calculations

A Long Pulse energy calculation is shown in the Trend View in Figure 5-7. This is used to characterize long single-pulse events up to 10 seconds.

This is applicable when using a LabMax Touch Pro meter when Pulse Analysis is set to ON with the button in the Quick Access toolbar.

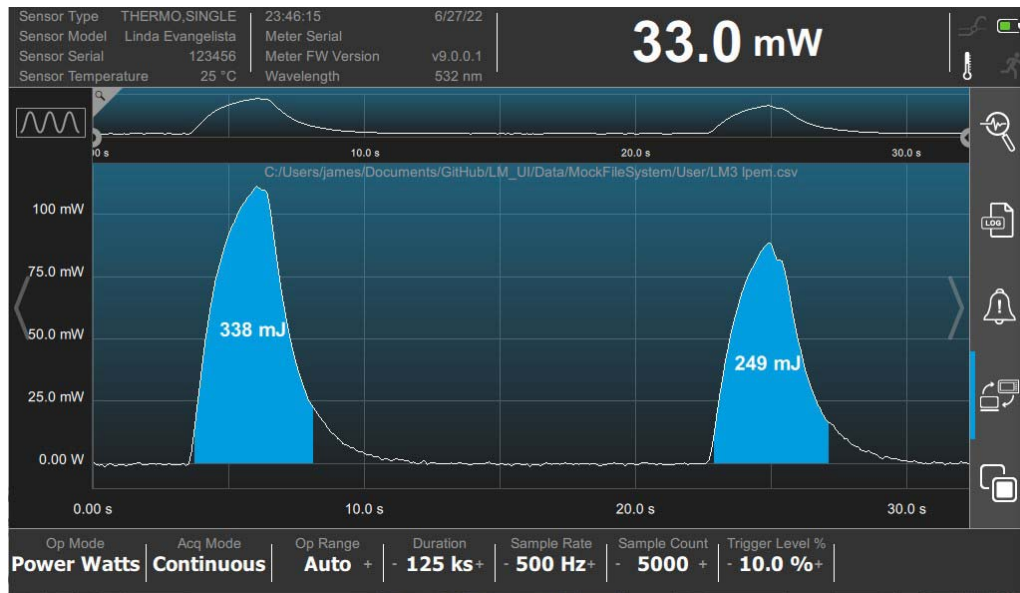


Figure 5-7. Long Pulse Energy Calculation

5.5 Measurement View

The Power Measurement View with use of standard thermopile is shown in Figure 5-8.

Measurements with use of pyroelectric sensors also display period measurement data. The period can be displayed as a duration of seconds or a frequency in Hertz. Tap the on-screen period value in any view to toggle between frequency, in hertz, and period, in seconds. Refer to examples in Figure 5-9.

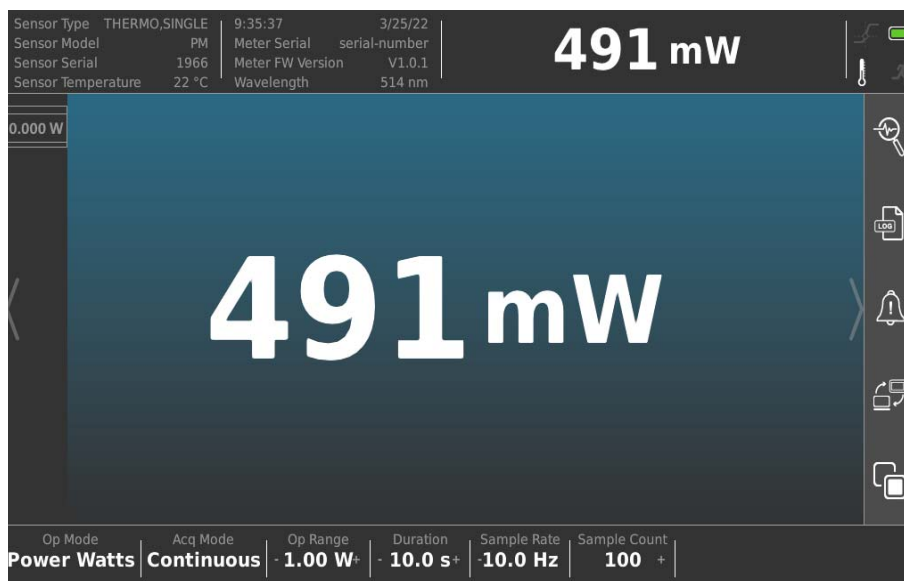


Figure 5-8. Touch Meter Power Measurement View



Figure 5-9. Touch Meter Power Measurement View

5.6 Beam Position/Stability View

The Beam Position view is shown in Figure 5-10. For quad sensors, this view shows the position of the laser beam on the sensor disk. Users must first press the RUN button on the meter to display beam position data.

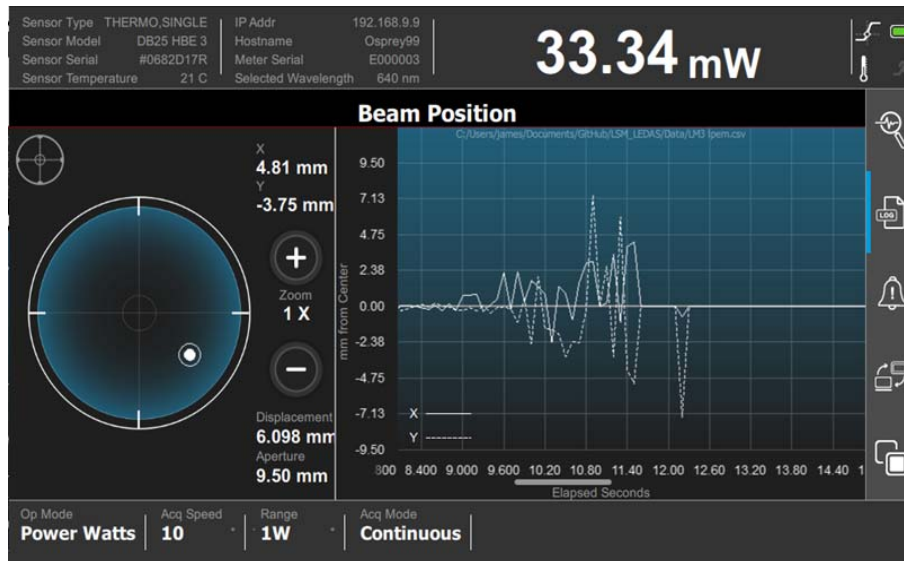


Figure 5-10. Touch Meter Beam Position View

5.7 Pyroelectric (Power) Watts Mode

The figure shows the options in Power Watts Operation mode, in the bottom information and button bar. The 'Op Mode' button can be pressed to toggle between Power Watts and Energy Joules modes.

Note that the buttons that are visible change depending on factors such as the selected Operating Mode or the attached sensor.

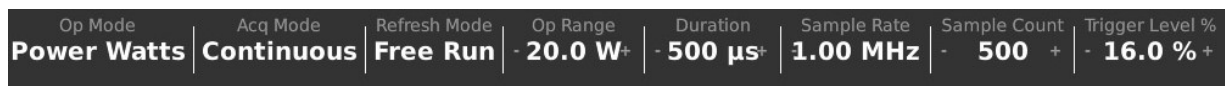


Figure 5-11. Bottom Information Bar - Watts Mode

Pyroelectric-specific power information settings are available and displayed. The following describes the functions of all button modes used in both Power Watts and Energy Joules modes:

Acquisition Mode: Toggles between Continuous and One Shot pulses.

Refresh Mode: Toggles between internal Triggered and Free Run pulses. Only applies to sensors that have trigger functionality, such as Pyroelectric and PowerMax Pro sensors, with fast channel mode.

Op Range: Allows manual selection of operating range (varies by sensor).

Duration: Allows selection for pulse duration between 1.00 and 10.00 ms.

Sample Rate: Allows selection of sample count rate.

- Pyroelectric sensors: **not applicable** (sample rate auto-selected)
- PowerMax Pro sensors: 1.00 Hz to 1.00 MHz.
- All other sensors: 1Hz to 10Hz

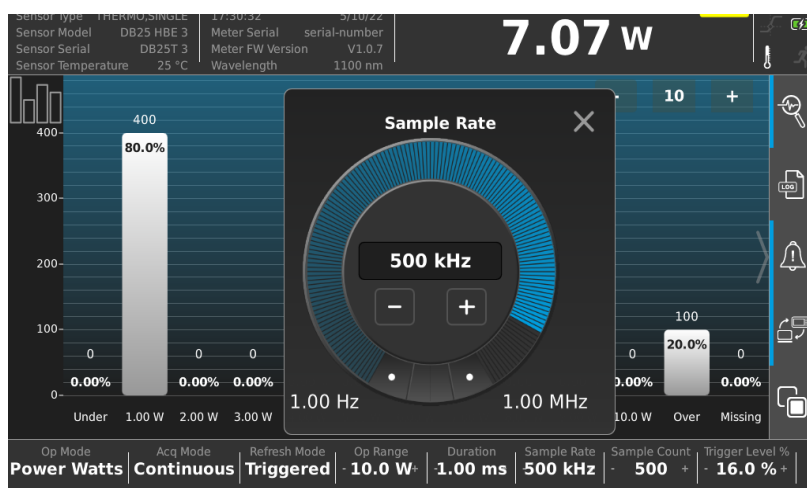


Figure 5-12. Sample Rate Setting

Sample Count: Allows selection of sample count value between 1000 and 100000. Note that directional arrows indicate the dial can be continuously rotated in order to reach the desired value.

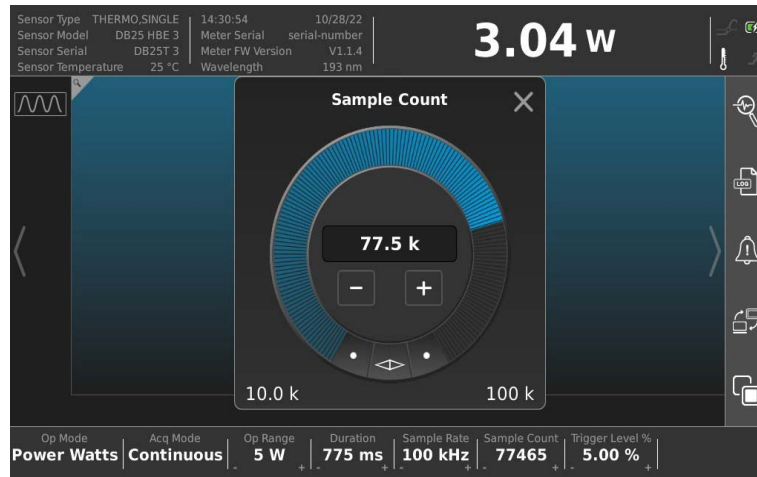


Figure 5-13. Sample Count Setting Dial

Trigger Level %: Allows selection of internal Trigger Level percentage in terms of the selected operating range, 0 to 100%.

NOTICE

Triggers and their indicators only apply to certain sensors and operating modes. They do not apply to thermopile and optical sensors.

5.8

Pulsed Thermopile Energy Joules Mode

Figure 5-14 shows options in Energy Joules Operation mode, accessed via the bottom information and button bar. Press the 'Op Mode' button to toggle between Joules and Power Watts modes.

Note that the buttons that are visible change depending on factors such as the selected Operating Mode or the attached sensor.



Figure 5-14. Bottom Information Bar - Energy Joules Mode

5.9 Auto Range Setting

This setting is available only for the thermopile and optical sensors. Acquisition source setting must be set to 'Slow' in the Acquisition Settings menu or via long-press of the Op Range button in the bottom button panel. Refer to Figure 5-15.

Pressing AUTO toggles between Auto Ranging and Manual Ranging mode.

- Auto Ranging mode instructs the meter to select the best measurement range for the incoming signal.
- Manual Ranging mode requires that the user select the range.

With Auto Ranging, unless it is at the top range, the instrument automatically ranges up rather than go into an over-range condition.



Figure 5-15. Auto Range Mode Selection - via Settings Menu or via Bottom Button Panel

NOTICE

If the measurement is above the maximum range allowed by the sensor, an over-range condition will occur, even while in Auto Ranging mode.

5.10 Indicators

As necessary, the user interface displays information in certain temporary conditions via indicators, visible here in the Measurement View in the Title Bar.

These indicators are also visible in the Tuning Measurement, and Statistics views, in addition to the Title Bar Measurements View.

Figure 5-16 shows possible indicators that can display on the touch-

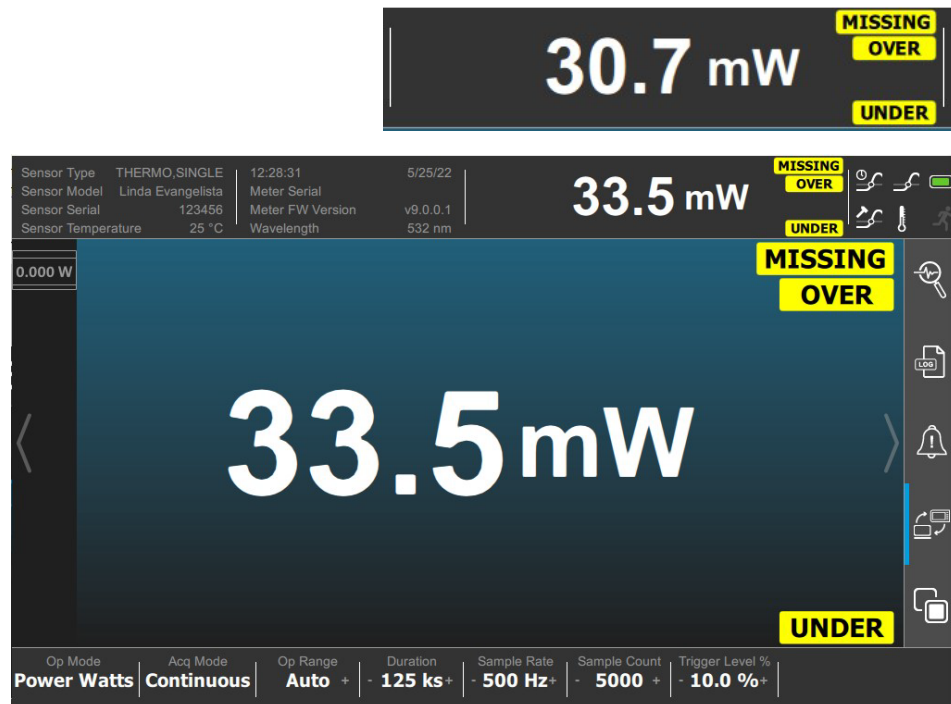


Figure 5-16. Indicator Display Types

screen.

MISSING: Indicates a hardware error condition that only happens with pyroelectric sensors, known as ‘missing pulses’. Normally for pyroelectric, the sensor receives a continuous sequence of power pulses.

The hardware detects the start and stop of the pulses automatically and generates an energy sample for each one it finds. Detection relies on various operating conditions, and sometimes fails to detect a pulse.

Causes and their remedies include:

- Pulse peak was less than 0.05% of range (remedy is to change to a more sensitive range).

- Baseline drifting too low (because the rep rate of the laser is too high).
- Gap in sequence numbers from the FPGA (either an FPGA failure, or a PCIe failure) -- this also applies to PowerMax Pro/Energy.

OVER: Indicates that the acquisition hardware encountered signals that are too large for the current range. User should switch to a higher range or to Auto Range (thermopile and optical sensors only). If a display value is greater than the maximum allowable level for the selected range, over-ranging takes place.

UNDER: Indicates that the acquisition hardware encountered signals that went negative. This may mean the meter must be zeroed.

NOTICE

Measurement range selection is dependent on the sensor type and characteristics, as well as the wavelength of operation.

5.10.1 Meter Must be Zeroed

A configuration change may require the meter to be set to zero. When this occurs, a warning indicator appears at the top of the screen.

A popup message also displays. Refer to the example in Figure 5-17.

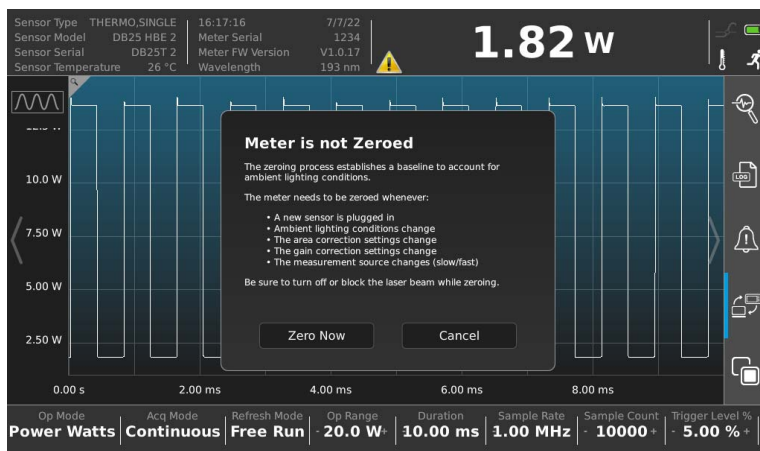


Figure 5-17. Meter is not Zeroed Popup Message

If the meter is not set to zero (user presses 'Cancel'), the warning indicator continues to display at the top of the screen. Refer to Figure 5-17.

For information on the Zero mode, refer to 'Set Meter to Zero' (p. 87).

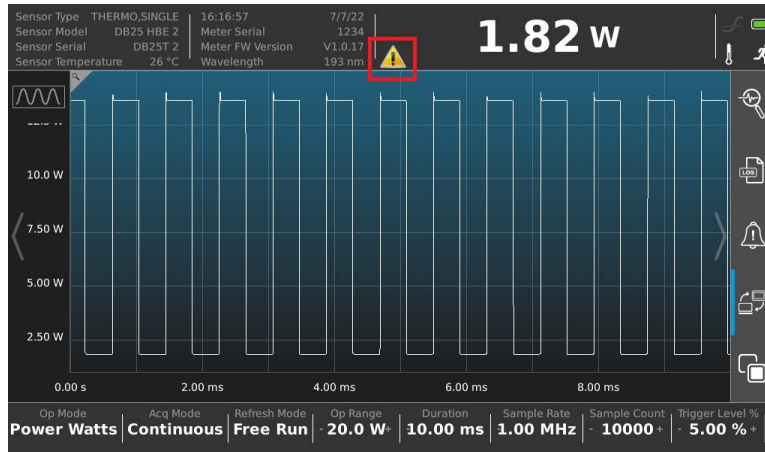


Figure 5-18. Meter is not Zeroed Warning Indicator

5.11 Set Meter to Zero

The ZERO indicator indicates that the instrument is in Zero mode. When the ZERO button is pressed, a Zeroing Meter message displays in the center of the screen and disappears when the zeroing process completes.

This indicator is not displayed when either of the following conditions exist:

- An invalid sensor is attached to the instrument.
- The instrument is in a Non-Zero mode (a pyro probe is used or acquisition mode is operating).

Pyroelectric sensors have a relative zero and, therefore, the ZERO indicator is not used with these types of sensors.

Optical sensors, on the other hand, use semiconductor diodes that have an absolute zero reference. When an *optical* sensor is attached to the instrument, pressing the Zero button causes the meter to toggle between the Zero and the Non-Zero modes.

Pressing the ZERO button clears all data and resets all values to zero. One exception is for PowerMax Pro sensors, it only sets the active channel measurement source to zero.

The meter does not retain its zero values when it is turned off and then on again.



NOTICE

It is recommended that the meter is set to zero after first setting it on and before beginning any new set of power measurements. It should be the first thing that is done when using a thermopile or PmP 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, the Zero button should be pressed 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 can only zero a finite level of offset. If zeroing on a selected range is unsuccessful, the meter displays an error message.

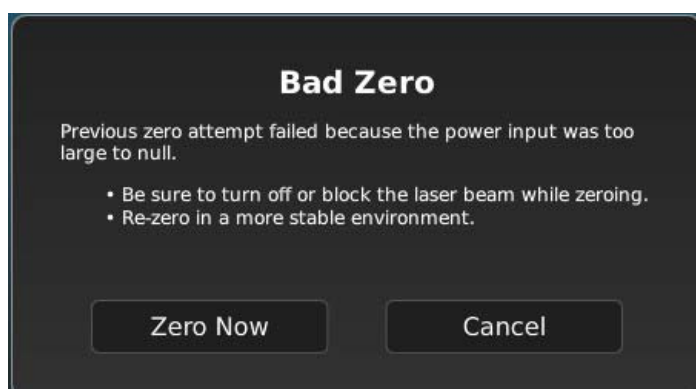


Figure 5-19. Bad Zero Error

NOTICE

If zero procedure is unsuccessful, this means that the power input is too large to zero it. Procedure must be done in a more stable environment, or a different range must be selected.

5.12 Sensor Errors

If an invalid or unrecognized sensor is attached to the instrument, the meter and sensor data area at the top left of the screen displays 'NONE' for the Sensor Type. A message can also display that indicates the sensor failed to initialize. If this occurs, contact Customer Service for support—refer to 'Service and Support' (p. 243) for contact information.

5.13 Trigger States

NOTICE

Triggers and their indicators only apply to certain sensors and operating modes. They do not apply to thermopile and optical sensors.

Triggering is done with either an external trigger input or a user-adjustable internal trigger. This section describes the following:

- External trigger input
- External trigger output
- User-adjustable internal trigger
- Analog output

5.13.1 External Trigger Input

External triggering to provide the most accurate readings. Since the meter is not looking for trigger events itself, the measured value is an actual laser pulse. External triggers also allow monitoring the missed pulses in Statistics mode, useful when diagnosing laser problems.

To prevent ground loop noise from interfering with accurate measurement, the external SMB trigger input is optically isolated from the LabMax Touch Meter internal ground by an optoisolator.

Figure 5-20 shows a simplified schematic of the external trigger input circuitry.

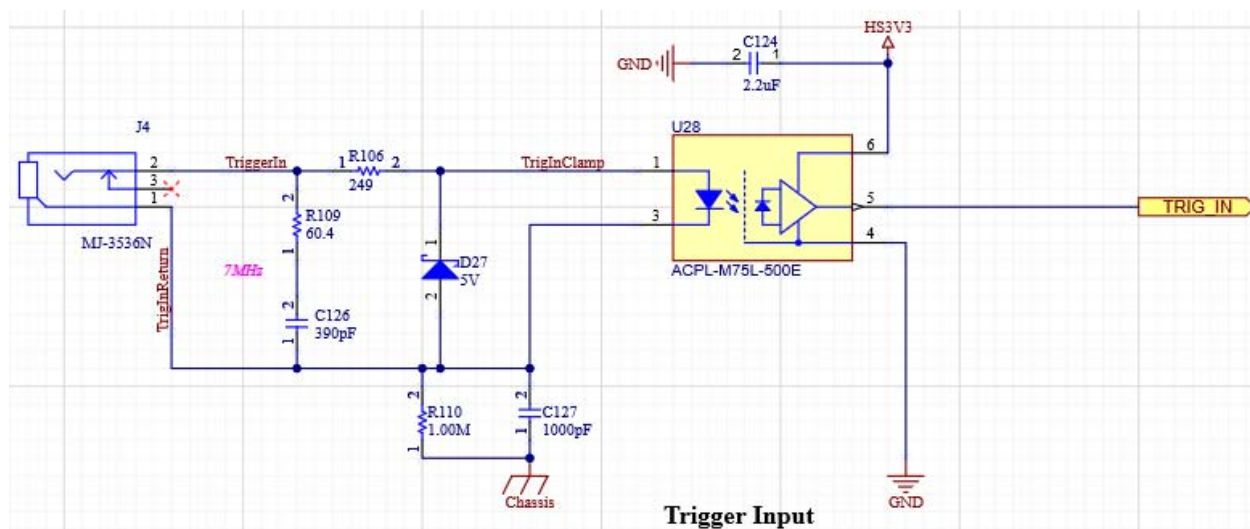


Figure 5-20. External Trigger Input Circuitry

Figure 5-21 shows examples of trigger outputs. Trigger input pulse must be 3 to 6V, 500 nS pulse from a 50 ohm source. If a current source is used, the minimum trigger current is 5 mA. One possible buffer circuit is shown in Figure 5-21.

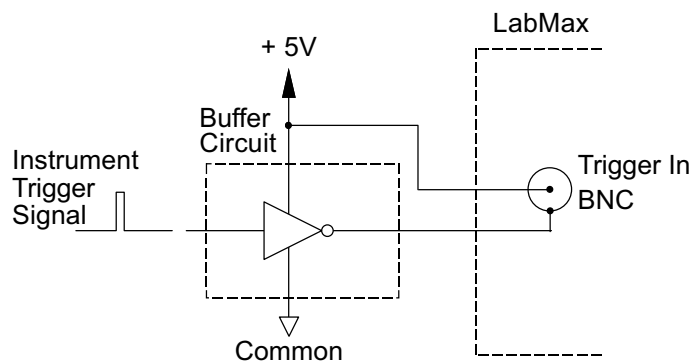


Figure 5-21. Boost Source Current of Triggering Device

The external trigger signal can be either a rising or a falling edge. Trigger polarity is selected in the Acquisition Settings menu (refer to Figure 5-22) or in the Coherent Measurement Connection software.

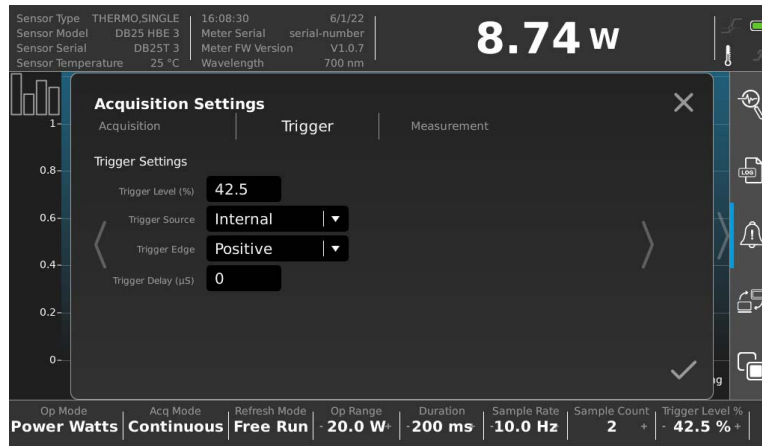


Figure 5-22. Trigger Settings

**CAUTION!**

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

5.13.2**External Trigger Output**

The Trigger Out BNC connector on the side panel of the LabMax Touch Meter is a 15 nS, 5V pulse from a 50 ohm source. It is designed to cascade into another device's trigger input. Refer to 'Side Panels and Ports' (p. 16).

5.13.3**User-Adjustable Internal Trigger****NOTICE**

Triggers and their indicators only apply to certain sensors and operating modes. They do not apply to thermopile and optical sensors.

The internal trigger can be set to 0% to 100% of the operating range for pyroelectric and PowerMax Pro sensors. Refer to 'Pyroelectric (Power) Watts Mode' (p. 81).

Instead of triggering the meter using an external waveform, the internal trigger analyzes the signal waveform and waits for the set trigger level increase or decrease in the incoming signal. If the range is set to 1W and

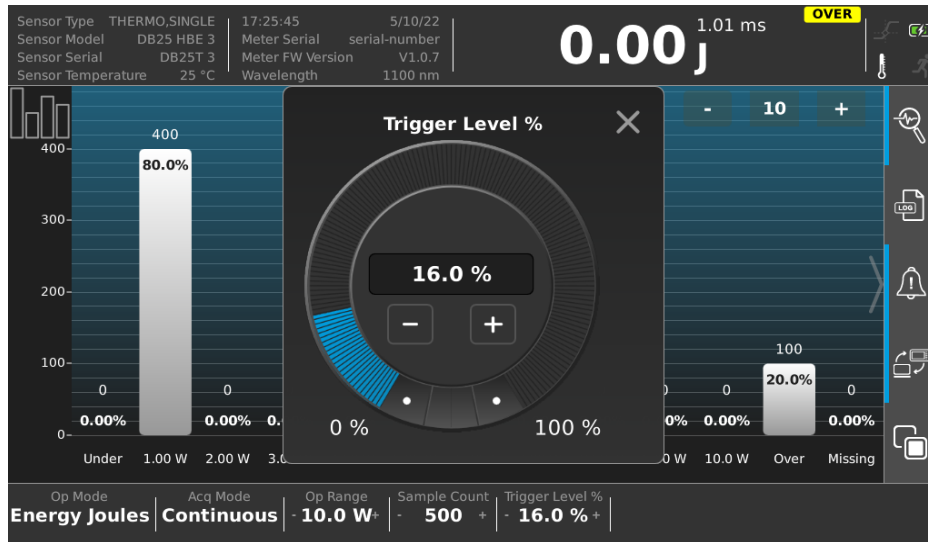


Figure 5-23. Trigger Level Setting

the trigger to 10%, then the meter will wait till a 100mW rise/fall is seen on the meter and be triggered on that edge. This internal trigger is not applicable to thermopiles or optical sensors.

5.14 Analog Output Voltage Range

When power is on, the Analog Out SMB connector outputs a voltage in proportion to the current laser measurement.

The output voltage is zero (0) volts when the measured energy or power is zero (0) or less. The output voltage is the full-scale output voltage when the measured energy or power is full-scale or over-ranged. The full-scale output voltage (1, 2, or 4V from a 50 ohm source) is selected via the meter or the host interface. Factory default full-scale output voltage is 2V.

Analog output Full Range can be set under the Measurement tab of the Acquisition Settings. Refer to Figure 4-18. This voltage correlates with what the operating range is set to. For an operating range of 100mW and an Analog Output Full Range of 2VDC, then an output of 2V correlates to 100mW and an output of 0V correlates to 0mW.

6

Operation - Touch Screen Interface

6.1 Overview

Before any measurements described in this section are taken, read and observe all safety precautions about working in a laser environment.



CAUTION!

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

This section provides instructions about how to take common power measurements with the LabMax Touch Meter. This is done with the direct touchscreen interface for the following measurement types:

- **Basic** – A nearly instant average power reading between 1Hz to 10 Hz sampling rate. PowerMax Pro and legacy thermopile and optical sensors (non-pyroelectric).
- **PowerMax Pro Variable High-speed** – A power reading selected between 1.00Hz to 1MHz sampling rate, with use of PowerMax Pro sensors. Applicable to use of LabMax Touch Pro meter model only.
- **Pyroelectric (pyro)** – A high-speed energy reading with the use of a pyroelectric sensor up to 10,000 pulses per second.

For information on operation with the Coherent Meter Connection software, refer to 'Operation - Coherent Meter Connection' (p. 121).

The following sections provide procedures for these measurement types.

The types of measurement modes and the related compatible sensors are described in Figure 6-1.

Table 6-1. Measurement Types

Energy Measurement Types	Sensor	Description	What Displays On-screen
Pyroelectric	Pyroelectric	The sensor natively measures energy.	Trend chart with Y-axis in Joules.
Pulsed-Thermopile-Joules (PTJ), also known as Long-Pulse-Energy-Mode (LPEM)	Thermopile	Sensor natively measures power, and software integrates the power curve to obtain energy.	Trend chart with Y-axis in watts, blue polygons show the integration area under each pulse. Energy values are superimposed on the pulses.
PMP/energy (LabMax Touch Pro only)	PowerMax Pro (PMP)	Similar to PTJ, but the data stream is too fast to integrate in software. Instead, integration is done in hardware (FPGA)	Trend chart with Y-axis in Joules.
Pulse Analysis (LabMax Touch Pro only)	PowerMax Pro (PMP)	Integration is done in software post-processing over the capture buffer	Trend chart with Y-axis in Watts. Horizontal and vertical markers are placed on key points of the waveform. A table of results is available in the pulse analysis dialog. Results can be exported to a file.

6.2 Take a Basic Power Measurement

The Basic power measurement mode is best used to measure the average power of either Continuous Wave (CW) or the average power of high-repetition rate (pulsed) lasers.

Basic mode is compatible with PowerMax-Pro sensors and with thermopile and optical power sensors.

6.2.1

Overview

The Basic power measurement uses a typical 10 Hz sampling rate.

In 10 Hz sampling mode, PowerMax-Pro sensors provide extremely fast (almost instantaneous) average power readings. This is similar to a photodiode, while also taking advantage of the sensor's ability to directly read very high powers.

However, because data is sampled every 100 milliseconds, temporal pulse information is not displayed. To view temporal information, use a high-speed mode (p. 100) instead.

Use Basic mode when measuring the average power of high repetition rate, short-pulsed lasers such as picosecond, femtosecond, and nanosecond lasers.

- Ultrafast and q-switched laser pulses are too fast for PowerMax-Pro sensor to resolve temporal pulse information.
- High-Speed Mode sampling rates tend to alias with the high kHz pulse repetition rates.

6.2.2

Basic Measurement Procedure

Note that illustrations shown in this section are not repeated in subsequent tutorials for the exact same steps.

1. Connect the sensor to the LabMax Touch Meter.
2. Set the LabMax Touch Meter to ON by pressing the Power button.



CAUTION!

Make sure either the laser is OFF or the beam is blocked until ready to take a power measurement.

3. Press the MENU function button to display the Settings menu. Refer to Figure 6-1.

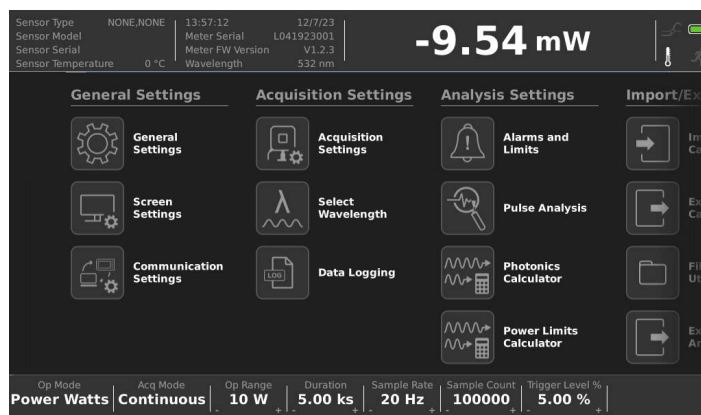


Figure 6-1. Settings Main Menu

4. Press the **Acquisition Settings** button on the touch screen.
5. Make sure that the **Acquisition** sub-tab is selected. Refer to Figure 6-2.

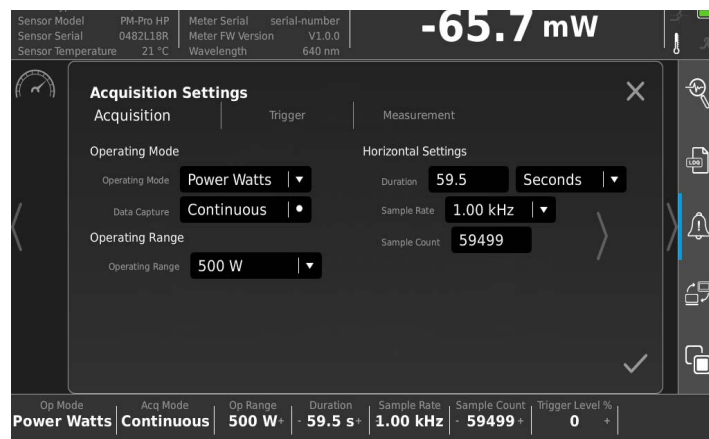


Figure 6-2. Acquisition Settings

6. Make sure that Power Watts is selected in the **Operating Mode** field.

7. In the **Range** field, set the operating range to the next value higher than the maximum expected power. Operating range can also be set by pressing **OpRange** in the bottom menu bar. Refer to Figure 6-3.

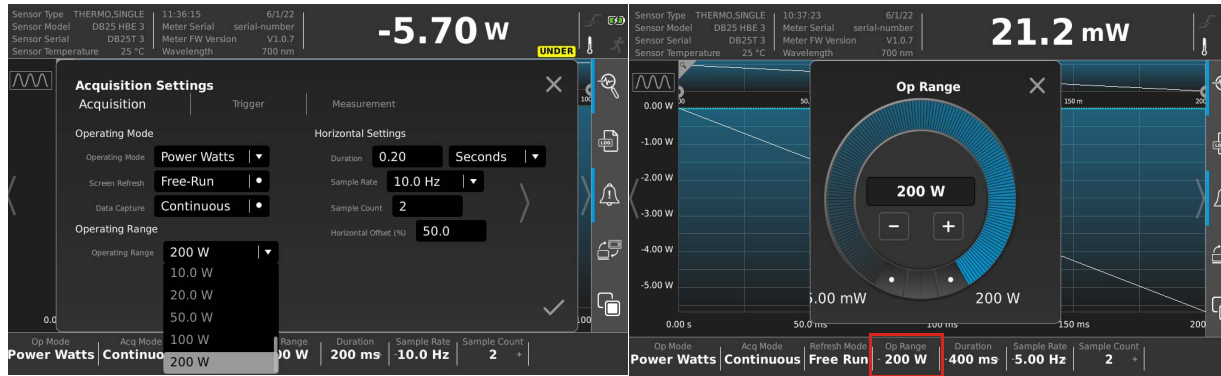


Figure 6-3. Set Operating Range from Settings Menu or Bottom Button Bar

8. The default range is specific to each sensor's electronics, so should be set each time a sensor is replaced, or the meter is power-cycled. Select **Continuous** in the **Data Capture** field if data collection should continue until it is manually stopped. Deselect **Continuous** to have data collection end after the data buffer is full.
9. Select the Sample Rate to be collected in the **Sample Rate** field, from 1 to 10Hz.
10. Press the **Measurement** sub-tab. Refer to Figure 6-4.

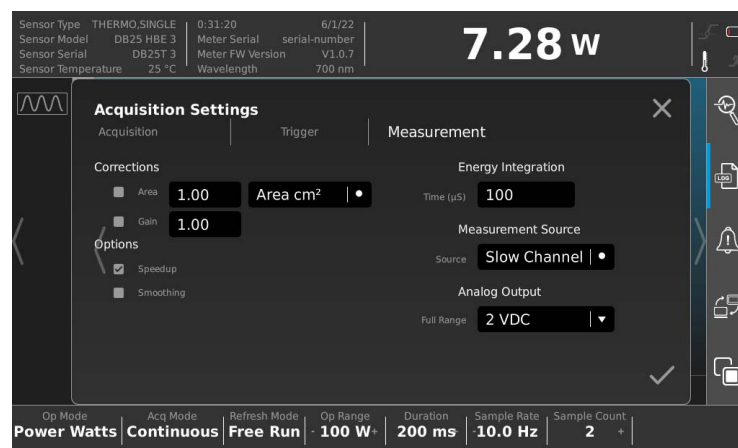


Figure 6-4. Acquisition Settings - Measurement

11. Make adjustments, as necessary in the Acquisition Settings menu. Refer to 'Acquisition - Measurement Tab' (p. 53)
12. Press the BACK function button to close the Settings menu.
13. Press the WAVELENGTH function button.
 - Select the needed wavelength from the drop-down menu. If the laser wavelength is not available, choose the one closest to it.
 - Alternatively, press **Add Wavelength** to provide a value that is added to the Wavelength Table.

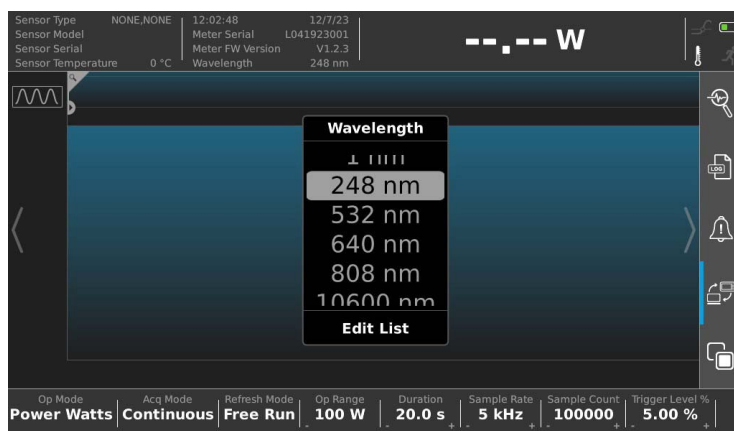


Figure 6-5. Select Wavelength

NOTICE

The default wavelength is specific to each sensor's electronics, so should be set each time a sensor is replaced, or the meter is power-cycled

14. Swipe left or right on the touchscreen to select the Trending view. Refer to the example in Figure 6-6.

NOTE: To zero the meter, the laser must be set to OFF (or the beam blocked).

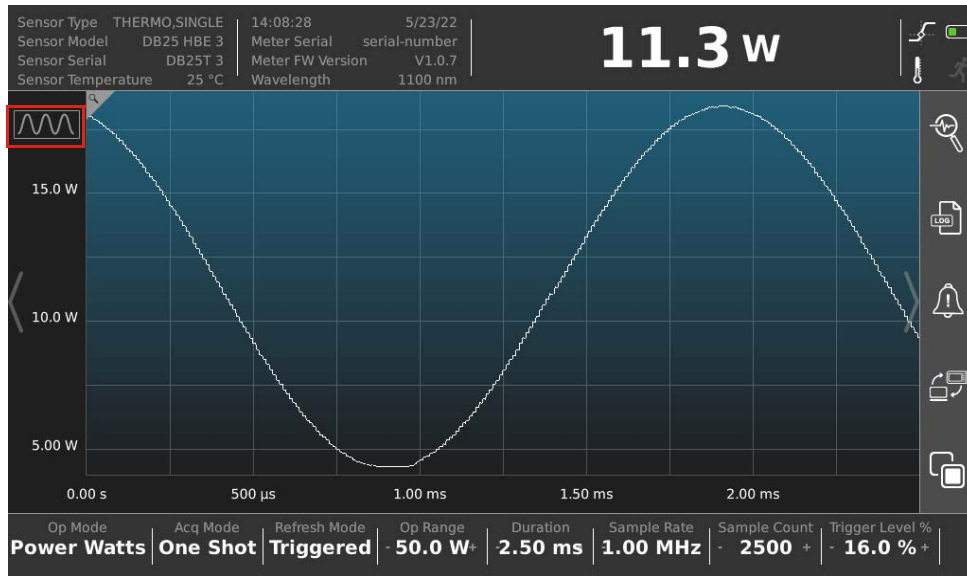


Figure 6-6. Trend View

15. Press the ZERO function button to measure the baseline value for the sensor.
16. If desired, press the **Log** button in the Quick Access toolbar to save the measurement data to a log file. Refer to Figure 6-7.



Figure 6-7. Log File Button

CAUTION!

Make sure either the laser is OFF or the beam is blocked until ready to take a power measurement.

17. Set the laser to ON and expose the sensor to the laser beam.
18. Press the RUN/STOP function button to begin data collection, and then activate the laser.
19. Press the RUN/STOP function button to end data collection.
Data is visible in the Trending chart and the touchscreen displays a live reading.
20. To zoom in or out on the trending chart, do the following:
 - a.) Press the magnifying glass button at the top of the trend view window.
 - b.) Drag the displayed sliders to select the zoom area. The chart display changes to show the selected section.
(or)
 - c.) Press the **Trend Zoom Setting** button at the top left to open the Trend Zoom settings. Refer to Figure 6-6.
21. When done, set laser to OFF.

6.3 Take a Variable High-speed Measurement with PowerMax Pro Meters

6.3.1 About PowerMax Pro Meter Measurements

This procedure is only for the use of Coherent PowerMax-Pro sensors.

With the LabMax Touch Pro meter, power readings are completed with a selectable sample rate between 1.00Hz to 1MHz. With the standard LabMax Touch meter, only sample rates from 1.00Hz to 10Hz are selectable.

6.3.2 Measurement Procedure

1. Connect the PowerMax Pro sensor to the LabMax Touch Meter.
2. Press the Power button to set the meter to ON.



CAUTION!

Make sure either the laser is **OFF** or the beam is blocked until ready to take a power measurement.

3. Press the MENU function button to display the Settings menu.
4. Press the **Acquisition Settings** button in the Settings Menu. Refer to Figure 6-1.
5. Press the **Measurement** sub-tab.
For more information about these settings, refer to 'Acquisition - Measurement Tab' (p. 53).

The Fast Channel source setting is typically used in the Acquisition settings.

6. Make sure that **Fast Channel** is selected in the **Measurement Source** field. Refer to Figure 6-15. This allows selection of sample rates up to 1MHz. It is not available for legacy sensors.

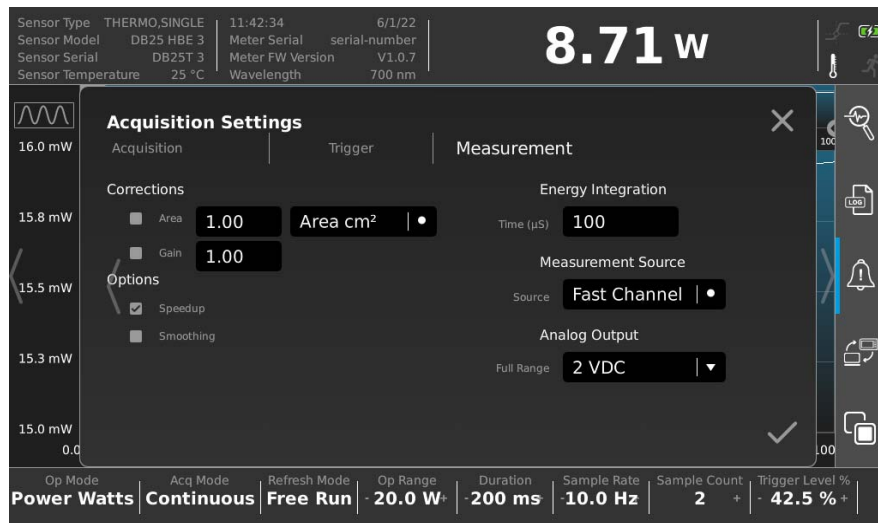


Figure 6-8. Acquisition Settings - Measurement

7. Press the **Acquisition** tab.
8. Make sure that Power Watts is selected in the **Operating Mode** field.
For more information about these settings, refer to 'Acquisition Settings Tab' (p. 50).

9. In the **Range** field, set the operating range to the next value higher than the maximum expected power. Operating range can also be set by pressing Op Range in the bottom menu bar. Refer to Figure 6-9.

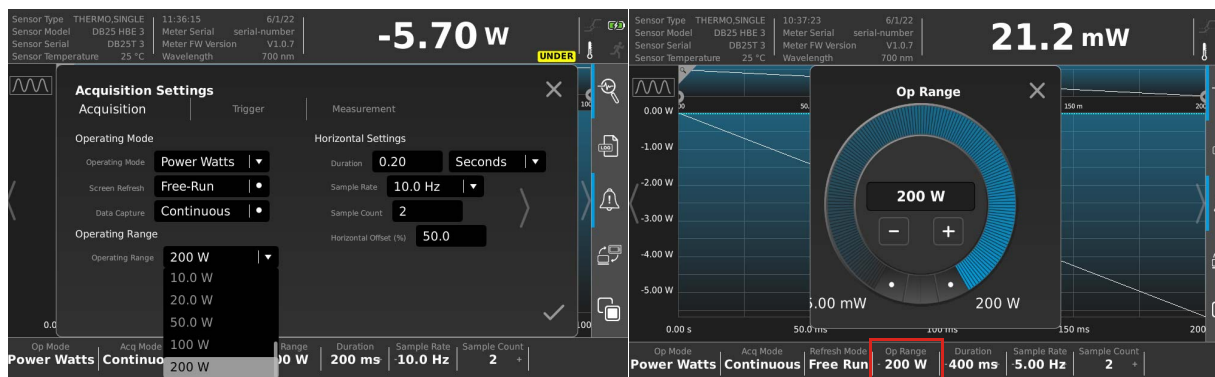


Figure 6-9. Set Operating Range from Settings Menu or Bottom Button Bar

This range value should be *above* the anticipated power measurement. The default range is specific to each sensor's electronics, so should be set each time a sensor is replaced, or the meter is power-cycled.

10. Select **Continuous** in the **Data Capture** field if data collection should continue until it is manually stopped. Deselect **Continuous** to have data collection end after the data buffer is full.
11. Select the rate for samples to be collected in the **Sample Rate** field, up to 1MHz.
12. Press the WAVELENGTH function button, and then do the following:
 - Select the needed wavelength from the drop-down menu. If the laser wavelength is not available, choose the one closest to it. Refer to Figure 6-10.

- Alternatively, press **Add Wavelength** to provide a value to add to the Wavelength Table.



Figure 6-10. Select Wavelength

NOTICE

The default wavelength is specific to each sensor's electronics, so should be set each time a sensor is replaced, or the meter is power-cycled

13. Adjust trigger settings:
 - a.) Press the Trigger sub-tab in the Acquisition Settings menu. For more information about these menu settings, refer to 'The fields are used to set the buffer capacity. The user sets 2 of the 3 settings and the other is calculated based on these.' (p. 52).
 - b.) Make sure that the **Trigger Source** is set to internal and the **Trigger Edge** is set to positive. Refer to the LabMax Touch Operator's Manual for more instruction on trigger options.
 - c.) Set the **Trigger Level %** to a percentage of the Operating Range that is *below* the expected pulse energy to be measured.
14. Press the MENU function button to exit out of the Settings menu.

NOTE: To zero the meter, the laser must be set to OFF (or the beam blocked).
15. Press the ZERO function button to measure the baseline value for the sensor.
16. If desired, press the **Log** button in the Quick Access toolbar to save the measurement data to a log file. Refer to Figure 6-7.
17. Swipe left or right on the touchscreen to select the Trending view.



Figure 6-11. Log File Button



CAUTION!

Exposure to laser radiation can be harmful. Direct eye contact with the output beam from a laser **WILL** cause serious eye injury and possible blindness. Follow all safety precautions when working in a laser environment.

18. Set the laser to ON and expose the sensor to the laser beam.
19. Press the RUN/STOP function button to begin data collection.



Figure 6-12. Trend View (with zoom)

20. To zoom in or out on the trending chart, do the following:
 - a.) Click the magnifying glass button at the top of the trend view window.

- b.) Drag the sliders that display to select the zoom area. The chart display changes to show the selected section.
21. When measurement is complete, press the RUN/STOP function button to end data collection.
If data logging was selected, the measurement is now saved as a log file in the meter's memory. Refer to the LabMax Touch Meter Operator's Manual for more information on log files and file management.
22. When done, set laser to OFF.

6.4 Perform a Pulse Analysis

This section describes how to perform Pulse Analysis and is applicable to the LabMax Touch Pro meter only. Note the following:

- Pulse Analysis is performed only on measurements when used with the LabMax Pro Meter and can be done with any power sensor.
- Pulse analysis is disabled for Energy data, for Pyroelectric sensors, and whenever the capture buffer contains no data.

6.4.1 Enable Pulse Analysis

To perform Pulse Analysis, do the following when a measurement has been taken:

1. Press the **Pulse Analysis** button in the Quick Access toolbar to activate pulse analysis. Refer to Table 4-3 (p. 43).
2. Press the MENU function button to display the main settings menu.
3. Press the **Pulse Analysis** button in the Settings menu to display pulse analysis settings. Refer to Figure 6-1.

For more information about these settings, refer to 'Pulse Analysis Settings' (p. 58).

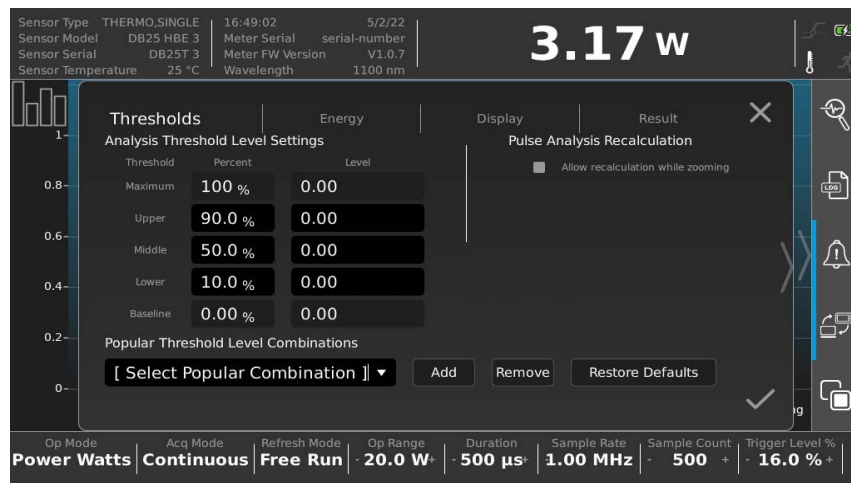


Figure 6-13. Pulse Analysis Settings

4. Adjust pulse settings, as necessary. Refer to Figure 6-13.

6.4.2 View the Trending Chart

1. On the touchscreen, scroll left or right to view the trending chart, as shown in the examples in Figure 6-14:



Figure 6-14. Trending Charts

6.4.3 Capture Pulses

To capture pulses, do the following:

1. Connect the sensor to the LabMax Touch Pro Meter.
2. Set the LabMax Pro Touch Meter to ON.
3. Press the Menu function button and then press **Pulse Analysis**. Refer to Figure 6-1.

For more information about these settings, refer to 'Pulse Analysis Settings' (p. 58)

4. Make sure that the checkbox next to **Allow recalculation while zooming** is checked.
5. Set the desired parameters for the measurement mode with the main settings menu and Quick Access toolbar buttons, as necessary.
6. On the touchscreen, scroll left or right to go to the Trending view, as shown in the example in Figure 6-15.

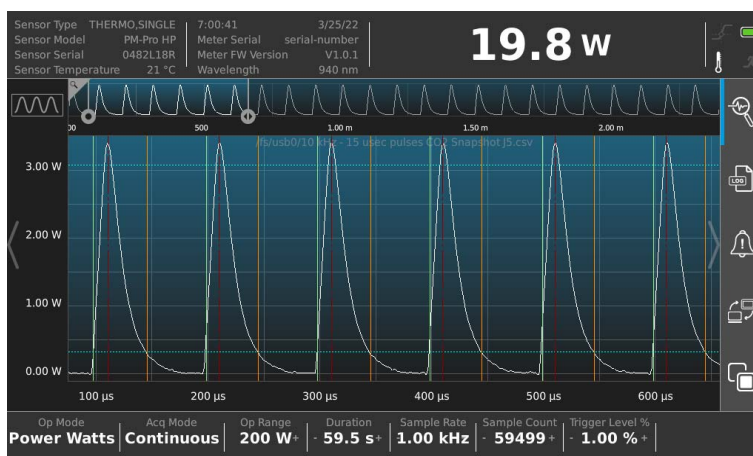


Figure 6-15. Display Trending View

7. Press the **Trend Settings** for zoom button in the top left. Refer to Figure 6-16. The Trend Settings for zoom popup menu displays.



Figure 6-16. Trend Settings for Zoom

8. Adjust the zoom settings, as necessary. Refer to 'Trend View Settings' (p. 65).
9. To view analysis results, press the MENU function button and then press the **Pulse Analysis** button in the Settings menu. The example in Figure 6-17 shows results for three captured pulses.



Figure 6-17. Pulse Analysis Results

10. To change the number of pulses captured, return to the Trending view and adjust the Trend Zoom Settings to include a greater number of pulses.
11. If a pulse is not captured with pulse analysis, return to the **Pulse Analysis Settings** screen and press **Restore Defaults** button in the Thresholds tab. Refer to Figure 6-13.
12. Return to the **Result** tab in the **Pulse Analysis** settings screen to compare the data for multiple pulses.

6.4.4 View and Save Results

1. Press the MENU function button, and then press the **Pulse Analysis** button in the Settings menu.
2. Press the **Results** sub-tab to display the Overall Results Summary. Refer to the example figure:



Figure 6-18. Pulse Analysis Results

Note that a status icon displays that results are available for logging.

3. Press the **Menu** function button. Then press **Export Capture Data**.
4. Follow the prompts to export the data file. Refer to 'Export Capture Data' (p. 62).

If no pulses are detected, the Analysis Results window displays a message.

6.5 Pyroelectric Energy Measurement

This tutorial describes how to take an energy reading with a pyroelectric sensor.

6.5.1 Set Up Basic Settings

1. Connect the pyroelectric sensor to the LabMax Touch Meter.
2. Set the LabMax Touch Meter to ON.

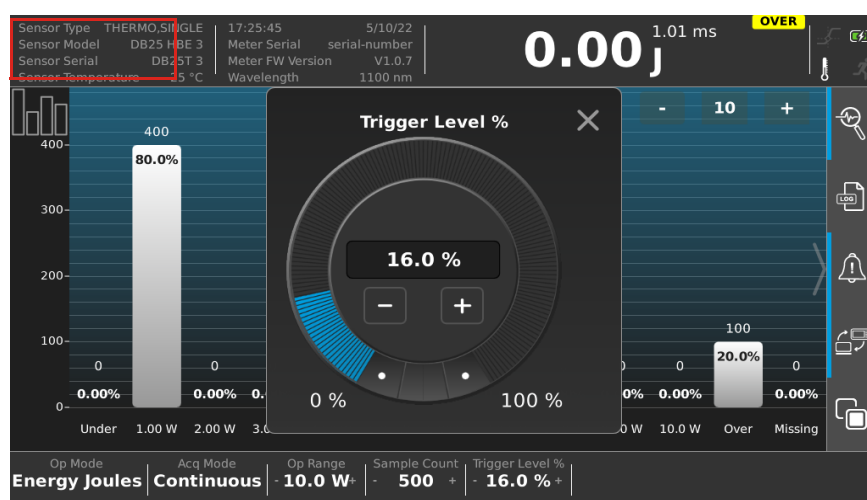


Figure 6-19. Bottom Information Bar - Energy Joules Mode Selected

3. Press the MENU function button to display the main Settings menu.
4. Press the **Acquisition Settings** button. Refer to Figure 6-1. For more information about the settings on this menu, refer to 'Acquisition Settings Tab' (p. 50)
5. Select Energy Joules in the **Operating Mode** field. Alternately, press the **Op Mode** button in the bottom menu to select Energy Joules.
6. Select the **Operating Range** for the sensor.

This value should be *above* the anticipated power measurement. The default range is specific to each sensor's electronics, so it should be set each time a sensor is replaced, or the meter is power-cycled.

7. Select **Continuous** in the **Data Capture** field if data collection should continue until it is manually stopped. Deselect **Continuous** to have data collection end after the data buffer is full.

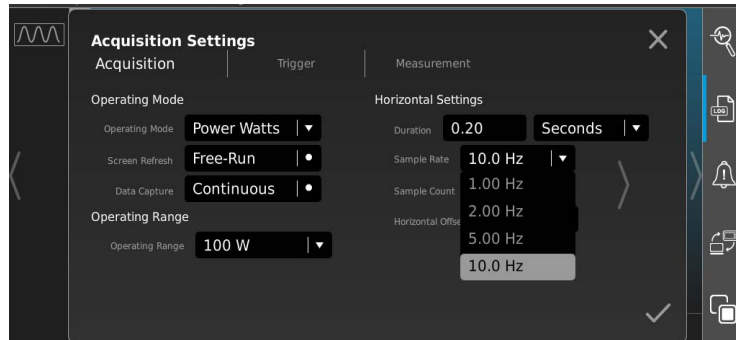


Figure 6-20. Acquisition Settings

8. Press the WAVELENGTH function button. Select the laser wavelength from the drop-down menu.
 - If the laser wavelength is not available, choose the one closest to it.
 - Alternatively, press **Add Wavelength** to provide a value to add to the Wavelength Table.



Figure 6-21. Select Wavelength

6.5.2 Set a Trigger Level

The trigger level is a threshold used to determine which signals are collected as energy measurements and which signals are ignored as noise. Set the trigger level at a threshold *below* the energy being measured and *above* the noise level of the sensor.

- Setting the trigger level too high can result in actual energy pulses being missed.
- Setting the trigger level too low can result in noise being picked up as readings.

To set a trigger level, do the following:

1. Press the MENU function button to display the Settings menu.
2. Press the **Acquisition Settings** button. Refer to Figure 6-1.
3. Press the **Trigger** tab to display Trigger settings. Refer to Figure 6-22. For more information about the settings on this menu, refer to 'The fields are used to set the buffer capacity. The user sets 2 of the 3 settings and the other is calculated based on these.' (p. 52).

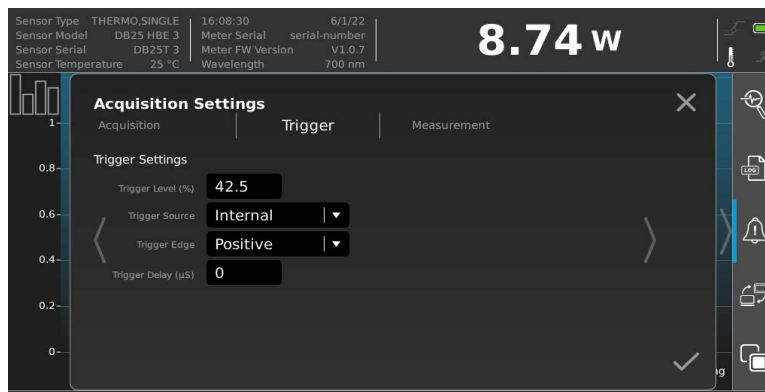


Figure 6-22. Acquisition Settings - Trigger

4. Select **Internal Trigger** in the **Trigger Source** field.
5. Set the Trigger Level. There are two ways:
 - a.) Type the percentage into the **Trigger Level %** field to a level that is *below* the expected pulse energy to be measured.
 - (or)
 - a.) Press **Trigger Level%** in the bottom button bar. Refer to Figure 6-23.
 - b.) Set the Trigger Level percentage in the popup menu to a level that is *below* the expected pulse energy to be measured.

Note that the trigger level is always set as a percentage of the selected operating range.

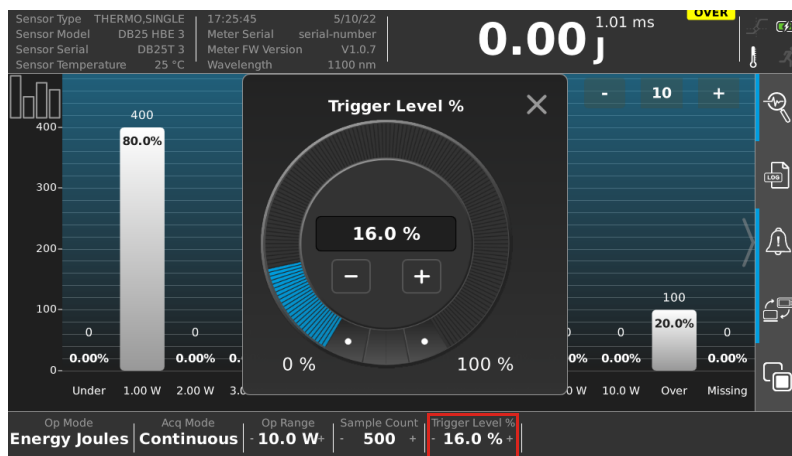


Figure 6-23. Trigger Level Setting

6.5.3

Set Acquisition Measurement Settings

1. Press the MENU function button to display the Settings menu.
2. Press the **Acquisition Settings** button. Refer to Figure 6-1.
For more information about the functions on this menu, refer to 'Acquisition Settings Menu' (p. 49).
 - a.) Press the **Measurement** tab. Refer to Figure 6-24.

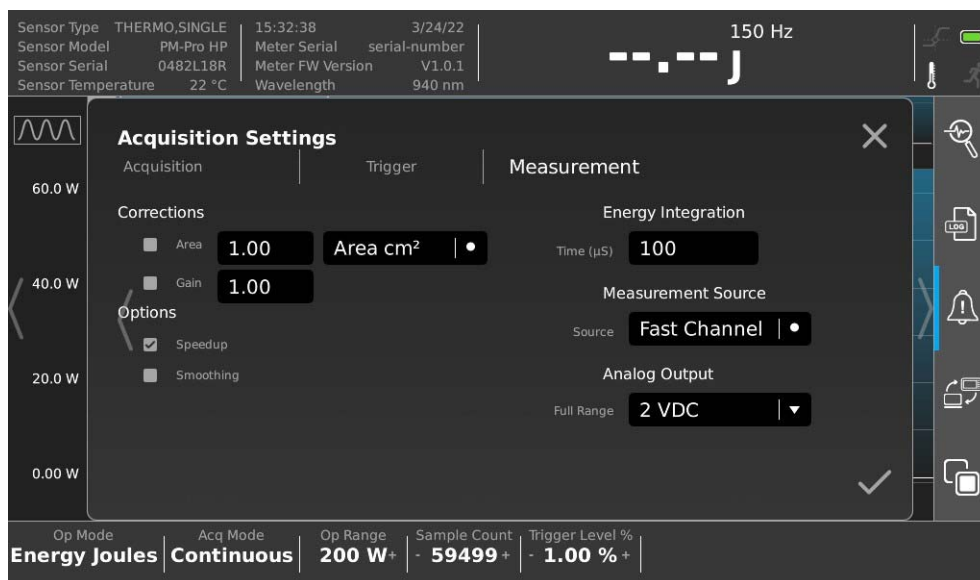


Figure 6-24. Configure Acquisition Measurement Settings

For more information about these menu settings, refer to 'Acquisition - Measurement Tab' (p. 53).

3. Made selections to the Measurement settings as, necessary, and then press the check button to accept.

6.5.4

Start Measurement and View the Results

1. If desired, press the **Log** button in the Quick Access toolbar to save the measurement data to a log file. Refer to Figure 6-7.

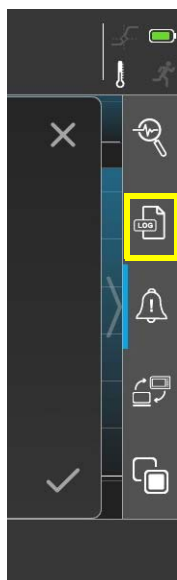


Figure 6-25. Log File Button

2. Scroll left or right on the main screen to go to the Trending View.



CAUTION!

Make sure that either the laser is set to OFF or the beam is blocked until a power measurement is to be taken.

3. Set the laser to ON and expose the sensor to the laser beam.



WARNING!

Exposure to laser radiation can be harmful. Direct eye contact with the output beam from a laser **WILL** cause serious eye injury and possible blindness. Follow all safety precautions (see p. 231).

4. Press RUN/STOP to start measurement and collect data.

NOTICE

If the trigger setting is too high, no data displays and a Wait trigger indicator displays.

Data is visible in the Trending chart and the touchscreen displays a live reading.

TIP: To determine if the meter is triggering appropriately, monitor both the energy level being measured and the calculation for the rep rate, also known as the PulseRepetition Frequency (PRF) rate.

5. If a Wait or Too Many Pulses message displays, or readings don't match the readings expected from the laser, readjust the trigger level setting. Start just above and slowly lower the threshold until pulses are visible at the expected rate.
6. If data logging was selected, the measurement is now saved as a log file in the meter's memory. Refer to the LabMax Touch Meter Operator's Manual for more information on log files and file management.
7. Press the RUN/STOP function button to end measurement and data collection.
8. When done, set laser to OFF.

6.6

Display Statistics

To display statistics, do the following:

1. Do the procedure to complete a measurement with the sensor and then press the RUN/STOP function button.
2. In the main window, swipe left or right to view the Statistics screen.

The associated statistics display in the statistics view:

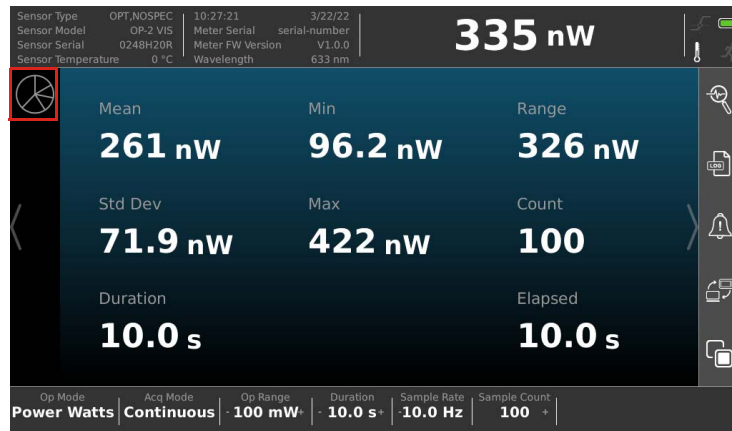


Figure 6-26. Statistics View

- To adjust how statistics are displayed, press the Statistics Settings button at the top left. Refer to highlight in Figure 6-26.

6.7 Save a Log File

To log measurement data to a file:

Perform the steps to set up data logging on the meter. Refer to 'Data Logging' (p. 56).

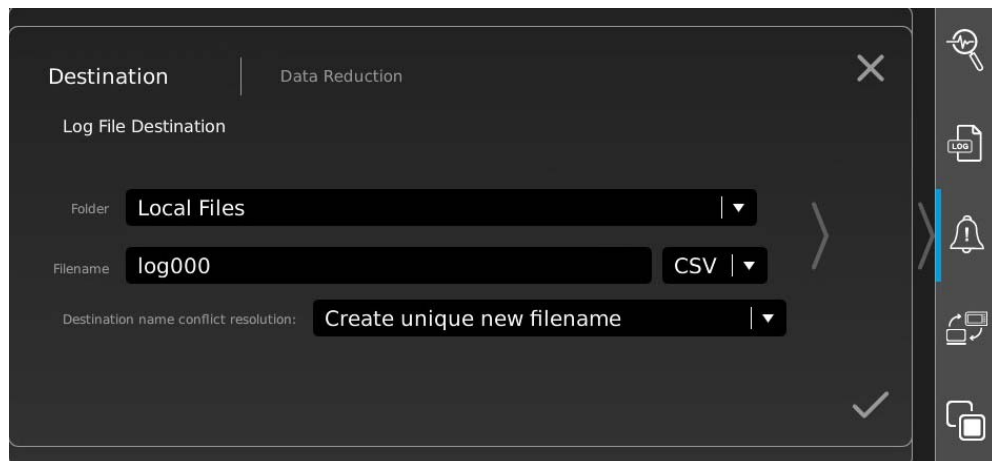


Figure 6-27. Configure Data Logging

- Complete a measurement with the sensor, as described in the sections above in this chapter.

When the RUN/STOP button is pressed to end data capture, the captured data is then saved as the specified log file.

6.8 Export Capture Data to File

To export and save the log file that is currently in the trend buffer to an external flash drive, do the following:

1. Insert a flash drive into one of the USB ports on the LabMax Touch Meter.
2. Press the MENU function button.
3. Press **Export Capture Data** in the **System Utilities** tab on the Settings menu. Refer to Figure 4-10.
4. Select the flash drive location in the **Folder** field.

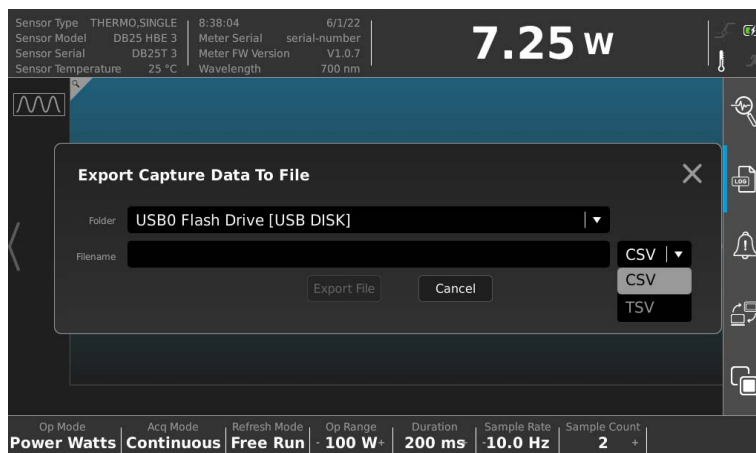


Figure 6-28. Save to File Settings

5. Select the file type (**CSV/TSV**) in the drop-down.
6. Press in the **Filename** field to type the name for the file and then press the Enter key on the touchpad keyboard.
7. Press the **Export File** button to save the file to the flash drive.

6.9 Export Log File to External Storage

To copy an existing log file to an external flash drive, do the following:

1. Insert a flash drive into one of the USB ports on the LabMax Touch Meter.
2. Press the MENU function button.
3. Press **File Explorer Utility** in the **System Utilities** tab on the Settings menu. Refer to Figure 4-10.
4. Navigate to find the file to copy. Refer to Figure 6-29.

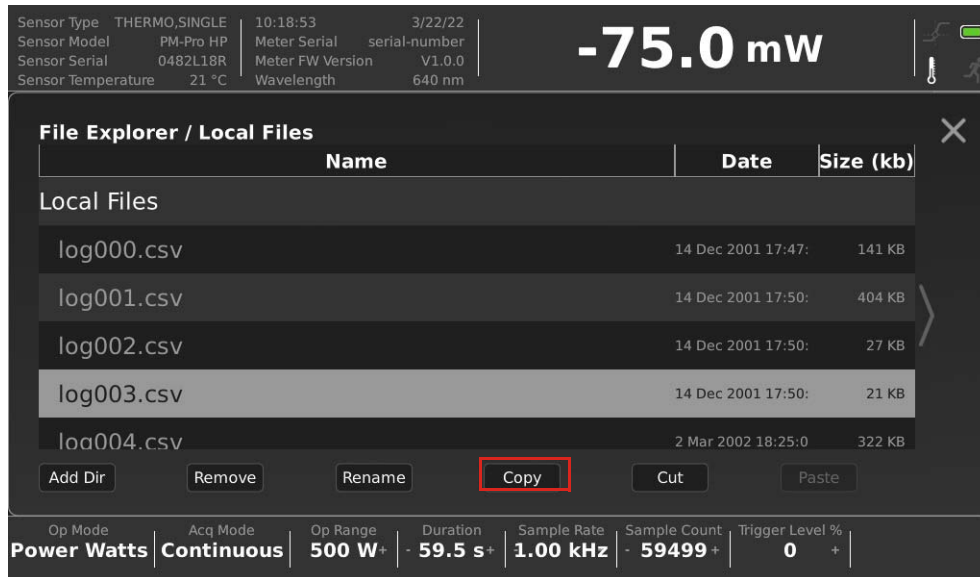


Figure 6-29. List of Local Log Files

5. Press to select the file and then press the **Copy** button.

6. Click any file in the destination drive/location, and then press **Paste**.

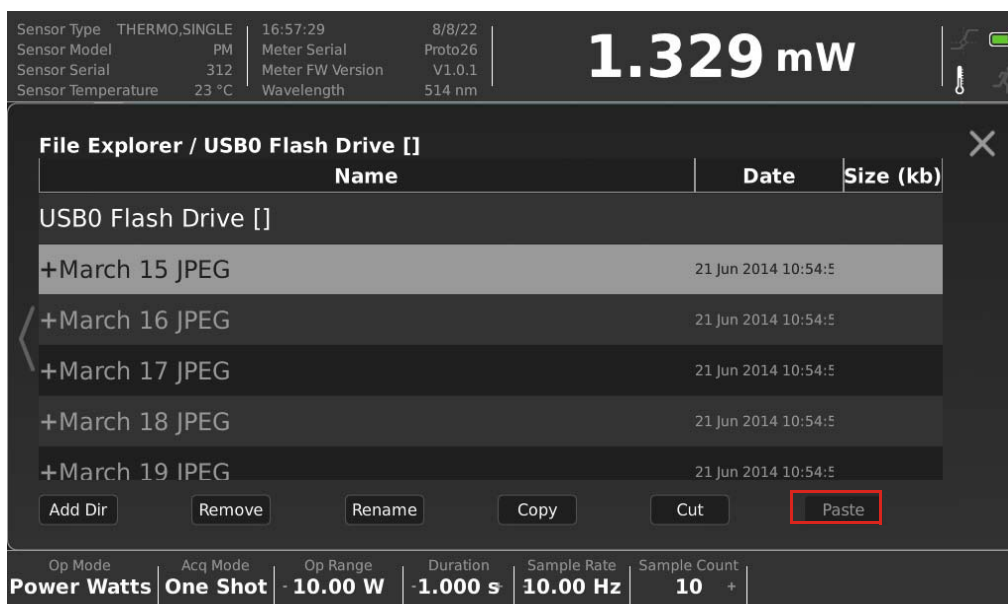


Figure 6-30. List of Local Log Files

When done, the new file displays as a copy in the new location in the folder.

7

Operation - Coherent Meter Connection

7.1 Overview

Before any measurements described in this section are taken, read and observe all safety precautions about working in a laser environment.

CAUTION!

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

This section provides a description of the graphical user interface for the Coherent Meter Connection (CMC) software. It also provides instructions about how to take power measurements with the LabMax Touch Meter with the CMC software for the following measurement modes:

- **Basic Low-speed** – A nearly instant average power reading at 10 Hz fixed sampling rate for legacy non-pyro sensors. Variable sampling rates from 1 to 10KHz for PowerMax Pro sensors and LabMax Touch Pro meter.
- **High-Speed (CMC)** – A high-speed power reading streaming at 20 kHz with only with the use of PowerMax Pro sensors.
- **Snapshot Mode (CMC)** – A burst of high-resolution power data sampled at 1MHz or 1 microsecond per sample, available only with use of PowerMax Pro sensors.
- **Pyroelectric** – A high-speed energy reading with use of a pyroelectric sensor, fixed at 10KHz.

NOTICE

To enable use of the PC software with the device, Remote Communications must be enabled on the touch screen with the quick access toolbar. Refer to 'Quick Access Toolbar on the Main Window' (p. 42).

For more information, refer to the Coherent Meter Connection Software User Manual.

7.2 Graphical User Interface

7.2.1 Manage Display Cursors

This section describes how to set up and manage the Cursors feature in the software.

The Cursors feature is a powerful tool to analyze pulses that have been captured. This feature can be used either after stopping live data collection or after importing a saved data file into the software.

7.2.1.1 Procedure

1. **[Trending view tab]** Right-click in the Graphics viewing panel to open the Trending Window Options menu. Refer to Figure 7-1.

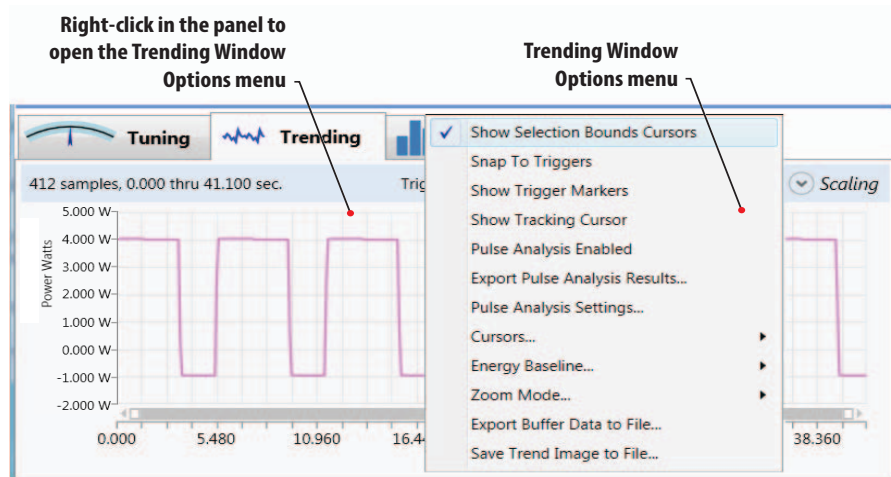


Figure 7-1. Trending Options

2. From the pop-up menu shown in Table 7-1, select the desired options to display:
3. Click the **Show Selection Bounds Cursors** check box in the pop-up menu. A horizontal dashed line is displayed at the baseline and in the middle to upper portion of the window.

Table 7-1. Select Cursor

Option	Description	
Show Selection Bounds Cursor...	Displays lines in the Trending chart.	
	Vertical	Mark sample time positions.
	Horizontal	Mark measurement levels.
Show Tracking Cursor	Allows inspection of a single pulse at a time.	
Cursors...	Allows a cursor to be dragged to zoom in on a range of data: <ul style="list-style-type: none"> • Reposition cursor. • Zero lower cursor. • Select entire buffer. 	

To display vertical lines, click the mouse at the side of the chart and drag a vertical line close to the pulse you want to view. Repeat on both the left and right sides of the chart.

Notice that the software shades the area under the pulse that falls between the cursors, as shown in Figure 7-2.

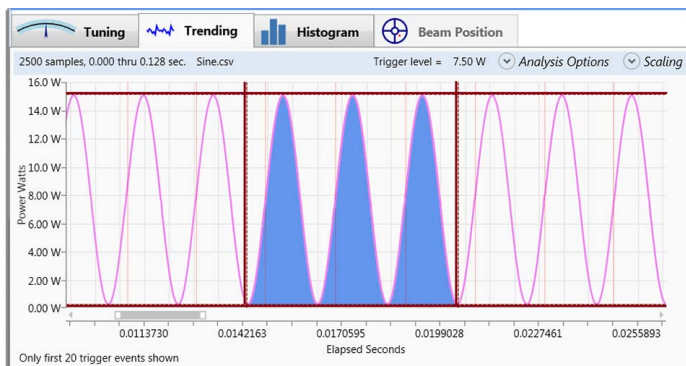


Figure 7-2. Trending Window

The default settings for cursors are set in equidistant thirds in the display panel.

After the first time they are used, cursor settings are retained until they are changed. Cursors across Start/Stop and Import/Export actions stay the same, rather than being reset each time.

4. Drag the cursors to fit around the necessary pulse shapes or features.
5. To zoom in on details of the pulse and further refine the data:
 - Click and drag the mouse around the pulse shape. When you release the mouse, the shape expands.

- Use the wheel on the mouse to zoom in and out on the shape of the pulse.

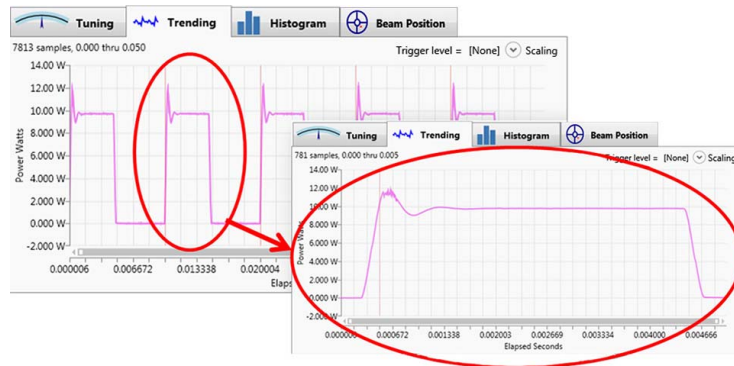


Figure 7-3. Zoom In/Out of the Pulse Display

The software calculates the energy of a pulse or pulses in the area selected by the cursors.

7.2.1.2

Selection Bounds Statistics

Based on the region of the plot selected by the cursors, statistics automatically update for the Selection Bounds. Go to the Statistics Panel on the right side of the window to see the results (as shown in Figure 7-4).



Figure 7-4. Selection Bounds

View the **Time Axis –Width** measurement to determine pulse width, rise-time, or fall time of a pulse in the plot.

7.2.1.3 Energy Baseline

To determine if the pulse energy calculation is based on the 0 mW baseline level or the lower cursor level, use the **Energy Baseline** option in the pop-up menu. You can also customize this level, as shown in Figure 7-5.

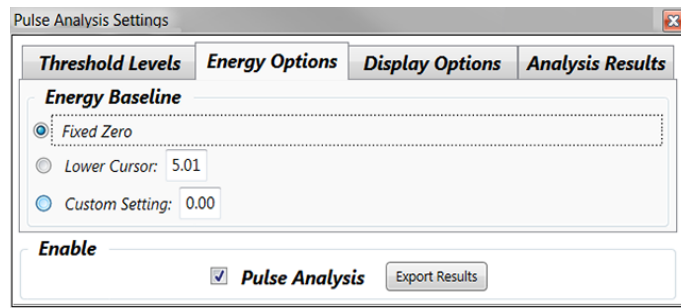


Figure 7-5. Set Energy Baseline

7.2.1.4 Snap To Triggers

Use the **Snap To Triggers** setting to set the cursors to the trigger point at the beginning of successive pulses.

Turning OFF **Snap To Triggers** allows the cursors to be moved to non-trigger positions, as shown in Figure 7-6.

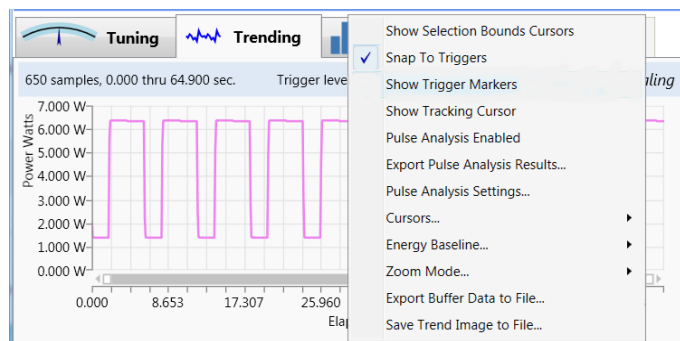


Figure 7-6. Snap to Trigger

7.2.1.5 Reset Cursors

Cursor settings are retained across Start/Stop and Import/Export actions, rather than being reset each time as in previous releases.

To reset cursors to their original positions:

1. Go to any area in the Trending window and right-click to display a pop-up menu.
2. From the pop-up menu, select Cursors ... > Reposition Cursors.

7.2.1.6 Show Tracking Cursor

A tracking cursor can be used separately or in combination with the Selection Cursor Bounds.

When selecting Show Tracking Cursor from the pop-up menu, a set of dashed lines are displayed (one horizontal, one vertical). The intersection of the horizontal and vertical lines over the pulse is the sample point, as shown in Figure 7-7.

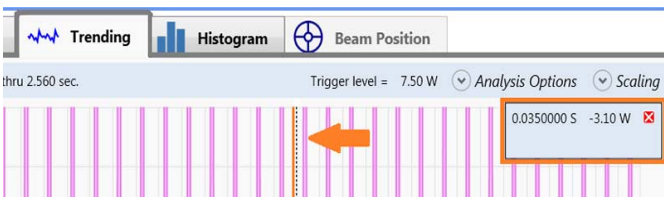


Figure 7-7. Show Tracking Cursor

Continue to zoom in to refine the data.

The data box in the right corner of the Trending chart shows the current values for the width and power level. This information is not used for statistics or analysis, but for purposes of review and inspection only.

7.3 Take a Basic Power Measurement

The Basic power measurement mode is best used to measure the average power of either Continuous Wave (CW) or the average power of high-repetition rate (pulsed) lasers.

Basic mode is compatible with PowerMax-Pro sensors, as well as with thermopile and optical power sensors.

7.3.1

Overview

The Basic power measurement mode uses a typical 10 Hz sampling rate.

In 10 Hz sampling mode, PowerMax-Pro sensors provide extremely fast (almost instantaneous) average power readings. This is similar to a photodiode, while also taking advantage of the sensor's ability to directly read very high powers.

However, because data is sampled every 100 milliseconds, temporal pulse information is not displayed. To view temporal information, use High-Speed Mode (p. 134) or Snapshot Mode (p. 138) instead.

Use Basic mode when measuring the average power of high repetition rate, short-pulsed lasers such as picosecond, femtosecond, and nanosecond lasers.

- Ultrafast and q-switched laser pulses are too fast for PowerMax-Pro to resolve temporal pulse information.
- High-Speed Mode sampling rates tend to alias with the high kHz pulse repetition rates.

7.3.2

Basic Measurement Procedure

Illustrations shown in this section are not repeated in subsequent tutorials for the exact same steps.

1. Set the LabMax Touch Meter laser power meter to On.
2. Double-click the shortcut icon to run LabMax Touch Meter PC software.



CAUTION!

Make sure either the laser is OFF or the beam is blocked until you are ready to take a power measurement.

3. **[Home tab]** To take a basic power measurement, select or change the following settings in the Home tab:
4. **[Home tab]** Make sure that the check box for **High-Speed Mode** is *not* checked.

[Home tab] Press the **Zero** button shown in Figure 7-9 to measure the baseline value for the sensor. A dialog box displays the zeroing process; this takes only a few seconds.

NOTE: To zero the meter, the laser must be set to OFF (or the beam blocked).

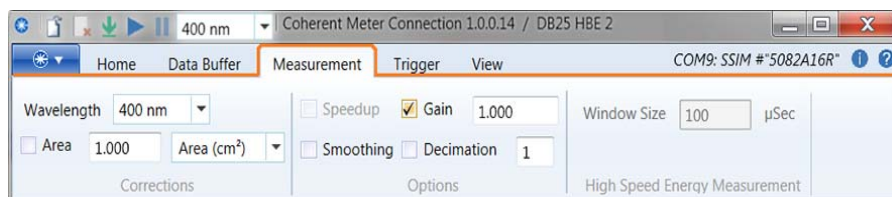


Figure 7-8. Settings for a Power Measurement



Figure 7-9. Zero to Set Baseline

For a basic power measurement, select or change the following settings in the **[Data Buffer tab]**:

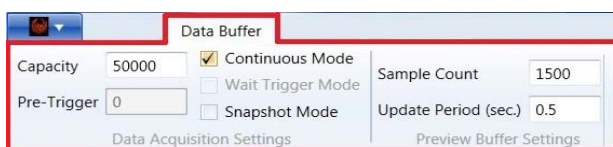


Figure 7-10. Data Buffer Settings

5. **[Data Buffer tab]** In the **Capacity** field, enter a value that represents the sample size you want to collect. This value is also the sample size used to calculate Statistics.
6. **[Data Buffer tab]** For the **Continuous Mode** check box:
 - Click the check box if you want data collection to continue until you manually stop it.
 - Deselect the check box to have data collection end after the Data buffer is full (when it reaches the value in the Capacity field).

For a basic power measurement, select or change the following settings in the **[Measurement tab]**:

7. **[Measurement tab]** Select your laser **Wavelength** from the drop-down menu. If the laser wavelength is not available, choose the setting that is closest to it.

Alternatively, type the specific wavelength to replace [None]; the value you enter is added to the Wavelength Table.

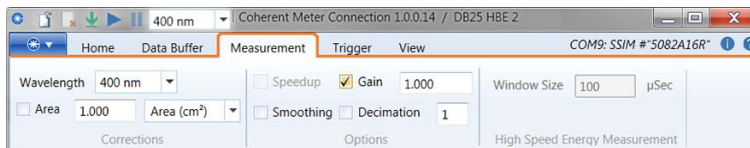


Figure 7-11. Measurement Tab Settings

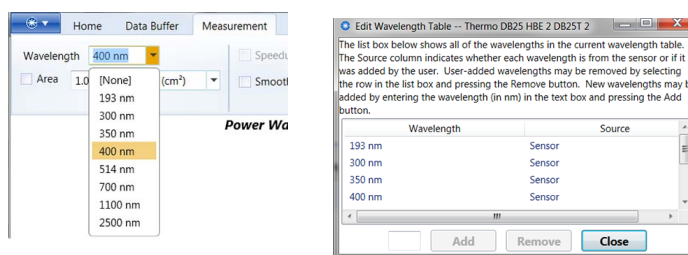


Figure 7-12. Select the Wavelength

8. [Trending view tab] Click the Trending tab in the lower half of the window to display the Graphics viewing panel.

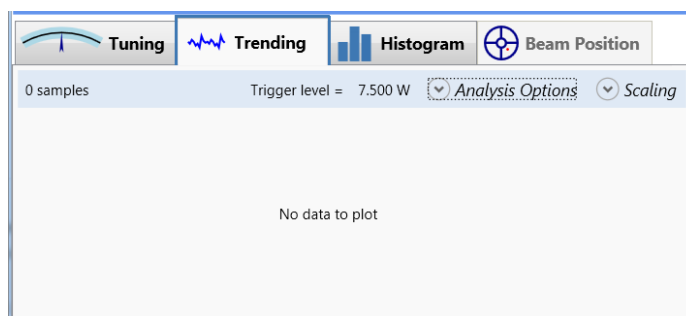


Figure 7-13. Display Trending Graphics Panel

9. Set the laser to On and expose the sensor to the laser beam.



CAUTION!

Exposure to laser radiation can be harmful. Direct eye contact with the output beam from a laser WILL cause serious eye injury and possible blindness. Follow all safety precautions (see p. 231).

10. [Quick Access toolbar or Home tab] To begin data collection, press the **Start** button in the toolbar or the Home tab.

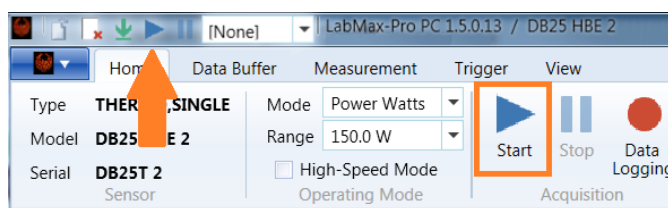


Figure 7-14. Start Measurement

11. [Quick Access toolbar or Home tab] To end data collection, click the **Stop** button in either the toolbar or the Home tab.

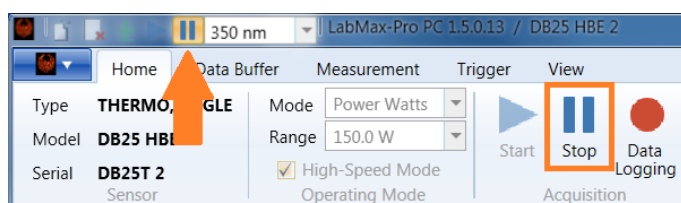


Figure 7-15. Stop Measurement

The following example shows how and where information is displayed during data collection:

- Data is visible in the Trending chart.
- The panel displays a live reading.
- Statistics in the sidebar on the right are updated in real time (based upon data entering the buffer).

The Trending view chart and Statistics can be viewed to see the overall minimum and maximums for the data.

12. In the [Home tab], click a button to **Export** or **Clear** the capture. The Clear icon can also be clicked in the Quick Access toolbar.



Figure 7-16. Trending View

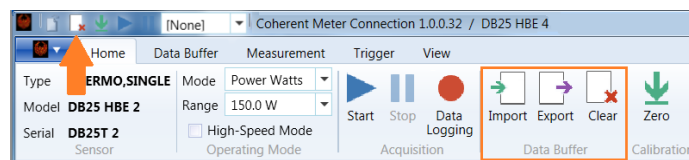


Figure 7-17. Export or Clear the Capture

7.3.3

Zoom Mode

The following examples describe how to zoom in or out when viewing the measurement in the Trending view chart.

- Click and drag the mouse, then release to define a portion of the display. The chart zooms in to display the selected section.
- Use the mouse wheel to zoom in or out.
- Use the scroll bar to define a portion of the display (drag either the left or right handle in the scroll bar) or scroll the display (drag the scroll bar to the left or right).

Alternatively, right-click in the Trending chart and select zoom settings from the pop-up menu.

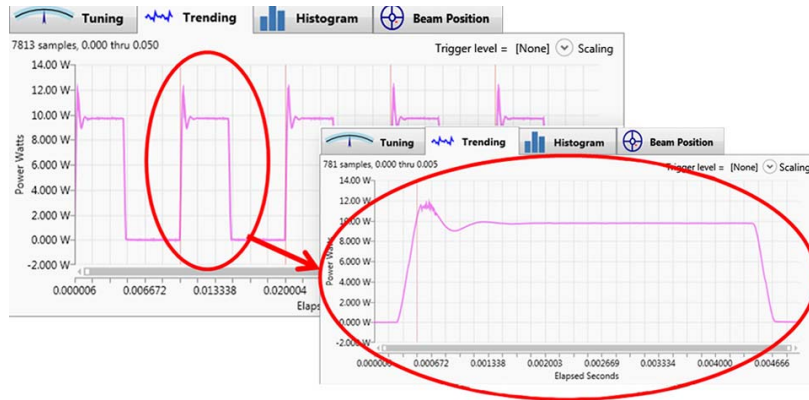


Figure 7-18. Zoom Mode

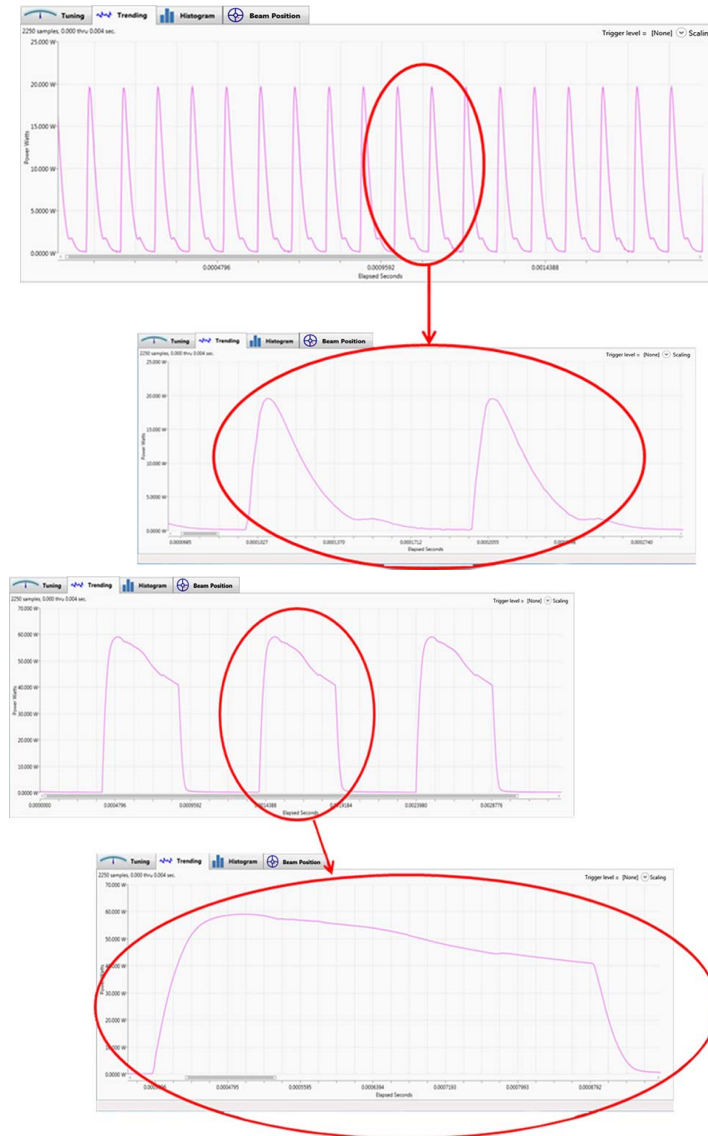


Figure 7-19. Select the Area to Zoom

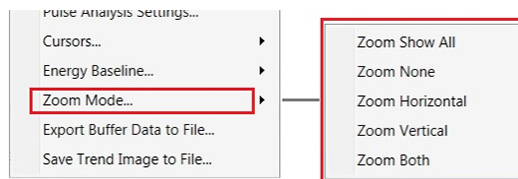


Figure 7-20. Zoom Options

7.4 Take a High-Speed Measurement

Variable High-Speed Mode is compatible only with PowerMax-Pro sensors.

High-speed mode operates at a continuous data sampling rate of 20 kHz, permitting pulse shape analysis of modulated lasers with repetition rates up to 2.5 kHz.

These types of pulse trains are common in many laser-based material processing applications, such as micro welding. This mode can also be useful for viewing the settling times of Continuous Wave lasers after the laser is fired.

- A data point is sampled every 50 microseconds, making this mode very useful for real-time visualization of temporal shape of modulated lasers with pulse lengths hundreds of microseconds or longer. This mode also provides fast feedback about changes in power output from Continuous Wave sources.
- High-Speed Mode is also used to determine the appropriate trigger level in or for Snapshot Mode (see p. 138). High-Speed Mode can be used to confirm that the LabMax Touch Meter is accurately triggering on the laser pulses before moving into Snapshot Mode.
- To avoid aliasing effects between the meter sampling rate and the laser pulses, High-Speed Mode cannot be used with lasers modulated at over 2.5 kHz pulse repetition frequency.

Figure 7-21 illustrates the type of detail displayed for a CO₂ laser when using High-Speed Mode.

Figure 7-21. Example - High-Speed Mode

7.4.1 High-Speed Measurement Procedure

1. Double-click the shortcut icon to start LabMax Touch Meter PC software.



CAUTION!

Make sure either the laser is OFF or the beam is blocked until you are ready to take a power measurement.

2. **[Home tab]** To take a high-speed measurement, select or change the following settings in the Home tab:

3. [Home tab] Verify that the check box for High-Speed Mode **is** checked.

Home tab] Click the **Range** drop-down menu, and select one:

- AUTO (for auto-range)
- A fixed range for low-power limits
- A fixed range for high-power limits

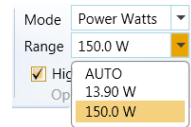


Figure 7-22. Select Range

Notes about Range:

NOTICE

If the measurement is above the maximum range allowed by the sensor, an over-range condition will occur, even while in Auto Ranging mode.

- The number of ranges listed depends on the sensor used; some sensors offer more than two ranges.
 - AUTO is generally used only for a single range at slow speed.
 - AUTO is not allowed in Snapshot or non High-Speed Mode operations.
4. [Home tab] Press the **Zero** button to measure the baseline value of the sensor. A dialog box displays the zeroing process; this takes only a few seconds. To zero the meter, the laser must be turned OFF (or the beam blocked).
[Data Buffer tab] For a high-speed measurement, select or change the following settings in the Data Buffer tab:
 5. [Data Buffer tab] In the **Capacity** field, enter a value that represents the desired sample size to collect. This value is also the sample size used to calculate Statistics.
 6. [Data Buffer tab] For the **Continuous Mode** check box:
 - Click the check box to continue data collection until it is manually stopped.

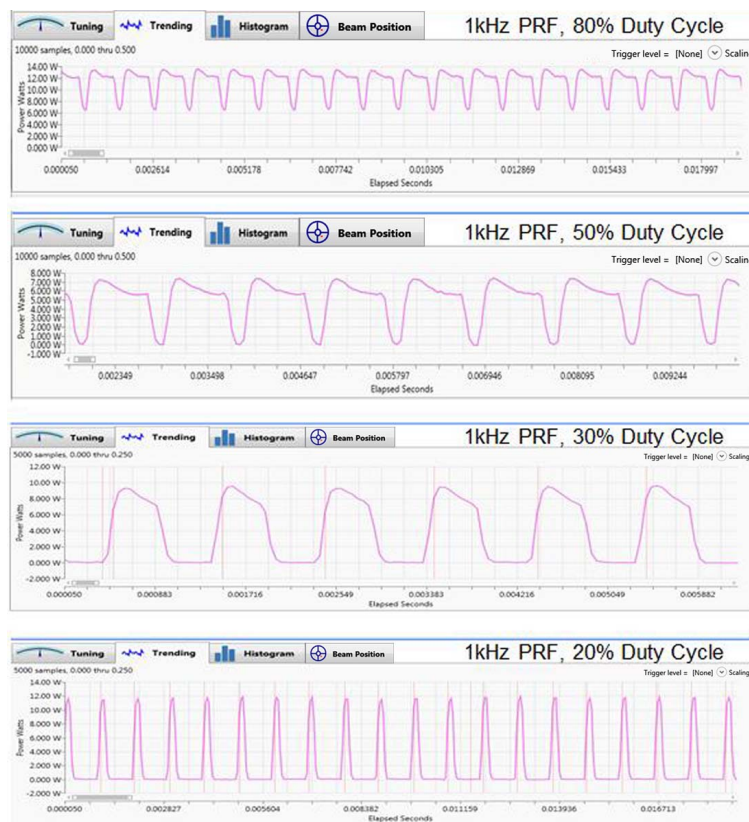


Figure 7-23. Examples - High-speed Mode

- Deselect the check box to have data collection end after the Data buffer is full (when it reaches the value in the Capacity field).
7. [Data Buffer tab] Verify that the check box for **Snapshot Mode** is *not* checked.
 8. [Measurement tab] Select the laser wavelength from the drop-down menu.
 - If the laser wavelength is not available, choose the one closest to it.
 - Alternatively, type the specific wavelength to replace [None]; the value you enter is added to the Wavelength Table.
 9. [Trending view tab] Click the **Trending** tab in the lower half of the window to display the Graphics viewing panel.
 10. Turn on the laser and expose the sensor to the laser beam.



CAUTION!

Exposure to laser radiation can be harmful. Direct eye contact with the output beam from a laser **WILL** cause serious eye injury and possible blindness. Follow all safety precautions when working in a laser environment.

11. [Quick Access toolbar or Home tab] To begin data collection, press the **Start** icon in either the toolbar or the Home tab.

Information is displayed as follows during data collection:

- Data is visible in the Trending chart.
- The panel displays a live reading.
- Statistics in the sidebar on the right are updated in real time (based upon data entering the buffer).

12. [Trending view tab] The loading indicator at the bottom of the Graphics viewing panel displays in **green** while data is loading.



Figure 7-24. Loading Graphics View

TIP: If the application displays a 'Missing' warning during data collection, it means data was lost while transferring the data in real time from the meter's buffer to the PC.

This usually occurs because the computer is not able to keep up with the high rate of data continuously streaming from the meter. To avoid this:

- Ensure that the USB connection is a USB 2.0 High-Speed port, and then close other open applications.
- Reduce the Capacity buffer size.
- Export the data file to examine the error indicators to determine where and how much data was lost.

13. [Quick Access toolbar or Home tab] To end data collection, click the **Stop** icon in either the toolbar or the Home tab.
14. Zoom in or out to view measurements in the Trending chart.
15. In the [Home tab], click the icons to either export or clear the measurement.

7.5 Take a Snapshot Measurement

A faster high-speed sampling mode, called Snapshot Mode, provides burst sampling at a rate of 1 MHz or 1 microsecond per sample (capture rate to the internal buffer inside the meter). This measurement has a maximum of 250 milliseconds.

This is a special acquisition mode that lets you see the temporal characteristics of modulated pulses used in commercial cutting, engraving and drilling applications. The temporal detail in Snapshot Mode illustrates the true performance of the laser—previously masked by slow thermopiles—thereby providing more information to help set up process recipes and monitor system performance in manufacturing.

TIP: To avoid aliasing effects between the meter sampling rate and the laser pulses, do not use this mode with lasers modulated at over 120 kHz pulse repetition frequency.

Due to the high rate of data acquisition in this mode, it is necessary to temporarily store the data in the instrument's hardware buffer, as it is not possible to upload it in real-time via the USB connector.

After data acquisition is complete, the instrument uploads the data to the PC, where it is placed in the Capture buffer and displayed in the software.

Figure 7-25 shows the data quality and high pulse shape fidelity that is achievable. This example is a snapshot based on:

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

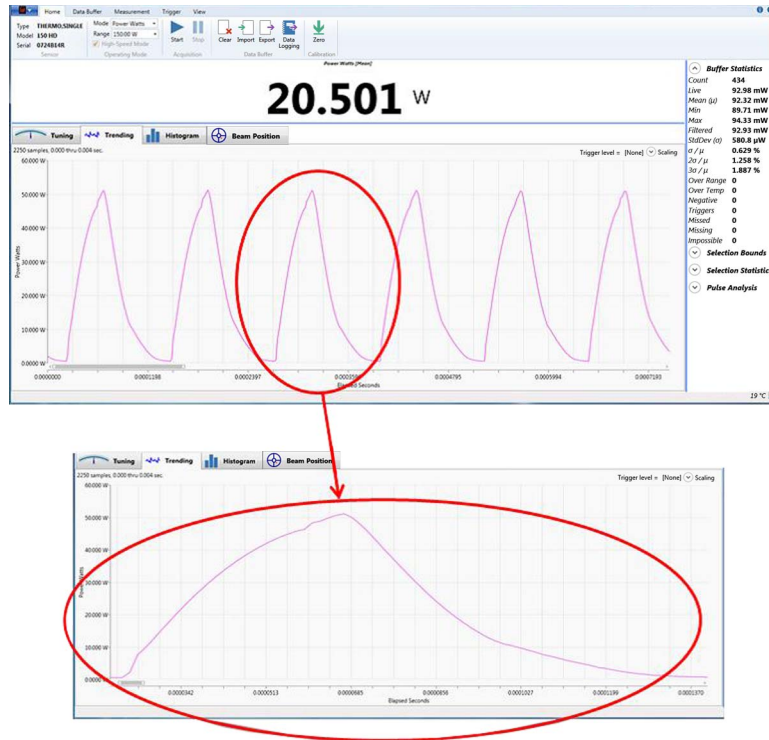


Figure 7-25. Example - Snapshot Mode

7.5.1 Snapshot Sample Size

The maximum size of the Snapshot buffer is 250,000 samples (250 milliseconds of data collection at 1MHz).

The user can request a snapshot of any number of samples up to 250,000 by adjusting the buffer Capacity setting in the Data Buffer tab. This field does not allow an entry greater than 250,000 when Snapshot Mode is enabled.

A smaller number of samples reduces the time to collect and upload them, and speeds up the response that displays on the user interface. A sample size that is set too small may not result in a collection window that is not long enough to view your entire pulse.

The 250,000 samples may be divided between pre-trigger samples and regular (post-trigger) samples as follows: $0 \leq \text{pre-trigger} \leq \text{capacity}$ and $1 \leq \text{capacity}$.

The Snapshot mode sample rate is variable.

'Horizontal offset' is displayed as a percentage (see acquisition settings menu). 0% places the trigger at the left side of the screen, 100% places it at the right side.

Preview mode is disabled when Snapshot mode is enabled. The user interface is updated at the completion of each Snapshot buffer upload.

It takes approximately a third of a second for the meter to acquire 250,000 samples and another 12 seconds to upload the data. That is, it takes approximately 12.3 seconds before the data can be viewed. A smaller number of samples require proportionally less time to display the data.

7.5.2 Overview of Process

During Snapshot Mode, the hardware waits for a trigger event before acquiring data. There is no preview of the data when waiting for a trigger. The recommended sequence is as follows:

1. Configure the laser and sensor for measurement.
2. Configure data acquisition settings on the LabMax Touch Meter meter initially only in High-Speed Mode. This shows the presence of triggers, or data even in the absence of triggers.
3. Fine-tune trigger levels in High-Speed Mode, then change settings on the meter to Snapshot Mode.
4. Start the meter.
5. Start the laser. This triggers data acquisition. When a trigger is found, the meter starts filling the Capture buffer.
6. If a trigger event is not automatically detected, press the Force Trigger button at the bottom of the panel to manually acquire a Snapshot.
7. When the buffer is full, data is sent to the user interface and displayed in the Graphics viewing panel on the Trending tab.

In practice, it may take some experimentation to determine the various settings and appropriate trigger levels.

- If the Continuous mode check box is checked, the meter automatically loops.
- If Continuous mode is not selected, the meter stops and awaits further instructions.

The duration of a Snapshot depends on the laser pulse length and the number of pulses you want to capture.

7.5.3 Procedure: Define Settings

The first part of the procedure is done in High-Speed Mode to define the data acquisition settings, including trigger settings.

1. Double-click the shortcut icon to start the PC software.



CAUTION!

Make sure that either the laser is turned OFF or the beam is blocked until you are ready to take a power measurement.

2. [Home tab] For a Snapshot measurement, first configure only High-Speed Mode in the Home tab to take trial measurements:
3. [Home tab] Verify that the check box for **High-Speed Mode** *is* checked.
4. [Home tab] Click the **Range** drop-down menu and select either of the **fixed** ranges. (This signifies the maximum power limits for each range.) Snapshot does not support Auto ranging.
5. [Home tab] Press the **Zero** button to measure the baseline value for the sensor. A dialog box displays the zeroing process; this takes only few seconds.



CAUTION!

Before you zero the meter, make sure either the laser is turned OFF or the beam is blocked.

[Data Buffer tab] To take initial trial measurements in High-Speed Mode, select or change the following settings in the Data Buffer tab:

6. [Data Buffer tab] Enter a value in the **Capacity** field that represents the sample size you want to collect.

A setting of 20,000 represents one second of data collection, which should be adequate to set up Snapshot Mode.

This value is also the sample size used to calculate Statistics. The purpose of this step is to confirm good data collection and proper pulse triggering.

- If this setting is '0' (zero), Snapshot begins at the time of the trigger event, which occurs after the first pulse begins.
- If you want to capture the portion of the first pulse before the trigger event, add some pre-trigger samples.

7. [Data Buffer tab] Verify that the check box for **Continuous Mode** *is* checked.
8. [Data Buffer tab] Verify that the check box for **Snapshot Mode** is *not* yet checked.
9. [Measurement tab] Select the laser **Wavelength** from the drop-down menu. If the laser wavelength is not available, choose the one closest

to it. Alternatively, type in a specific wavelength to add it to the Wavelength Table.

10. **[Trigger tab]** Enter a Level setting in **Watts** that represents a level approximately 50% between zero and the peak power you expect each pulse to have.

Any trigger setting between the data minimum and maximums causes a trigger



Figure 7-26. Trigger Settings

If the peak power is unknown, enter a setting between zero and the average power in the **Trigger Level** field.

11. Verify Trigger Settings:
 - **Source** is set to 'Internal'.
 - **Edge** is set to 'Positive'.
 - **Delay** is set to '0' (zero).
12. **[Trending tab]** Right-click within the Graphics viewing panel to display a pop-up menu. Select **Show Trigger Markers**. This setting confirms that the meter is auto triggering on the pulses.

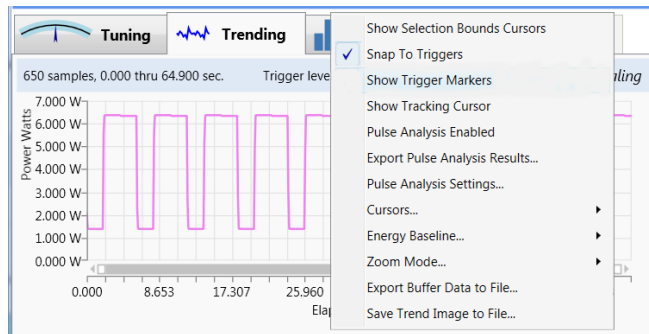


Figure 7-27. Show Trigger Markers

This setting is available only if there is data in the buffer, and remains in effect until you change it. If there is no data, first run a trial measurement, then select **Show Trigger Markers**.

13. Set the laser to ON and expose the sensor to the laser beam.



WARNING!

Exposure to laser radiation can be harmful. Direct eye contact with the output beam from a laser **WILL** cause serious eye injury and possible blindness. Follow all safety precautions (see p. 231).

7.5.4

Procedure: Trial Measurement

To begin a trial measurement:

1. [Quick Access toolbar or Home tab] Press the **Start** icon in the toolbar or the Home tab.
2. [Quick Access toolbar or Home tab] To end the measurement, press the **Stop** icon in the toolbar or the Home tab.
3. [Trending view tab] After the data is loaded, the result for the trial measurement is plotted in the Trending chart.

Confirm that each pulse has a trigger marker, represented by a **magenta** vertical line plotted at each trigger event.

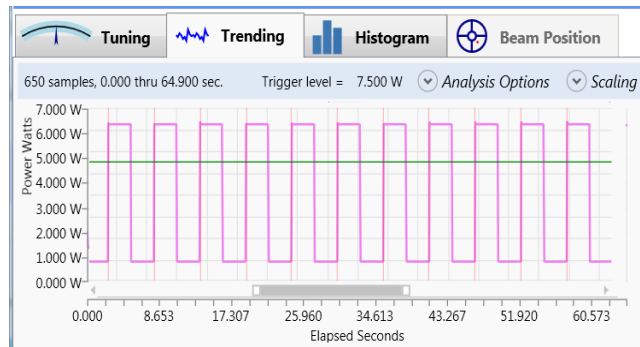


Figure 7-28. Show Trigger Event

- If the **magenta** trigger markers are not visible, or are not consistently triggering on each pulse event, adjust the Trigger Level setting in the Trigger tab.
- The **green** line in the Trending chart represents the trigger threshold level.

Continue to repeat trial measurements until trigger events are occurring as expected.

7.5.5 Procedure: Take a Snapshot

After trigger events are occurring and pulses are displaying properly, move into Snapshot Mode.

1. **[Data Buffer tab]** Click the check box for **Snapshot Mode**.

If settings (such as Range and Data Buffer) are not configured correctly and Snapshot Mode is selected, the following dialog box displays to indicate any errors:

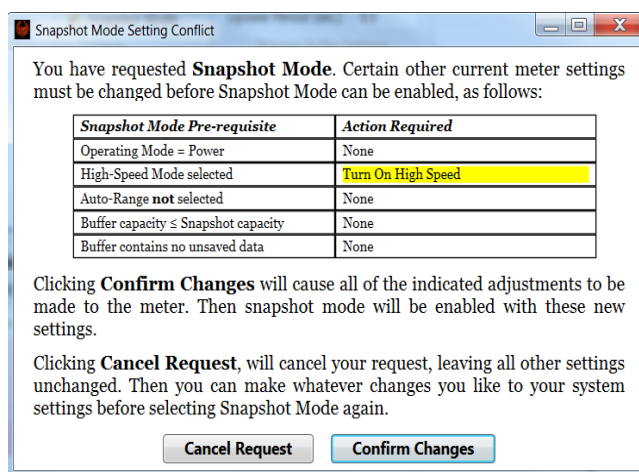


Figure 7-29. Set Snapshot Mode

To resolve, click the **Confirm Changes** button, and LabMax Touch Meter PC software automatically adjusts the settings.

2. Turn on the laser and expose the sensor to the laser beam.



WARNING!

Exposure to laser radiation can be harmful. Direct eye contact with the output beam from a laser **WILL** cause serious eye injury and possible blindness. Follow all safety precautions (see p. 231).

3. **[Quick Access toolbar or Home tab]** To begin a measurement in Snapshot Mode, press the **Start** icon in the toolbar or the Home tab.
A Snapshot Mode icon displays in the Status bar at the bottom of the Trending window. The Status bar is blank when the buffer is loaded in Non-Continuous mode or if Stop is pressed.
 - A **red** oscillating bar displays until the laser fires and a trigger event is detected.



Figure 7-30. Trigger Event Detected

- When a trigger event is detected, the Snapshot Mode bar turns **green** and actively displays the progress of loading the data from the internal Snapshot buffer in the meter to the PC application. This can take several seconds, depending upon the size of the Snapshot Capacity setting.



Figure 7-31. Loading Snapshot

If a trigger event does not occur, the system stays in the waiting state (the Snapshot icon displays the **red** waiting mode). If this happens, either:

- Press **Stop** to end data collection and exit Snapshot mode. Return to High-Speed Mode, and adjust trigger settings as needed.
(or)
- Press the **Force Trigger** button (on the oscillating bar). This forces the meter to collect Snapshot data, whether or not it finds a trigger.

Also, check if the Show Trigger markers menu option is enabled to ensure that triggers are occurring as expected before entering Snapshot mode.

4. [Quick Access toolbar or Home tab] To end data collection, press the **Stop** icon in the toolbar or the Home tab.

7.6 Pulse Analysis

This tutorial describes how to perform Pulse Analysis.

- Pulse Analysis is performed only on measurements when used with PowerMax-Pro sensors.
- Pulse Analysis is disabled for Energy data, for Pyroelectric sensors, and whenever the capture buffer contains no data.

7.6.1 Enable Pulse Analysis

To perform Pulse Analysis, the function must first be enabled. Do one of the following:

1. Right-click in the Trending Chart and select the menu option for **Pulse Analysis Enabled**.

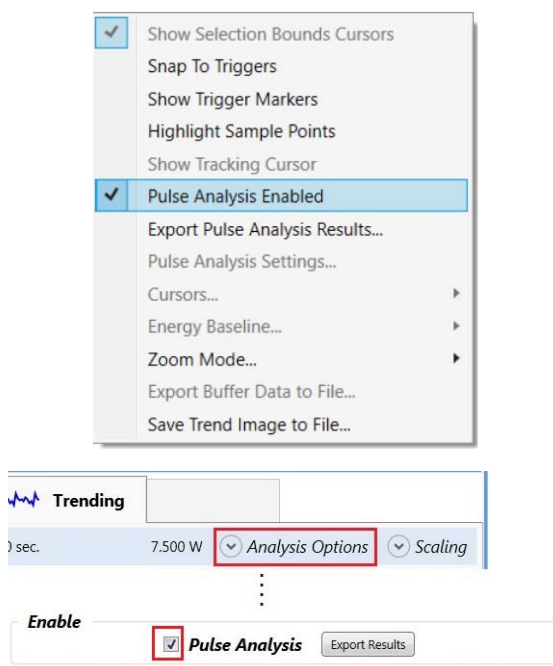


Figure 7-32. Select Pulse Analysis

(or)

Click the down-arrow for **Analysis Options**. A set of tabs are displayed in the dialog box. Click the check box at the bottom of any tab to enable Pulse Analysis.

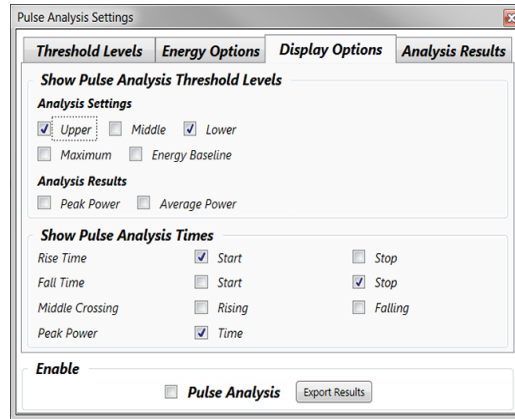


Figure 7-33. Optional Selection for Pulse Analysis

7.6.2 Display the Chart

The Trending Chart display changes, as shown in the following example:

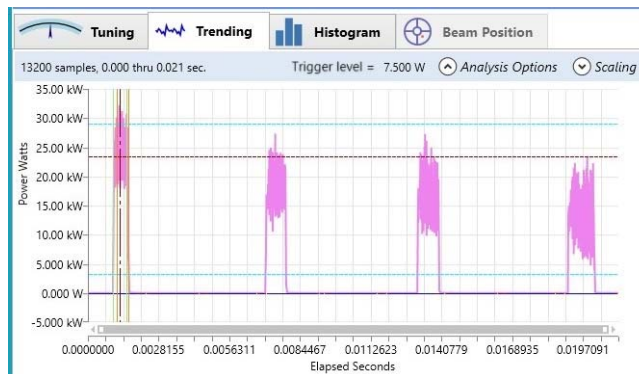


Figure 7-34. Display Trending Chart

Click the **Analysis Results** tab to view results, as shown in the following example:

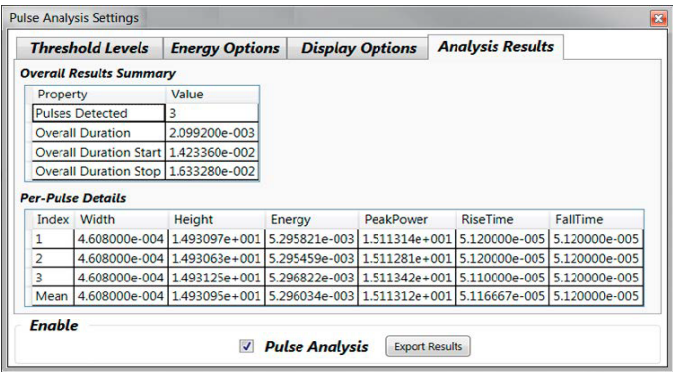


Figure 7-35. Analysis Results

If no pulses are detected, the Analysis Results window reports the following:

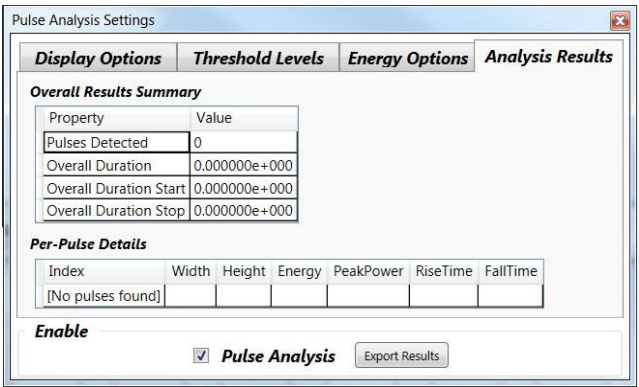


Figure 7-36. No Pulse Detected

7.6.3 Capture Pulses

To capture pulses:

1. Use the mouse and drag the light blue horizontal line in the Trending chart down to approximately 25 kW:

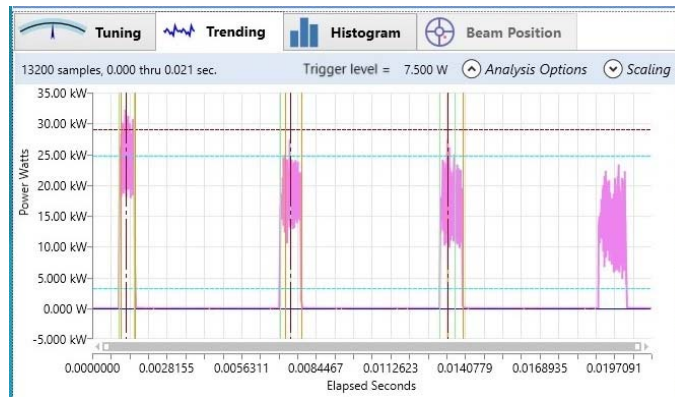


Figure 7-37. Capture Pulses

2. Select **Analysis Options** and then click the tab for Analysis Results. View details for THREE pulses that are detected.

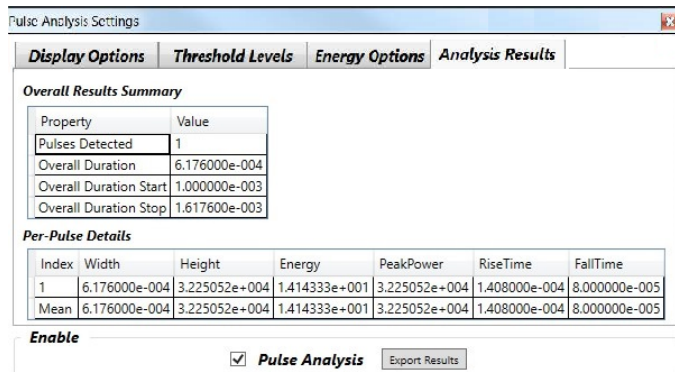


Figure 7-38. Pulse Analysis Results

3. To capture all FOUR pulses generated in this example, use the mouse to drag the blue line down further, to approximately 15 kW, as shown in the following example in Figure 7-39.
4. Select **Analysis Options** and then click the tab for Analysis Results. View details for FOUR pulses detected. Refer to Figure 7-40.
Note that the numbers also change in the Statistics Panel to the right of the Trending window.
5. Click the down-arrow for Pulse Analysis to view Pulse Count and more details.

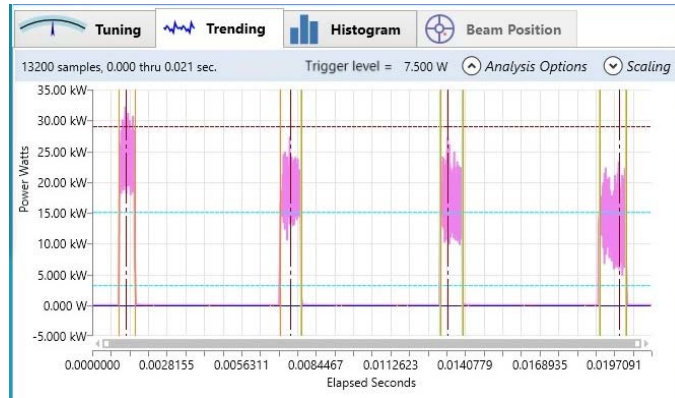


Figure 7-39. Compare Captures

Display Options

Threshold Levels

Energy Options

Analysis Results

Overall Results Summary

Property	Value
Pulses Detected	4
Overall Duration	1.916790e-002
Overall Duration Start	1.000000e-003
Overall Duration Stop	2.016790e-002

Per-Pulse Details

Index	Width	Height	Energy	PeakPower	RiseTime	FallTime
1	6.176000e-004	3.225052e+004	1.414333e+001	3.225052e+004	1.600000e-006	1.760000e-005
2	7.952000e-004	2.735912e+004	1.405352e+001	2.735912e+004	1.600000e-005	1.600000e-005
3	8.576000e-004	2.728881e+004	1.409465e+001	2.728881e+004	1.600000e-005	2.080000e-005
4	1.057500e-003	2.335424e+004	1.383289e+001	2.335424e+004	6.400000e-005	5.110000e-005
Mean	8.319750e-004	2.756317e+004	1.403110e+001	2.756317e+004	2.440000e-005	2.637500e-005

Enable

☒ Pulse Analysis

Export Results

Figure 7-40. View Multiple Pulses

7.6.4 Display Statistics

To select the statistics to be displayed:

- Right-click on the **Pulse Analysis** section.
- Either select each menu option from the pop-up menu or **Select All**. Refer to Figure 7-41.

The associated statistics are displayed in the right pane.

For more information about Pulse Analysis, refer to the on-line HELP files in the Coherent Meter Connection software.

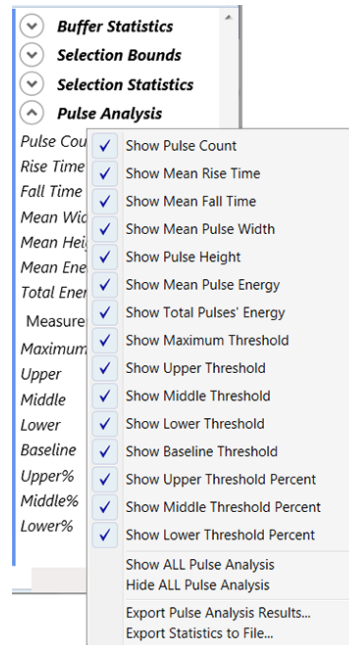


Figure 7-41. Select Analysis Options

7.7 Pyroelectric Energy Measurement

This tutorial describes how to take a high-energy reading using a pyroelectric sensor.

7.7.1 Procedure

1. Double-click the shortcut icon to run LabMax Touch Meter PC software.



CAUTION!

Make sure that either the laser is turned OFF or the beam is blocked until you are ready to take a power measurement.

2. [**Home tab**] select or change the following settings in the Home tab:
 - In the drop-down menu for **Mode**, select Energy Joules.
 - In the drop-down menu for **Range**, select the energy range (typically the next higher range than the expected energy level being measured).

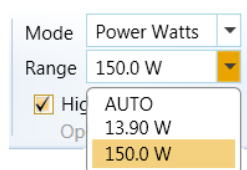


Figure 7-42. Select Range

3. [**Data Buffer tab**] Select or change the following settings in the Data Buffer tab:
4. [**Data Buffer tab**] In the **Capacity** field, enter a value that represents the sample size you want to collect. This value is also the sample size used to calculate Statistics.
5. [**Data Buffer tab**] For the **Continuous Mode** check box:
 - Click the check box to have data collection continue until it is manually stopped.
 - Deselect the check box to have data collection end after the Data buffer is full (which is when it reaches the value you entered in the Capacity field).

TIP: If the application displays a 'Missing' warning, it means data was lost while transferring the data in real time from the meter's buffer to the PC.

This usually occurs because the computer is not able to keep up with the high rate of data continuously streaming from the meter. If this warning is displayed:

- Ensure the USB connection is a USB 2.0 High-Speed port and close other open applications.
 - Reduce the Capacity buffer size.
 - Export the data file to examine the error indicators to determine where and how much data was lost.
6. **[Measurement tab]** Select the laser wavelength from the drop-down menu. If the laser wavelength is not available, choose the one closest to it.

Alternatively, type a specific wavelength to replace [None]; the value you enter is added to the Wavelength Table.

7.7.2

Set a Trigger Level

1. **[Trigger tab]** Set an appropriate **Trigger Level** (based on either units of joules or percent).
2. Set the **Source** to Internal.



Figure 7-43. Set Trigger

TIP: If the energy level being measured is known, the trigger level can be entered as a joules value that is lower than the expected energy level to be measured.

Alternately, the trigger level can be set as a percentage of the currently selected energy range.

The trigger level is a threshold used to determine which signals are collected as energy measurements and which signals are ignored as noise. Set the trigger level at a threshold below the energy being measured and above the noise level of the sensor.

- Setting the trigger level too high can result in actual energy pulses being missed.
- Setting the trigger level too low can result in noise being picked up as readings.

To view the acceptable limits for the trigger level settings, hover the cursor over the settings in the software.

7.7.3

Display the Results

1. **[Trending view tab]** Click the **Trending** tab in the lower half of the window to display the Graphics viewing panel.
2. Set the laser to ON and expose the sensor to the laser beam.



WARNING!

Exposure to laser radiation can be harmful. Direct eye contact with the output beam from a laser WILL cause serious eye injury and possible blindness. Follow all safety precautions (see p. 231).

3. **[Quick Access toolbar or Home tab]** To begin data collection, click the **Start** icon in either the toolbar or the top Home tab.

The following example shows information displayed during data collection:

- Data is visible in the Trending chart.
- The panel displays a live reading.
- Statistics in the sidebar on the right are updated in real time (based upon data entering the buffer).

TIP: To determine if the meter is triggering appropriately, monitor both the energy level being measured and the calculation for the rep rate, also known as the Programmable Rate Frequency (PRF) rate.

If those readings do not match the readings expected from the laser, readjust the trigger level setting until the energy level and the rep rate fall within an acceptable range.

4. **[Quick Access toolbar or Home tab]** To end data collection, press the **Stop** icon in the toolbar or the Home tab.

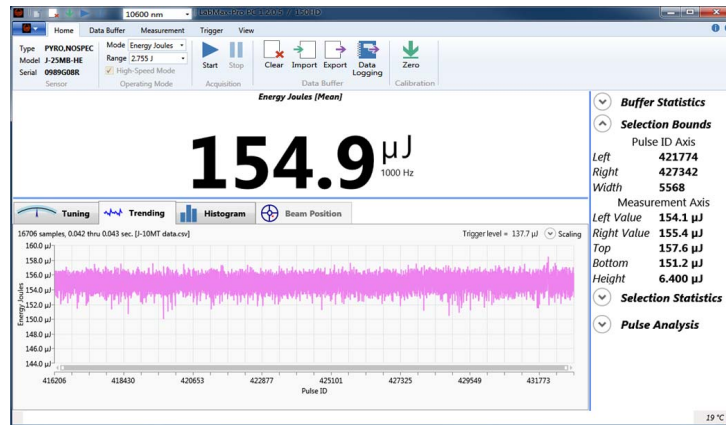


Figure 7-44. View Data Collection

8 External Computer Control Host Commands

This section describes the external control and host software interface for the LabMax Touch Meter touch screen.

8.1 Communication Channels

NOTICE

To enable remote PC interface with the meter, Remote Communications must be enabled on the touch screen with the quick access toolbar. Refer to 'Quick Access Toolbar on the Main Window' (p. 42).

LabMax Touch Meter supports three different communication channels:

- RS-232
- USB
- Ethernet

Only one channel can be active at a given time. To simplify set-up, all channels listen passively for incoming commands. As soon as a channel receives a valid command, it becomes the active channel.

Each of these channels can be viewed as a bidirectional byte-stream and therefore operate with the same command protocol and syntax.

The USB channel presents itself as a virtual COM port.

The Ethernet port uses TCP/IP and the meter listens on a user-configurable port (default is 58975).



NOTICE

The Ethernet channel is unencrypted and unauthenticated. Therefore, it is unsuitable for communicating over a public network, such as the Internet. The assumption is that the customer will use the device only on a local network, behind a company firewall.

8.2 Communication Protocol

The meter uses SCPI syntax, similar to other test and measurement equipment.

Commands are strings of ASCII characters. Commands are grouped into a hierarchy by functional area. Levels in the hierarchy are separated by colons (:). The protocol is case-insensitive; however, most commands have a long and a short form. It is customary (but not required) to:

- Capitalize the characters that are required for the short form.
- Use lowercase for the additional characters that may be sent for the long form.

For example, both are equally valid:

```
CONFigure:GAIN:FACTOR 1.0
CONF:GAIN:FACT 1.0
```

Most commands can also be queried by appending a question mark:

```
CONFigure:GAIN:FACTOR? // host sends a query 1.0
                        // meter replies with the value
CONF:GAIN:FACT?
1.0
```

All communication is initiated by the host sending a command to the meter. The meter simply responds to requests from the host.

Table 8-1. Touch Meter Host Commands

LabMax Touch Command	Description	Argument
SCPI Common Commands		
*IDN?	Queries meter identification string, such as model name, FW version, FW date	
*RST	Resets all parameters to their default values.	
*TST	Run the self-test procedure.	
*TST?	Queries the self-test status.	
*WAI	Blocks until all pending commands have been processed.	
System Options		
Local Control Lockout		
SYSTem:REMOte	Places the meter in remote mode.	

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
SYSTem:LOCal	Places the meter in local mode.	
SYSTem:REStart	Restart the meter.	
SYSTem:SHUTdown	Power off the meter.	
Meter Information		
SYSTem:STATus?	Queries the system status.	
SYSTem:INForma-tion:BATTery:HEALth?	Queries the battery health as a percentage.	
SYSTem:INForma-tion:BATTery:PERCent?	Queries the remaining battery capacity as a percent of full charge.	
SYSTem:INForma-tion:BATTery:STATus?	Queries the current battery status.	
SYSTem:INFormation:INSTru-ment:BOARD?	Queries the board ID.	
SYSTem:INFormation:INSTru-ment:CPU:TEMPerature ?	Queries the cpu temperature in Celsius.	
SYSTem:INForma-tion:FPGA:FVER?	Queries the FPGA firmware version.	
SYSTem:INForma-tion:FPGA:HVER?	Queries the FPGA hardware version.	
SYSTem:INFormation:INSTru-ment:FVER?	Queries the meter firmware version.	
SYSTem:INFormation:INSTru-ment:MDATe?	Queries the meter manufacture date.	
SYSTem:INFormation:PNUMber?	Queries the meter part number.	
SYSTem:TIME	Sets the time maintained within the meter.	{hour},{minute},{second}
SYSTem:TIME?	Queries the time maintained within the meter.	
SYSTem:DATE	Sets the date maintained within the meter.	{year},{month},{day}
SYSTem:DATE?	Queries the date maintained within the meter.	
SYSTem:INFormation:INSTru-ment:SNUMber?	Queries the meter serial number.	
Sensor Information		
SYSTem:INForma-tion:PROBe:TYPE?	Queries the currently-connected sensor type.	

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
SYSTem:INForma-tion:PROBe:MODeI?	Queries the currently-connected sensor model.	
SYSTem:INForma-tion:PROBe:SNUMber?	Queries the serial number of the sensor.	
SYSTem:INForma-tion:PROBe:RESPonsivity?	Queries the currently-connected sensor calibration responsivity.	
SYSTem:INForma-tion:PROBe:CDATe?	Queries the calibration date of the sensor.	
SYSTem:INForma-tion:PROBe:TEMPerature?	Queries the head temperature of the sensor.	
SYSTem:INForma-tion:PROBe:DIAMeter?	Queries the sensor diameter.	
SYSTem:INForma-tion:PROBe:CODe?	Queries the probe code.	
Display Control		
DISPlay:BACKlight	Controls the backlight on/off state.	{DEFault ON OFF}
DISPlay:BACKlight?	Queries the backlight on/off state.	
DISPlay:INTensity	Controls the backlight intensity.	{DEFault float: 0.0-1.0}
DISPlay:CLEar	Clears the text display.	
DISPlay:SAVE	Save a screenshot to internal or external flash.	{string} Optional path argument
DISPlay:TEXT	Displays text message on the GUI. Limited to 80 characters.	{string}
Numeric Display Resolution		
CONFigure:RESolution	Sets the number of display digits used for displaying measurements.	{DEFault integer}
Meter Configuration Management		
MEMory:STATe:SAVE	Stores the current configuration to the named configuration file.	{filename}
MEMory:STATe:RECall	Loads and activates the configuration state held in the named configuration file.	{filename}
Communication Settings		

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
Message Handshaking		
SYSTem:COMMUnicate:HAnd-shaking	Selects the state of SCPI message round-trip handshaking.	{ON OFF}
SYSTem:COMMUnicate:HAnd-shaking?	Queries the state of SCPI message round-trip handshaking.	
Ethernet Specific		
SYSTem:COMMUnicate:ETHernet:DHCP?	Queries whether the router automatically assigns network settings to the meter.	
SYSTem:COMMUnicate:ETHernet:GATeway?	Queries the default gateway for network communications.	
SYSTem:COMMUnicate:ETHernet:HOSTname?	Queries the hostname used for network communication.	
SYSTem:COMMUnicate:ETHernet:IPADdr?	Queries the IP address of the meter.	
SYSTem:COMMUnicate:ETHernet:MAC?	Queries the MAC address of the meter.	
SYSTem:COMMUnicate:ETHernet:PORT?	Queries the port number on which the meter listens for communications from a remote host.	
SYSTem:COMMUnicate:ETHernet:NETMask?	Queries the subnet mask for network communications.	
Serial Specific		
SYSTem:COMMUnicate:SERial:BAUD	Selects the transmit and receive baud rates together.	{DEFault 9600 19200 38400 57600 115200}
SYSTem:COMMUnicate:SERial:BAUD?	Queries the transmit and receive baud rates together.	
SYSTem:COMMUnicate:SERial:PARity	Selects the parity bit setting.	{DEFault EVEN ODD NONE}
SYSTem:COMMUnicate:SERial:PARity?	Queries the parity bit setting.	
SYSTem:COMMUnicate:SERial:SBITs	Sets the number of stop bits used.	{DEFault 1 2}
SYSTem:COMMUnicate:SERial:SBITs?	Queries the number of stop bits used.	
SYSTem:COMMUnicate:SERial:PACE?	Selects the flow control method for meter to host communication.	{DEFault XON NONE}

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
SYSTem:COMMuni- cate:SERial:PACE?	Queries the flow control method for meter to host communication.	
Measurement Setup and Control		
Measurement Mode Select		
CONFigure:MEASure	Selects the meter measurement mode.	{DEFault J W}
CONFigure:MEASure?	Queries the meter measurement mode.	
Display Mode Select		
CONFigure:DISPlay	Selects the display mode.	{DEFault HISTo- gram STATis- tics TRENd P STability TUN E MEASure}
Area Correction		
CONFigure:AREA:CORRection	Enables or disables area correction.	{DEFault ON OFF}
CONFigure:AREA:CORRection?	Queries area correction.	
CONFigure:AREA:APERture	Sets the aperture area.	{float}
CONFigure:AREA:APERture?	Queries the aperture area.	
Analog Output Full Scale Voltage		
CONFigure:AOUT:FSCale	Selects the full scale output voltage at the analog output connector.	{DEFault 1 2 4}
CONFigure:AOUT:FSCale?	Queries voltage at the output connector.	
CONFigure:SPEedup	Sets the speedup algorithm for thermopile sensors.	{DEFault ON OFF}
Data Display Smoothing		
CONFigure:AVERage:PULSe	Sets the display data smoothing window size in number of pulses.	{DEFault OFF AUT O integer}
CONFigure:AVERage:PULSe?	Queries the display data smoothing window size.	
CONFigure:AVERage:TIME	Sets the display data smoothing window size in seconds.	{DEFault OFF AUT O integer}
CONFigure:AVERage:TIME?	Queries the display data smoothing window size.	
Wavelength Correction		
CONFigure:WAVElength:CORRec- tion	Enables or disables wavelength correction.	{DEFault ON OFF}

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
CONFigure:WAVElength:CORRec-tion?	Queries the wavelength correction.	
CONFigure:WAVElength:WAVE-length	Sets the operational wavelength.	{MAXimum MINimum integer}
CONFigure:WAVElength:WAVE-length?	Queries the operational wavelength.	
CONFigure:WAVElength:LIST?	Queries the wavelength table entries.	
Gain Compensation		
CONFigure:GAIN:COMPensation	Enables or disables gain compensation.	{DEFAULT ON OFF}
CONFigure:GAIN:COMPensation?	Queries gain compensation.	
CONFigure:GAIN:FACTor	Sets the gain compensation factor	{DEFAULT 0.001.....100000.0} {DEFAULT float}
CONFigure:GAIN:FACTor?	Queries the gain compensation factor	
Probe Zero		
CONFigure:ZERO	Sets the current sensor input voltage as the zero baseline voltage.	
CONFigure:ZERO?	Queries the current sensor input voltage.	
Range Select		
CONFigure:RANGE:SElect	Selects the meter measurement range.	{float} (maximum expected measurement value)
CONFigure:RANGE:SElect?	Queries the meter measurement range.	
CONFigure:RANGE:AUTO	Enables or disables automatic selection of the meter measurement range.	{DEFAULT ON OFF}
CONFigure:RANGE:AUTO?	Queries the meter measurement range.	
CONFigure:RANGE:LIST?	Queries list of available ranges.	
Trigger Parameters		
TRIGger:SOURce	Selects the trigger source.	{DEFAULT INTERNAL EXTERNAL}
TRIGger:SOURce?	Queries the trigger source.	
TRIGger:LEVel	Sets the trigger level.	{DEFAULT float:0.0-100.0}
TRIGger:LEVel?	Queries the trigger level.	

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
TRIGger:SLOPe	Selects the external trigger edge.	{DEFAult POSi- tive NEGative}
TRIGger:SLOPe?	Queries the external trigger edge.	
TRIGger:DELAy	Sets the external trigger delay time.	{DEFAult integer:0- 1000}
TRIGger:DELAy?	Queries the external trigger delay time.	
TRIGger:FORCe	Manually force a trigger event.	
TRIGger:FREE	Sets the free-run mode.	{DEFAult ON OFF}
TRIGger:FREE	Queries the free-run mode.	
TRIGger:PTJ:LEVel	Sets the trigger level for the Pulsed-Thermopile-Joules algorithm.	{DEFAult LOW ME Dium HIGH}
TRIGger:STATus?	Queries the trigger status.	
Measurement Source		
CONFigure:MEASure:SOURce:LIS T?	Queries the available channels for the currently attached sensor.	
CONFigure:MEASure:SOURce:SE Lect	Sets the selected measurement source.	{DEFAult SLOW F AST}
CONFigure:MEASure:SOURce:SE Lect?	Queries the selected measurement source.	
PMP Measurement Window/Integration Period		
CONFigure:MEASure:WINDow	Sets the energy integration period for PMP sensors in terms of microseconds (when PMP, measurement set to fast, operating mode set to J, this is how long to integrate after trigger event).	{integer}
CONFigure:MEASure:WINDow?	Queries the energy integration period.	
Alarms and Limits		
LIMIT:FAULt:HIGHlight	Enables/disables highlight measurement window.	{DEFAult ON OFF}
LIMIT:FAULt:HIGHlight?	Queries whether the highlight measurement window is on or not.	
LIMIT:FAULt:STOP	Enables/disables stop on fault.	{DEFAult ON OFF}
LIMIT:FAULt:STOP?	Queries stop on fault.	
LIMIT:FAULt:COUNt?	Returns number of measurements that failed the criteria since start of acquisition.	
LIMIT:MAXimum	Set the maximum threshold for alarm/limit testing.	{float}

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
LIMIT:MAXimum?	Queries the maximum threshold for alarm/limit testing.	
LIMIT:MINimum	Set the minimum threshold for alarm/limit testing.	{float}
LIMIT:MINimum?	Queries the minimum threshold for alarm/limit testing.	
LIMIT:CRITeria	Set the pass criteria for alarm/limit testing.	{ DEFault INSid e OUTSide LE SMIN LEQMI N GTRMIN G TEMIN LESM AX LEQMAX GTRMAX GT EMAX}
LIMIT:CRITeria?	Queries the pass criteria for alarm/limit testing.	
LIMIT:STATe	Enables alarm/limit testing.	{DEFault ON OFF}
LIMIT:STATe?	Queries alarm/limit testing.	
Data Acquisition Commands		
ACQ:STATe	Sets the acquisition state.	{DEFault ON OFF}
ACQ:STATe?	Queries the acquisition state.	
INITiate	Begins collecting data to the fetch buffer.	
ABORt	Stops collecting data to the fetch buffer.	
ACQuire:BSIZe	Sets the acquisition batch size.	{integer (2-250000)}
ACQuire:BSIZe?	Queries the statistics batch size.	
ACQuire:DURation	Sets the statistics batch size (time).	{float}
ACQuire:DURation?	Queries the statistics batch size (time).	
ACQuire:SRATe	Sets the sample rate in terms of samples/second.	{float}
ACQuire:SRATe?	Queries the statistics sampling rate (pulses).	
ACQuire:STATe	Turns the acquisition state on or off. {ON OFF}	
ACQuire:STATe?	Queries the acquisition state.	
ACQuire:OFFset	Sets the horizontal (time) offset of the trigger event within the trend view.	{float}
CONFigure:READings:CONTinuous	Sets the behavior of the FETCH queue.	{DEFault LAST ST REAm}
CONFigure:READings:CONTinuous?	Queries behavior of the FETCH queue.	

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
Measurement Data Format		
CONFigure:READings:SEND	Selects which items are included in the FETCH data	{DEFAULT token_list}
CONFigure:READings:SEND?	Queries which items are included in the FETCH data	
CONFigure:READings:HEADers	Selects whether or not data value identification strings will prefix data values reported over the host interface.	{DEFAULT ON OFF}
CONFigure:READings:HEADers?	Queries whether or not data value identification strings will prefix data values reported over the host interface.	
CONFigure:READings:MODE	Sets the data format for the FETCH query.	{ASCII BINARY}
CONFigure:READings:MODE?	Queries the data format for the FETCH query.	
Statistics		
CONFigure:STATistics:DISPlay	Selects which items are displayed in the statistics view in the GUI.	{DEFAULT token_list}
STATistics:CLEar	Clears the trend buffer and statistics accumulators.	
STATistics:LIMit	Sets the maximum number of measurements over which to compute statistics.	{DEFAULT INFinite integer}
STATistics:LIMit?	Queries the maximum number of measurements over which statistics are computed.	
STATistics:MODE	Sets the statistics mode.	{DEFAULT BUFFER ACCumulate}
STATistics:MODE?	Queries the statistics mode.	
STATistics:1SIG?	Return the ratio of standard deviation to mean, expressed as a percentage.	
STATistics:2SIG?	Return the 2x ratio of standard deviation to mean, expressed as a percentage.	
STATistics:3SIG?	Return the 3x ratio of standard deviation to mean, expressed as a percentage.	
STATistics:ALL?	Return all of the above values as a comma-separated list.	
STATistics:COUNT?	Return the number of measurements in the statistics interval.	
STATistics:DOSe?	Return the sum of all measurements in the statistics interval.	
STATistics:FLAG?	Returns the bitwise or flags for all measurements that contributed to the statistics.	

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
STATistics:MAXimum?	Return the maximum measurement in the statistics interval.	
STATistics:MEAN?	Returns the mean of all measurements in the statistics interval.	
STATistics:MINimum?	Returns the minimum measurement in the statistics interval.	
STATistics:MISSEd?	Returns the number of missed pulses during the measurement interval.	
STATistics:RANGe?	Returns the range of all measurements in the statistics interval.	
STATistics:STDV?	Returns the standard deviation of all measurements in the statistics interval.	
STATistics:WAIT?	Wait for statistics to complete.	{timeout}
Data Query		
FETCh:NRECORDs?	Queries the number of unread data records available in the fetch buffer at the time of the query.	
FETCh:NEXT?	Queries the next N unread available measurement data record(s) in the fetch buffer at the time of the query.	{integer}
FETCh:ALL?	Queries all unread available measurement data records at the time of the query. Gets the entire contents of the fetch buffer. The queue is cleared as a result.	
FETCh:MISSing?	Queries the missing data count due to a measurement data transmission queue full condition. Queries number of measurements that were dropped due to a buffer full condition.	
READ?	Returns the latest measurement at the time of the query.	
FETCh:WAIT?	If STREAm was selected AND a count was specified for the INITiate command, this pauses the interface until the requested measurements have been collected. Optional timeout in terms of milliseconds which defaults to 10000 if not specified. Query returns 1 when all the requested measurements have been collected, or 0 if a timeout occurs.	[timeout]
FETCh:TREND	Copies the trend buffer into the fetch buffer.	
Data Logging		

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
LOG:REDuce:CONDition	Determines how often to save a measurement.	{DEFAULT ALL TIME COUNT}
LOG:REDuce:CONDition?	Queries how often a measurement is saved.	
LOG:REDuce:COUNt	Sets number of measurements to acquire before writing one measurement to the log.	{integer}
LOG:REDuce:COUNt?	Queries number of measurements to acquire before writing one measurement to the log.	
LOG:REDuce:METHod	Selects how to reduce the data stream.	{DEFAULT AVERAGE DISCARD}
LOG:REDuce:METHod?	Queries how the data stream is reduced.	
LOG:REDuce:TIME	Sets the time interval between writing measurements to the log, in units of seconds.	{float}
LOG:REDuce:TIME?	Queries the time interval between writing measurements to the log, in units of seconds.	
LOG:DELimiter	Selects the log file format to use.	{DEFAULT COMMA TAB}
LOG:DELimiter?	Queries the log file format to use.	
LOG:FNAME	Sets the log filename.	{string}
LOG:FNAME?	Queries the log filename.	
LOG:CONFLICT	Selects what action to take when the filename points to an existing file.	{DEFAULT UNIQUE OVERWRITE APPEND}
LOG:CONFLICT?	Queries what action is taken when the filename points to an existing file.	
LOG:STATe	Enables/disables logging.	{DEFAULT ON OFF}
LOG:STATe?	Queries whether logging is enabled/disabled.	
File System Commands		
MEMory:CATalog?	Lists the contents of a directory. Optional quoted string naming the directory to list, no argument provided lists the current working directory.	{directory}
MEMory:CDIRectory	Sets the current working directory.	{string}
MEMory:CDIRectory?	Queries the current working directory.	
MEMory:MDIRectory	Creates a new directory.	{dirname}
MEMory:DELete	Deletes a file.	{filename}
MEMory:RDIRectory	Removes a directory.	{dirname}

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
MEMory:REName	Renames (or moves) a file or directory.	{quoted original file/dir name},{quoted new file/dir name}
MEMory:COpy	Copies a source file to a destination.	{source},{destination}
MEMory:STORe	Export the trend buffer to a file in flash memory.	{filename}
MEMory:FILE:OPEN	Open a file in read,write, or append mode	{file-name},{READ WRITE APPend}
MEMory:FILE:CLOSE	Closes the currently open file.	
MEMory:FILE:DATA	Writes a block of data to the currently open file.	{binary block}
MEMory:FILE:DATA?	Reads a block of data from the currently open file.	{integer}
MEMory:LOAD	Import a CSV or TSV from flash memory into the trend buffer.	{filename}
MEMory:REDIRectory:RECurSive	Recursively remove a directory. Same as MEMory:RDIRectory, but the directory does not need to be empty.	{dirname}
MEMory:WAIT?	Waits for asynchronous copy/rename operation to complete. Optional timeout in millisecond.	{timeout}
Error Records		
SYSTem:ERRor:COUNT?	Queries the number of error records in the error queue.	
SYSTem:ERRor:NEXT?	Queries the next error record in the error queue.	
SYSTem:ERRor:ALL?	Queries all error records in the error queue.	
SYSTem:ERRor:CLEar	Clears all error records in the error queue.	
Miscellaneous Commands		
ECHo	Returns the string that was passed as an argument.	{string}
INSTall	Begin firmware installation.	{filename}
Debugging		
DEBUg:EXPort:LOG	Exports log files, a system report, and any crash dumps to an external flash drive.	
Demo Source		

Table 8-1. Touch Meter Host Commands (Continued)

LabMax Touch Command	Description	Argument
DEMO:SOURce:FUNCTion	Sets the waveform shape for the demo source.	{OFF SINE RAMP TRIAngle SQUAre}
DEMO:SOURce:FUNCTion?	Queries the waveform shape for the demo source.	
DEMO:SOURce:PRATe	Sets the pulse rate for the demo source.	{float}
DEMO:SOURce:PRATe?	Queries the pulse rate for the demo source.	

8.3 External Control: Handshaking

Sometimes it is useful to get instant feedback whether a command passed or failed.

When handshaking is on, the meter reports either OK or ERR<N> after every command/query. This can also help with flow-control when commands are being sent programmatically.

The OK/ERR<N> response indicates that the meter finished processing the previous command and is ready for the next command.

```

SYSTem:COMMunicate:HANDshaking ON // turn on handshaking
OK                                // meter sends OK, is
                                // ready for next command

SYSTem:COMMunicate:HANDshaking? // send a query
ON                                // meter replies with the
value                            //
OK                                // meter sends OK, is ready
for                              //
                                // the next command

INVAlid:COMManD                  // send an invalid command

ERR100                           // meter sends error, is
ready                            //
                                // for the next command

```

8.4 Data Commands

The Read and Fetch commands are described in this section.

8.4.1**READ**

The most simple way to get a measurement from the meter is to use the READ? query. This returns the latest measurement at the time of the query, and is analogous to glancing at the numeric readout on the display.

```
READ?
9.5896E-01
```

This value is updated only a few times per second, and no care is taken to avoid duplicate measurements. The READ query may return the same value if queried too fast. If duplicate measurements are undesirable or if fast measurements are needed, consider using the FETCH commands below.

8.4.2**FETCH**

The meter has an internal buffer that is 250k samples deep. These commands control filling the buffer:

```
INITiate [count] // Enables measurement data collection,
                  // optional argument specifies the number of
                  // measurements to collect
ABORT           // Disables measurement data collection
```

This command determines whether the buffer acts as a FIFO (STREAm), or simply holds the latest sample (LAST).

```
CONFigure:READings:CONTinuous {LAST|STREAm}
```

If STREAm was selected *and* a count was specified for the INITiate command, then the following query can be used to pause the interface until the requested measurements have been collected. This query takes an optional timeout argument in terms of milliseconds, which defaults to 10000 if not specified.

The query returns 1 when all the requested measurements have been collected, or 0 if a timeout occurs.

```
FETCH:WAIT? [timeout]
```

The buffer can be read using these commands:

```
FETCH:NRECORDs? // Queries the number of unread data records
                  available
FETCH:NEXT?      // Queries the next unread available measure-
ment
                  data record
FETCH:ALL?       // Queries all unread available measurement
data
                  records
FETCH:MISSing?   // Queries how many samples were dropped due to
                  buffer full
```

Data streaming can be accomplished by sending the `FEtCh:NEXt?` or `FEtCh:ALL?` query in a loop. In this case, it may be useful to periodically check `FEtCh:MISSing?` to see if any samples were dropped due to a buffer overflow condition.

The trend buffer can be copied into the fetch buffer and then queried using the normal `FEtCh` commands. This can be used to access the data shown in the trend view. For example:

```
FEtCh:TREND // copy trend buffer -> fetch buffer
FEtCh:ALL?  // query the data
```

8.5 Binary Data Transfer

While ASCII communication is often simpler, it has significant overhead that can make it unsuitable for large data transfers. For example, a 4-byte floating point number is typically formatted as 12 ASCII characters `"1.234E+00\r\n"`

Use this command to switch to binary mode:

```
CONFigure:READings:MODE BINary
```

This setting affects the data returned by the `FEtCh` query:

```
FEtCh:ALL?
#542960[.....BINARY DATA.....]OK
```

where:

- The `#` character signifies the start of a binary block
- Followed by the **Length-of-Length** field: a single ASCII digit. In this case, `'5'` indicates the length field is 5 characters.
- Followed by the **Length** field: 0-9 ASCII digits, depending on the length-of-length field. In this case, `'42960'` indicates a length of 42960 bytes.
- Followed by block of binary data with the specified length.
- Followed by `'OK'` if handshaking is ON.
- Followed by the usual newline, now the meter is ready for the next command.

8.6 Buffers and Data Flow

Figure 8-1 shows how data flows from the acquisition module to the various memories in the system, and the various commands that gate the data flow.

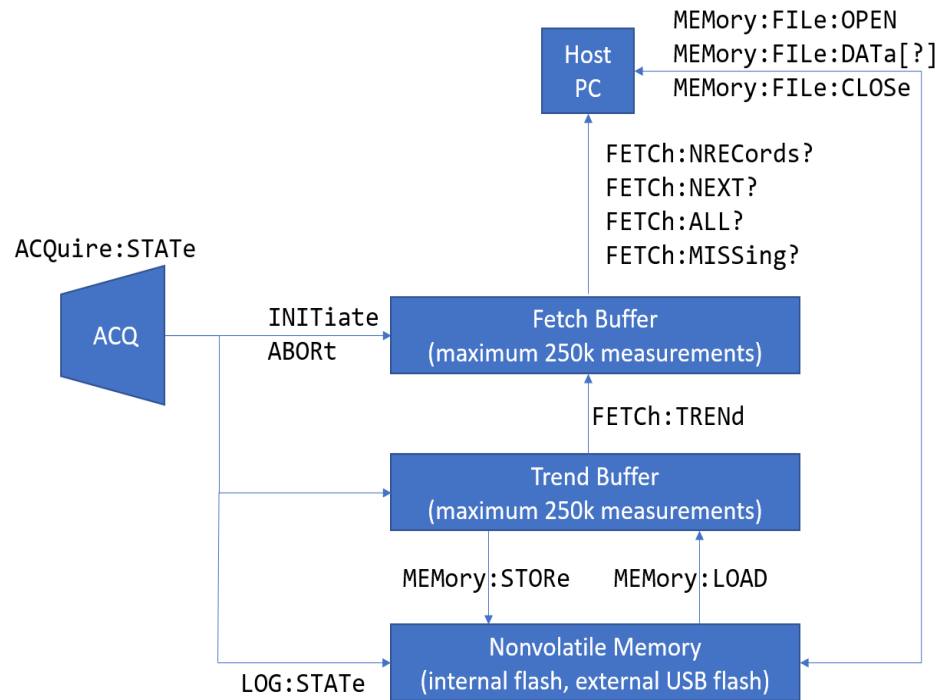


Figure 8-1. Buffers and Data Flow

8.6.1 Valid File Paths

Some commands operate on files in nonvolatile memory. Files are referenced using UNIX-style file paths:

- Directories are separated by slashes '/' (backslashes are allowed, but forward slashes are preferred).
- A path beginning with a slash is considered an absolute path.
- A path not beginning with a slash is considered a relative path (relative to the current working directory).
- Two dots '..' is an alias for the parent directory.

All commands that accept a file path as an argument can operate only on the paths listed in Table 8-2. All other path-prefixes are considered invalid, and the command is rejected. All relative paths must resolve to a location underneath one of these paths.

Table 8-2. User-Accessible Data Locations

Media	Absolute Path	UI Alias	Host Interface Alias
Internal Flash (eMMC)	/fs/loc	Local Files	/loc
USB Flash Drive	/fs/usb0	USB0	/usb0
USB Flash Drive	/fs/usb1	USB1	/usb1

8.6.2 Valid File Types

Table 8-3 lists the types of files that the meter can operate on. All file types are identified by a 3-character extension.

Table 8-3. File Types

Extension	Type	Function
.bmp	Bitmap Image	Screenshot
.csv	Comma Separated Values	Data logging, data export
.tsv	Tab Separated Values	Data logging, data export
.ini	Configuration Settings	Save/Recall settings
.img	Firmware Image	Firmware update

8.7 Acquisition Commands

For time-based measurements (thermopile, optical, PMP in Watts mode), acquisition is defined by the following equation:

$$\text{Duration} = \text{BufferSize} / \text{SampleRate}$$

The BufferSize and SampleRate can be specified directly, in which case the Duration is updated automatically. Alternatively, a user can specify the Duration and an appropriate BufferSize and SampleRate are picked from a table.

For pulse-based measurements (pyro, PMP in Joules mode), acquisition is defined by the BufferSize and Decimation.

8.7.1 Duration

Set/get the acquisition Duration in terms of seconds. This command is only allowed for time-based sensors (thermopile, optical, PMP in Watts mode).

```
Command: ACQuire:DURation {float}
Default: 10.0
Query:   ACQuire:DURation?
Reply:   {float}
```

Setting the duration implicitly updates the Sample Rate and Buffer Size. First, the fastest sample rate is chosen that can satisfy the duration without exceeding the maximum buffer size (500k). Then the buffer size is calculated according to the equation:

$$\text{Duration} = \text{BufferSize} / \text{SampleRate}$$

Duration determines whether the meter operates in streaming or snapshot mode. For long durations (slow sample rates), the meter operates in streaming mode, which means the data scrolls across the trend view in real time. For short durations, the sample rate is too fast to show the data in real time. Instead, snapshots of data are taken in response to trigger events, and there may be gaps between the snapshots.

Table 8-4 shows Duration for fast sensors (PMP).

Table 8-4. Duration for Fast Sensors (PMP)

Duration	Sample Rate	Buffer Size	Mode
$2\mu\text{s} \leq t \leq 100\text{ms}$	1 MHz	$2 \leq n \leq 500000$	Snapshot
$100\text{ms} < t \leq 160\text{ms}$	625 kHz	$62501 \leq n \leq 500000$	Snapshot
$160\text{ms} < t \leq 200\text{ms}$	500 kHz	$80001 \leq n \leq 500000$	Snapshot
$200\text{ms} < t \leq 500\text{ms}$	200 kHz	$40001 \leq n \leq 500000$	Snapshot
$500\text{ms} < t \leq 1\text{s}$	100 kHz	$50001 \leq n \leq 500000$	Streaming
$1\text{s} < t \leq 2\text{s}$	50 kHz	$50001 \leq n \leq 500000$	Streaming
$2\text{s} < t \leq 5\text{s}$	20 kHz	$40001 \leq n \leq 500000$	Streaming
$5\text{s} < t \leq 10\text{s}$	10 kHz	$50001 \leq n \leq 500000$	Streaming
$10\text{s} < t \leq 20\text{s}$	5 kHz	$50001 \leq n \leq 500000$	Streaming

Table 8-4. Duration for Fast Sensors (PMP) (Continued)

Duration	Sample Rate	Buffer Size	Mode
20s < t ≤ 50s	2 kHz	40001 ≤ n ≤ 100000	Streaming
50s < t ≤ 100s	1 kHz	50001 ≤ n ≤ 100000	Streaming
100s < t ≤ 200s	500 Hz	50001 ≤ n ≤ 100000	Streaming
200s < t ≤ 500s	200 Hz	40001 ≤ n ≤ 100000	Streaming
500s < t ≤ 1ks	100 Hz	50001 ≤ n ≤ 100000	Streaming
1ks < t ≤ 2ks	50 Hz	50001 ≤ n ≤ 100000	Streaming
2ks < t ≤ 5ks	20 Hz	40001 ≤ n ≤ 100000	Streaming
5ks < t ≤ 10ks	10 Hz	50001 ≤ n ≤ 100000	Streaming
10ks < t ≤ 20ks	5 Hz	50001 ≤ n ≤ 100000	Streaming
20ks < t ≤ 50ks	2 Hz	40001 ≤ n ≤ 100000	Streaming
50ks < t ≤ 100ks	1 Hz	50001 ≤ n ≤ 250000	Streaming

Table 8-5 shows Duration for slow sensors (thermopile, optical).

Table 8-5. Duration for Slow Sensors (Thermopile, Optical)

Duration	Sample Rate	Buffer Size	Mode
200ms ≤ t ≤ 10ks	10 Hz	2 ≤ n ≤ 100000	Streaming
10ks < t ≤ 20ks	5 Hz	50001 ≤ n ≤ 100000	Streaming
20ks < t ≤ 50ks	2 Hz	40001 ≤ n ≤ 100000	Streaming
50ks < t ≤ 100ks	1 Hz	50001 ≤ n ≤ 250000	Streaming

8.7.2

Buffer Size

Set/get the Buffer Size in terms of measurements. This command is valid for all sensors.

Command: ACQuire:BSIZE {integer: 2-250000}

Default: {varies per sensor}

Query: ACQuire:BSIZE?

Reply: {integer}

For time-based sensors (thermopile, optical, PMP in Watts mode), setting the buffer size implicitly updates the duration according to the equation:

$$\text{Duration} = \text{BufferSize} / \text{SampleRate}$$

8.7.3 Sample Rate

Set/get the Sample Rate in terms of samples/second (Hz). This command is only allowed for time-based sensors (thermopile, optical, PMP in Watts mode).

Command: ACQUIRE:SRATE {float}
Default: {varies per sensor}
Query: ACQUIRE:SRATE?
Reply: {float}

Setting the Sample Rate implicitly updates the duration according to the equation:

$$\text{Duration} = \text{BufferSize} / \text{SampleRate}$$

Only certain Sample Rates are allowed, and the available Sample Rates depend on the type of sensor. The value is snapped to the nearest available Sample Rate. See the tables under Duration for a list of available Sample Rate.

Sample Rate is query-only for pyro probes because it is determined automatically from the rise and fall times of the probe.

8.7.4 Decimation

Set/get the pulse Decimation. This command only applies to pulse-based sensors (Pyro, PMP in Joules mode).

Command: ACQUIRE:DECIMATION {integer: 1-100000}
Default: 1
Query: ACQUIRE:DECIMATION?
Reply: {integer}

Keep every nth pulse and discard the rest. Default value of 1 means all the pulses are kept (no decimation).

8.8 Demo Source

There is a demo function available to produce test waveforms in the absence of a physical probe and laser source.

8.8.1 Demo Source Frequency

Set/get the Frequency in terms of Hz for the demo source.

```
Command: DEMo:SOURce:FREQuency {float}
Default: 1.0
Query:   DEMo:SOURce:FREQuency?
Reply:   {float}
```

8.8.2 Demo Source Function

Set/get the waveform shape for the demo source.

```
Command: DEMo:SOURce:FUNCTion {OFF|SINE|RAMP|TRIAngle|SQUAre}
Default: OFF
Query:   DEMo:SOURce:FUNCTion?
Reply:   {OFF|SINE|RAMP|TRIAngle|SQUAre}
```

OFF means the external (real) signal source is used; otherwise, the demo function overrides the external signal.

8.8.3 Demo Source Pulse Rate

Set/get the Pulse Rate (that is, the rep rate) for the simulated laser source.

```
Command: DEMo:SOURce:PRATe {float}
Default: 20e3
Query:   DEMo:SOURce:PRATe?
Reply:   {float}
```

The maximum rate is 20 kHz. This command only applies to pulse-based sensors (Pyro, PMP in Joules mode).

8.8.4 Horizontal Offset

Set/get the horizontal (time) offset of the trigger event within the trend view.

```
Command: ACQuire:OFFSet {float}
Default: 50.0
Query:   ACQuire:OFFSet?
Reply:   {float}
```

This is a percentage, where 0 places the trigger event at the left side of the trend view and 100 places it at the right side.

This setting only applies in Snapshot mode; that is, when all the following are true:

- A PMP sensor is attached
- The Selected Source is set to FAST
- The operating mode is set to WATTS
- The Acquisition Duration is 0.5 seconds or less

8.8.5 Mode

Set/get the acquisition mode.

```
Command: ACQuire:MODe {DEFault|CONTInuous|SINGLe}  
Default: CONTInuous  
Query:   ACQuire:MODe?  
Reply:   {CONTInuous|SINGLe}
```

where:

- CONTInuous -- the meter continues acquiring until told to stop
- SINGLe -- the meter automatically stops after the buffer size (or duration) is reached. In snapshot mode, the meter stops after the first trigger event.

8.8.6 State

Set/get the Acquisition State. ON means running, OFF means stopped.

```
Command: ACQuire:STATe {DEFault|ON|OFF}  
Default: OFF  
Query:   ACQuire:STATe?  
Reply:   {ON|OFF}
```

8.9 Alarms and Limits Commands

8.9.1 Highlight Measurement Window

Enable highlight measurement window.

```
Command: LIMIT:FAULt:HIGHlight {DEFault|ON|OFF}  
Default: OFF  
Query:   LIMIT:FAULt:HIGHlight?  
Reply:   {ON|OFF}
```

When ON, the measurement window on the graphical user interface changes color as soon as a measurement fails the criteria.

8.9.2 Stop on Fault

Enable stop on fault.

Command: LIMIT:FAULT:STOP {DEFault|ON|OFF}

Default: OFF

Query: LIMIT:FAULT:STOP?

Reply: {ON|OFF}

When ON, acquisition is stopped as soon as a measurement fails the criteria.

8.9.3 Fault Count

Returns the number of measurements that failed the criteria since the start of acquisition.

Query: LIMIT:FAULT:COUNT?

Reply: {long integer}

8.9.4 Maximum

Set the maximum threshold for alarm/limit testing.

Command: LIMIT:MAXimum {float}

Default: 5.0

Query: LIMIT:MAXimum?

Reply: {float}

This threshold is compared to each incoming measurement according to the LIMIT:CRITERia.

8.9.5 Minimum

Set the minimum threshold for alarm/limit testing.

Command: LIMIT:MINimum {float}

Default: 0.0

Query: LIMIT:MINimum?

Reply: {float}

This threshold is compared to each incoming measurement according to the LIMIT:CRITERia.

8.9.6

Pass Criteria

Set the pass criteria for alarm/limit testing.

Command: LIMIT:CRITeria
 {DEFault|INSide|OUTSide|LESMIN|LEQMIN|GTRMIN|GTEMIN|LES-
 MAX|
 LEQMAX|GTRMAX|GTEMAX}
 Default: INSide

Query: LIMIT:CRITeria?

Reply: {INSide|OUTSide|LESMIN|LEQMIN|GTRMIN|GTEMIN|LES-
 MAX|
 LEQMAX|GTRMAX|GTEMAX}

Table 8-6 lists how each incoming measurement is compared to the threshold(s).

Table 8-6. Pass Criteria

Measurement	Pass Criteria
INSide	Pass if (minimum $\leq$ value) and (value $\leq$ maximum)
OUTSide	Pass if (value < minimum) or (maximum < value)
LESMIN	Pass if (value < minimum)
LEQMIN	Pass if (value $\leq$ minimum)
GTRMIN	Pass if (value > minimum)
GTEMIN	Pass if (value $\geq$ minimum)
LES- MAX	Pass if (value < maximum)
LEQ- MAX	Pass if (value $\leq$ maximum)
GTR- MAX	Pass if (value > maximum)
GTE- MAX	Pass if (value $\geq$ maximum)

8.9.7

State

This command enables alarm/limit testing.

Command: LIMit:STATe {DEFault|ON|OFF}
 Default: OFF
 Query: LIMIT:STATe?
 Reply: {ON|OFF}

8.10 Configuration Commands

8.10.1 Analog Output Scale

Set/get 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}
```

8.10.2 Aperture Area

Set/get the aperture area in square centimeters. Minimum is 0.01, maximum is 500.0

```
Command: CONFIGure:AREA:APERTure
Default: 1.0
Query:   CONFIGure:AREA:APERTure?
Reply:   {float}
```

8.10.3 Area Correction

Set/get the area correction state.

```
Command: CONFIGure:AREA:CORRection {DEFAULT|ON|OFF}
Default: OFF
Query:   CONFIGure:AREA:CORRection?
Reply:   {ON|OFF}
```

8.10.4 Auto Range

Set/get the auto-range state.

```
Command: CONFIGure:RANGE:AUTO {DEFAULT|ON|OFF}
Default: OFF
Query:   CONFIGure:RANGE:AUTO?
Reply:   {ON|OFF}
```

When auto-ranging is on, the meter will automatically adjust the selected range in response to the measurement value. Only applies when the selected measurement source is SLOW.

8.10.5 Data Headers

When headers are ON, each item in the FETCh data is prefixed by its name.

```
Command: CONFigure:READings:HEADers {DEFAult|ON|OFF}
Default: OFF
Query:   CONFigure:READings:HEADers?
Reply:   {ON|OFF}
```

This setting only applies in ASCII mode. For example:

```
// Turn on all fields
CONFigure:READings:SEND PRI,QUAD,FLAG,SEQ,PER,UNIT

// Query data without headers
CONFigure:READings:HEADers OFF
FETCh:NEXT?
1.2340E-05,1.2,-4.6,0000,654321,123456,W

// Query data with headers
CONFigure:READings:HEADers ON
FETCh:NEXT?
PRI=1.2340E-05,QUAD=1.2,-4.6,FLAG=0000,SEQ=654321,PER=123456,
UNIT=W
```

8.10.6 Data Item Select

Select which items are included in the FETCh data.

```
Command: CONFigure:READings:SEND {DEFAult|token_list}
Default: PRI
Query:   CONFigure:READings:SEND?
Reply:   {token_list}
```

This command accepts one or more of the following tokens in any order (separated by commas). However, the FETCh query always sends the items in the order listed in Table 8-7.

Table 8-7. Data Items in FETCh Data

Token	Description	ASCII Mode	Binary Mode
PRI	Primary data value (Watts or Joules)	Scientific Notation (for example, "2.888E-03")	4-byte floating point (little endian)
QUAD	Quad distance X/Y data in mm (valid only when an LM probe is attached)	Two floating point values in X,Y order (for example, "-1.2,+1.5")	X: 4-byte floating point (little endian) Y: 4-byte floating point (little endian)
FLAG	Flags - see Table 8-8	4 hexadecimal digits (for example "00C0")	2-byte unsigned integer (little endian)

Table 8-7. Data Items in FETCh Data (Continued)

Token	Description	ASCII Mode	Binary Mode
SEQ	Sequence ID	Up to 10 decimal digits (for example, "1234567890")	4-byte unsigned integer (little endian)
PER	Pulse period in microseconds	Up to 10 decimal digits (for example, "1234567890")	4-byte unsigned integer (little endian)
UNIT	Primary data value display units	String format (for example, "W/cm2")	1 byte unsigned integer: 0x00=J, 0x40=J/cm2, 0x80=W, 0xC0=W/cm2

Table 8-8 explains the bits in the FLAG field.

Table 8-8. Bits in the FLAG Field

Bit Position	Hex Value	Qualification
0	0001	Trigger Event
1	0002	Baseline Clip
2	0004	Calculating (PTJ mode only)
3	0008	Final energy record (PTJ mode only)
4	0010	Over-range
5	0020	Negative Power
6	0040	Measurement is sped up
7	0080	Over-temperature error
8	0100	Missed measurement
9	0200	Missed pulse
10	0400	Reserved for future use
11	0800	Limit fault (See Alarms and Limits)
12-14	7000	Reserved for future use
15	8000	Error
N/A	0000	No qualification

8.10.7 Data Streaming Mode

Set/get the behavior of the FETCH queue.

```
Command: CONFIGure:READings:CONTInuous {DEFAULT|LAST|STREAm}
Default: LAST
Query:   CONFIGure:READings:CONTInuous?
Reply:   {LAST|STRE}
```

where:

- LAST means only the latest reading is kept.
- STRE means all readings are queued if there is space available in the queue.

This command takes effect next time INITIalize is sent.

8.10.8 Display Mode

Set/get the display mode. Selects which page is active on the graphical user interface.

```
Command: CONFIGure:DISPlay
         {DEFAULT|HISTogram|STATistics|TREND|PSTability|TUNE|MEA-
         Sure}
Default: TREND
Query:   CONFIGure:DISPlay?
Reply:   {HISTogram|STATistics|TREND|PSTability|TUNE|MEASure}
```

8.10.9 Gain Compensation

This command enables or disables gain compensation.

```
Command: CONFIGure:GAIN:COMPensation {DEFAULT|ON|OFF}
Default: OFF
Query:   CONFIGure:GAIN:COMPensation?
Reply:   {ON|OFF}
```

8.10.10 Gain Factor

This command gets/sets the gain factor. The minimum is 0.001, maximum is 100e3.

```
Command: CONFIGure:GAIN:FACTOR {DEFAULT|float}
Default: 1.0
Query:   CONFIGure:GAIN:FACTOR?
Reply:   {float}
```

8.11 Measurement Source

8.11.1 Available Sources

Returns a comma-separated list of the available channels for the currently attached sensor.

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

8.11.2 Selected Source

Set/get the selected measurement source.

```
Command: CONFigure:MEASure:SOURce:SElect {DEFault|SLOW|FAST}
Default: {depends on sensor}
Query:  CONFigure:MEASure:SOURce:SElect?
Reply:  {SLOW|FAST}
```

Depending on the sensor, there will either be one or two acquisition sources available in hardware. PMP probes have both the FAST and the SLOW source. Pyro probes have only the FAST source. All other probes (Thermopile, Optical) have only the SLOW source.

The fast source can sample at a maximum rate of one million samples per second, while the slow source can sample at a maximum rate of ten samples per second.

If the fast source is available, then the selected source defaults to FAST. Otherwise, the selected source defaults to SLOW.

8.11.3 Measurement Window (Integration Period)

Set/get the energy integration period for PMP probes in units of microseconds.

```
Command: CONFigure:MEASure:WINDow {integer}
Default: 100
Query:  CONFigure:MEASure:WINDow?
Reply:  {integer}
```

When a PMP probe is attached, the measurement source is set to FAST, and the operating mode is set to J (Joules), this setting determines how long to integrate after the trigger event.

8.11.4 Numeric Display Resolution

Set/get the number of digits displayed in the numeric readout(s) of the graphical user interface.

```
Command: CONFigure:RESolution {DEFAult|integer}
Default: 3
Query:   CONFigure:RESolution?
Reply:   {integer}
```

8.11.5 Operating Mode

Set/get the operating mode: either energy (Joules) or power (Watts).

```
Command: CONFigure:MEASure {DEFAult|J|W}
Default: J for Pyro probes, W for all other probes
Query:   CONFigure:MEASure?
Reply:   {J|W}
```

8.11.6 Range List

Returns a comma-separated list of available ranges. If auto-range is allowed by the current probe and configuration, then the first item in the list is AUTO.

```
Query:   CONFigure:RANGe:LIST?
Reply:   {float_list}
```

For example:

```
CONFigure:RANGe:LIST?
AUTO,2e-05,5e-05,0.0001,0.0002,0.0005,0.001,0.002,0.005,0.01,
0.02,0.05,0.1,0.2,0.5,1
OK
```

8.11.7 Selected Range

Set/get the selected range, defined as the maximum expected measurement value.

```
Command: CONFigure:RANGe:SElect {float}
Default: 5.0
Query:   CONFigure:RANGe:SElect? [MAXimum|MINimum]
Reply:   {float}
```

If the probe has more than one gain configuration, the selected range is used to configure the gain. The query takes an optional argument to return the min/max range for the probe; if no argument is given, it returns the currently selected range.

8.11.8 Selected Wavelength

Set/get the wavelength for wavelength compensation in units of nanometers.

```
Command: CONFigure:WAVElength:WAVElength {MAXimum|MINimum|integer}
Default: 193
Query:   CONFigure:WAVElength:WAVElength? [MAXimum|MINimum]
Reply:   {integer}
```

The query takes an optional argument to return the min or max wavelength for the currently attached sensor; if no argument is given, it returns the currently selected wavelength.

8.11.9 Smoothing (Pulse)

Set/get the smoothing window size in terms of an integer number of pulses.

```
Command: CONFigure:AVERage:PULSe {DEFault|OFF|AUTO|integer}
Default: AUTO
Query:   CONFigure:AVERage:PULSe?
Reply:   {OFF|AUTO|integer}
```

Applies only when a pulse-based sensor is attached. Minimum is 2, maximum is 999.

8.11.10 Smoothing (Time)

Set/get the smoothing window size in terms seconds, rounded to the nearest integer.

```
Command: CONFigure:AVERage:TIME {DEFault|OFF|AUTO|integer}
Default: AUTO
Query:   CONFigure:AVERage:TIME?
Reply:   {OFF|AUTO|integer}
```

Applies only when a time-based sensor is attached. Minimum is 1, maximum is 60.

8.11.11 Statistics Display

This command is unused, and may be removed.

```
Command: CONFigure:STATistics:DISPlay {DEFault|token_list}
Default: MEAN,MIN,MAX,STDV
Query:   CONFigure:STATistics:DISPlay?
Reply:   {token_list}
```

Valid tokens are
MEAN,MIN,MAX,STDV,1SIG,2SIG,3SIG,RANGe,DOSE,MISSEd.

8.11.12 Thermopile Speed-Up

Enables the speedup algorithm for thermopile probes.

Command: CONFigure:SPEedup {DEFAult|ON|OFF}

Default: ON

Query: CONFigure:SPEedup?

Reply: {ON|OFF}

Depending on the time constant of the probe, it can take several seconds for the measurement to ramp up to its final value. The speedup algorithm helps the measurement reach its final value faster. Speedup only applies to probes with a long time constant (i.e. thermopile).

8.11.13 Wavelength Correction

Enable wavelength correction.

Command: CONFigure:WAVElength:CORRection {DEFAult|ON|OFF}

Default: ON

Query: CONFigure:WAVElength:CORRection?

Reply: {ON|OFF}

8.11.14 Wavelength List

Return the list of calibration wavelengths for the currently attached sensor, in units of nanometers.

Query: CONFigure:WAVElength:LIST?

Reply: {integer_list}

The first/last items in this list are the min/max wavelength, respectively.

8.11.15 Zero

Command: Sets the current sensor input as the baseline.

Query: Returns the offset in Watts for the current range.

Command: CONFigure:ZERO

Query: CONFigure:ZERO?

Reply: {float>

This launches a procedure that measures the average ambient light hitting the sensor for each possible range. The command returns immediately, although the procedure may take several seconds to complete.

The status of the procedure can be monitored with the "SYSTem:STATus?" query. When complete, the measured offset is subtracted from all future measurements. This command has no effect if there is no probe present, or if a pyroelectric probe is present.

8.12 Data Commands

8.12.1 Data Format

Set/get the data format for the FETCh query.

Command: CONFigure:READings:MODE {ASCii|BINary}

Default: ASCii

Query: CONFigure:READings:MODE?

Reply: {ASCii|BINary}

8.12.2 Data Gating

8.12.2.1 Abort

Stop collecting data into the FETCh buffer.

Command: ABORT

8.12.2.2 Initialize

Begin collecting data into the FETCh buffer.

Command: INITialize [count]

Takes an optional count argument. If the argument is present, the meter will automatically ABORT after collecting the requested number of samples. Otherwise, the meter continues filling the FETCh buffer until the ABORT command is received.

NOTICE

ACQUIRE:STATE globally enables the data stream. It is not considered an error to send INITialize while ACQUIRE:STATE is OFF, but no data will be collected until ACQUIRE:STATE is turned ON.

8.13 Fetch

8.13.1 All

Get the entire contents of the fetch buffer. The queue is cleared as a result of this query. Query: FETCh:ALL?

Reply: {bulk data}

A list of measurements is returned, where each measurement is composed of one or more items. CONFigure:READings:SEND determines which items are sent for each measurement.

CONFigure:READings:MODE determines the format of the returned data:

- BINary -- the return data is a binary block, items are fixed-width and are sent in sequence without delimiters. Host software must take into account the size of each item to decode the data.
- ASCii -- the return data is ascii text. Measurements are separated by carriage-return-newlines (`\r\n`) and items within each measurement are separated by commas (`,`).

8.13.2 Missing

Get the number of measurements that were dropped due to a buffer full condition.

Query: FETCh:MISSing?

Reply: {integer}

8.13.3 Next

Get the next N measurements from the fetch buffer.

Query: FETCh:NEXT? [integer]

Reply: {integer}

Optional argument determines how many samples are returned; default is 1. The returned measurements are removed from the queue.

A list of measurements is returned, where each measurement is composed of one or more items. CONFigure:READings:SEND determines which items are sent for each measurement.

CONFigure:READings:MODE determines the format of the returned data:

- **BiNary** -- the return data is a binary block, items are fixed-width and are sent in sequence without delimiters. Host software must take into account the size of each item to decode the data.
- **ASCIi** -- the return data is ascii text. Measurements are separated by carriage-return-newlines (`\r\n`) and items within each measurement are separated by commas (`,`).

8.13.4 Number of Records

Returns the number of records currently in the fetch buffer.

Query: `FEtCh:NRECORDs?`
Reply: `{integer}`

8.13.5 Trend

Copies the trend buffer into the fetch buffer, which can then be queried using `FEtCh:NEXT?` and `FEtCh:ALL?`

Command: `FEtCh:TREND`

Use this command to access the data displayed in the trend view. This is particularly useful for obtaining snapshot data in snapshot mode.

This command implicitly sends `ABORt` to avoid conflicting with live acquisition data.

8.13.6 Wait

This query pauses the communications interface until the requested number of measurements have been collected into the fetch buffer.

Query: `FEtCh:WAIT? [integer]`
Reply: `{0|1}`

It takes an optional timeout argument in milliseconds, which defaults to 10000.

Care should be taken when specifying a timeout longer than a few minutes as it may make the communications interface unresponsive if the condition never occurs, and may require physical access to the device to reset it.

Returns 1 upon success, otherwise returns 0 if the timeout expires before the requested number of samples have been collected.

This query returns 0 immediately if either of the following requirements are not met:

- CONFigure:READings:CONTinuous must be set to STREam
- INITiate was previously sent, and a count was specified

8.13.7 Read Latest Measurement

This is the simplest way to get a measurement from the meter.

```
Query:  READ?
Reply:  {comma-separated list}
```

The READ? query returns the latest measurement at the time of the query, and is analogous to glancing at the numeric readout on the graphical user interface.

By default, this returns only the primary measurement value. Use CONFigure:READings:SEND to select additional items.

This value is only updated a few times per second, and no care is taken to avoid duplicate measurements. The read query may return the same value if queried too fast. If duplicate measurements are undesirable, or if fast time spacing is needed, consider using the FETCh commands instead.

8.13.8 Export Log Files and System Report

Exports log files, a system report, and any crash dumps to an external flash drive.

```
Command: DEBug:EXPort:LOG
```

The file 'system_report.tar.gz' is created at the root of the first external flash drive, overwriting any file with the same name. The file can be sent to Coherent Technical Support (see 'Service and Support' (p. 243)) for analysis and troubleshooting.

8.14 Display Commands

8.14.1 Backlight Enable

Controls the backlight on/off state.

```
Command: DISPlay:BACKlight {DEFault|ON|OFF}
Default: ON
Query:   DISPLAY:BACKLIGHT?
Reply:   {ON|OFF}
```

8.14.2 Backlight Intensity

Controls the backlight intensity. (DISPlay:CONTRast is an alias for the same value).

```
Command: DISPlay:INTensity {DEFAULT|float: 0.0-1.0}
Default: 0.67
Query:   DISPlay:INTensity?
Reply:   {float}
```

8.14.3 Clear

Clears the text display.

```
Command: DISPlay:CLEar
```

8.14.4 Screenshot

Save a screenshot to internal or external flash. Screenshots are written in bmp format.

```
Command: DISPlay:SAVE [string]
```

Takes an optional path argument, which defaults to the first available location in priority order:

- /usb0
- /usb1
- /loc

The path can specify a file or a directory. If it is a directory, then a file named "screenshotXXX.bmp" will be created in that directory, where XXX is the lowest numeric suffix that does not conflict with an existing file.

The command fails if it specifies a file that already exists, or if the parent directory does not exist.

8.14.5 Text

Displays the text message on the graphical user interface. The message is limited to 80 characters.

```
Command: DISPlay:TEXT {string}
```

8.15 Logging Commands

8.15.1 Data Reduction

Data reduction may be applied to slow down the data stream and/or reduce the size of the log files. Note that this data reduction applies only to logging, and is in addition to any acquisition data reduction; see 'Acquisition Commands' (p. 174).

8.15.2 Condition

Determines how often to save a measurement.

```
Command: LOG:REDuce:CONDition {DEFault|ALL|TIME|COUNT}
Default: ALL
Query:   LOG:REDuce:CONDition?
Reply:   {ALL|TIME|COUNT}
```

where:

- ALL -- all measurements are written to the log
- TIME -- one measurement is written every X seconds
- COUNT -- one measurement is written out of every X measurements

8.15.3 Count

Defines the number of measurements to acquire before writing one measurement to the log.

```
Command: LOG:REDuce:COUNt {integer}
Default: 1
Query:   LOG:REDuce:COUNt?
Reply:   {integer}
```

Applies only when LOG:REDuce:CONDition is set to COUNT.

8.15.4 Method

Determines how to reduce the data stream.

```
Command: LOG:REDuce:METHod {DEFault|AVERage|DISCard}
Default: AVERage
Query:   LOG:REDuce:METHod?
Reply:   {AVERage|DISCard}
```

where:

- AVERage -- intermediate measurements are averaged
- DISCard -- intermediate measurements are discarded

8.15.5 Time

Defines the time interval between writing measurements to the log, in units of seconds.

```
Command: LOG:REDuce:TIME {float}
Default: 1.0
Query:   LOG:REDuce:TIME?
Reply:   {float}
```

Applies only when LOG:REDuce:CONDition is set to TIME.

8.15.6 Delimiter

Specifies the file format to use.

```
Command: LOG:DELimiter {DEFAULT|COMMa|TAB}
Default: COMMa
Query:   LOG:DELimiter?
Reply:   {COMMa|TAB}
```

where:

- COMMa -- comma-separated-values (CSV) with period '.' as the decimal point
- TAB -- tab-separated-values (TSV) with comma ',' as the decimal point

8.15.7 Filename

Set/get the log filename.

```
Command: LOG:FNAME {string}
Default: "/loc/log000.csv"
Query:   LOG:FNAME?
Reply:   {string}
```

The command accepts an absolute or relative path, as long as it resolves to a location underneath one of the user-defined data locations (see 'Valid File Paths' (p. 173)). The query always returns an absolute path.

Valid extensions are ".csv" for comma-separated format, or ".tsv" for tab-separated format. If the filename points to an existing directory, then "log000.csv" is automatically appended.

8.15.8 Filename Conflict Resolution

Specifies what action to take when the filename points to an existing file.

Command: LOG:CONFLICT {DEFAULT|UNIQUE|OVERWRITE|APPEND}

Default: UNIQUE

Query: LOG:CONFLICT?

Reply: {UNIQUE|OVERWRITE|APPEND}

where:

- UNIQUE -- create a unique filename by incrementing the numeric suffix until it no longer collides with an existing file.
- OVERWRITE -- the new data overwrites the existing file
- APPEND -- the new data is appended to the existing file

8.15.9 State

Turn logging on/off. Logging is active when both LOG:STATE and ACQUIRE:STATE are set to ON.

Command: LOG:STATE {DEFAULT|ON|OFF}

Default: OFF

Query: LOG:STATE?

Reply: {ON|OFF}

The log file is opened as soon as both are set to ON.

The log file is closed as soon as either of them are set to OFF.

8.16 Memory Commands

8.16.1 Catalog

List the contents of the current working directory.

Query: MEMORY:CATALOG?

Reply: {list}

The first line of the reply contains the used and remaining storage space in terms of bytes. The following lines list the files and directories in the current working directory, along with their sizes in bytes. For example:

MEMORY:CATALOG?

used=256815104,remain=7561334784

"screenshot000.bmp",FILE,2457654

"screenshot001.bmp",FILE,2457654

"settings2.ini",FILE,1337

"settings.ini",FILE,1337

"log000.csv",FILE,606955

```
"log001.csv",FILE,568735  
"log002.csv",FILE,348172  
"test",DIR,4096  
OK
```

8.16.2 Copy

Copy a file from one location to another. Takes two quoted filenames as arguments.

Command: MEMory:COpy {source},{destination}

This command returns immediately and does not wait for the copy to finish. Instead, query MEMory:WAIT? to wait for the operation to finish, or poll bit position 12 (0x1000) of SYSTem:STATus?

Furthermore, only one copy/rename operation is allowed at a time. This command returns an error if another copy/rename is already in progress. Copying a directory to a subdirectory of itself is not allowed.

8.16.3 Current Working Directory

Set/get the current working directory. Relative file paths are with respect to this directory.

```
Command: MEMory:CDIRectory {string}  
Default: "/loc"  
Query:   MEMory:CDIRectory?  
Reply:   {string}
```

8.16.4 Delete

Delete a file. Takes a quoted filename as an argument.

Command: MEMory:DELeTe {filename}

8.16.5 Export Data File

Export the trend buffer to a file in flash memory. Takes a quoted filename as an argument.

Command: MEMory:STORe {filename}

8.17 File Transfer

8.17.1 File Close

Close the currently open file.

Command: MEMory:FILE:CLOSe

Opening a new file implicitly closes the currently open file.

*RST implicitly closes the currently open file.

8.17.2 File Data

The command writes a block of data to the currently open file.

Command: MEMory:FILE:DATa\n{binary block}

Query: MEMory:FILE:DATa? [integer]

Reply: {binary block}

The host sends the command, followed by a newline, followed by a binary block. A file must have been previously opened for writing, otherwise an error is returned. An error is returned if the storage medium is out of space.

In case the binary block is malformed or interrupted, the command times out after 10 seconds on inactivity, and the interface will be ready to accept a new command.

The query reads a block of data from the currently open file. It takes an optional argument specifying how many bytes to read. If the argument is not provided, it reads until end-of-file. A file must have been previously opened for reading, otherwise an error is returned.

This command/query is not supported on the RS-232 interface.

In the example below, the pound sign '#' signifies the start of a binary block. The following digit '2' indicates that the length is two digits. The next two digits '43' indicate the payload is 43 bytes. The payload in this example is made entirely of printable ascii characters, but this is not required.

See the section 'Binary Data Transfer' (p. 172) for further details about the binary block format.

For example:

```
...// write a file
MEMory:FILE:OPEN "test.txt" WRITe
MEMory:FILE:DATA
#243The quick brown fox jumps over the lazy dog
MEMory:FILE:CLOSe
```

```
// read the file back
MEMory:FILE:OPEN "test.txt" READ
MEMory:FILE:DATA?
#243The quick brown fox jumps over the lazy dog
MEMory:FILE:CLOSE
```

8.17.3 File Open

Opens a file.

Command: MEMory:FILE:OPEN {filename},{READ|WRITE|APPend}

Open a file in one of the modes listed in 'Mode to Open File' (p. 200):

Table 8-9. Mode to Open File

Mode	If the file exists	If the file does not exist...
READ	Open for reading	Return error
WRITE	Truncate and open for writing	Create it
APPend	open for writing at the end-of-file	Create it

This command implicitly closes any previously opened file before opening the new file. *RST implicitly closes the currently open file.

This command is not supported on the RS-232 interface.

8.17.4 Import Data File

Import a CSV (or TSV) file from flash memory into the trend buffer. Takes a quoted filename as an argument.

Command: MEMory:LOAD {filename}

8.17.5 Make Directory

Make a new directory. Takes a quoted directory name as an argument.

Command: MEMory:MDIRECTory {dirname}

8.17.6 Remove Directory Recursively

Remove a directory recursively. MEMory:RDIRectory but the directory does not need to be empty. Takes a quoted directory name as an argument.

Command: MEMory:RDIRectory {dirname}

8.17.7 Rename File or Directory

Rename a file or directory. Takes two quoted filenames as arguments.

Command: MEMory:REName {source},{destination}

8.18 State

8.18.1 Recall

Recalls a configuration file from the provided filename. Expects a filename with the extension “.ini”.

Command: MEMory:STATe:RECall {filename}

8.18.2 Save

Save a configuration file.

Command: MEMory:STATe:SAVE {filename}

If the filename argument points to a directory, then a file named “settings.ini” will be added to that directory.

Otherwise, it assumes the argument specifies a file, and the extension “.ini” will be appended if it is missing. If the filename has a different extension, then it will be changed to “.ini”.

8.19 Miscellaneous Commands

8.19.1 Echo

Returns the string that was passed as an argument. Useful for testing basic communication with the meter.

Command: ECHo {string}

Reply: {string}

8.19.2 Firmware Update

Begin firmware installation.

Command: INSTall [filename]

Takes an optional filename argument, which defaults to “/usb0/LabMax-Touch.img”.

The system automatically restarts during installation.

8.20 SCPI Common Commands

8.20.1 Identify

Returns the meter identification string, containing the manufacturer name, model name, and firmware version/date.

Query: *IDN?

Reply: {string}

For example:

*IDN?

Coherent, Inc - LabMax-Pro Touch - V0.1.12 - 03 Jun 2021

8.20.2 Reset

Resets all parameters to their default values.

Command: *RST

8.20.3 Self-Test

Run the self-test procedure, or query the status. (This is an alias of SYSTem:TEST)

Command: *TST

Query: *TST?

Reply: {NONE|RUNNING|PASSED|FAILED}

8.20.4 Wait

Blocks until all pending (previous) commands have been processed.

Command: *WAI

8.21 Statistics Commands

8.21.1 Clear

Clears the trend buffer and the statistics accumulators.

Command: STATistics:CLEar

8.21.2 Limit

Set/get the statistics limit, which is the maximum number of measurements over which to compute statistics.

Command: STATistics:LIMit {DEFault|INFinite|integer}

Default: INFinite

Query: STATistics:LIMit?

Reply: {INFinite|integer}

- In accumulate mode, the statistics keep updating until the count reaches this limit, then the statistics remain constant until they are cleared (either by the STATistics:CLEar command, or by a settings change).
- In buffer mode, this setting is ignored and the statistics are always computed over the entire trend buffer.

8.21.3 Mode

Set/get the statistics mode. In buffer mode, the statistics are computed over the trend buffer, and are recomputed whenever the trend buffer updates.

Command: STATistics:MODe {DEFault|BUFFer|ACCumulate}

Default: RECOrd

Query: STATistics:MODe?

Reply: {BUFFer|ACCumulate}

In accumulate mode, measurements are added to the statistics continuously until either a limit is reached or the statistics are cleared. Use accumulate mode to compute statistics over larger time spans than allowed by the trend buffer.

8.22 Results

8.22.1 1-Sigma

Return the ratio of standard deviation to mean, expressed as a percentage.

$1\text{SIG} = 100 * \text{stdDev} / \text{mean}$

Query: STATistics:1SIG?

Reply: {float}

8.22.2 2-Sigma

Return 2x the ratio of standard deviation to mean, expressed as a percentage.

$2\text{SIG} = 200 * \text{stdDev} / \text{mean}$

Query: STATistics:2SIG?

Reply: {float}

8.22.3 3-Sigma

Return 3x the ratio of standard deviation to mean, expressed as a percentage.

$3\text{SIG} = 300 * \text{stdDev} / \text{mean}$

Query: STATistics:3SIG?

Reply: {float}

8.22.4 All

Return all of the above values as a comma-separated list, optionally with headers if CONFIGure:READings:HEADers is set to ON.

Query: STATistics:ALL?

Reply: {comma-separated list}

For example:

CONFIGure:READings:HEADers ON

STATistics:ALL?

MIN=0,MAX=0.930271,MEAN=0.395016,STDV=0.240461,RANGE=0.930271,
DOSE=395.016,1SIG=60.8738,2SIG=121.748,3SIG=182.621,MISSED=0,C
OUNT=1000,FLAG=0000

CONFIGure:READings:HEADers OFF

STATistics:ALL?

0,0.930271,0.395016,0.240461,0.930271,395.016,60.8738,121.748,
182.621,0,1000,0000

8.22.5 Count

Return the number of measurements in the statistics interval (i.e. the population).

Query: STATistics:COUNT?
Reply: {long integer}

8.22.6 Dose

Return the sum of all measurements in the statistics interval.

Query: STATistics:D0Se?
Reply: {float}

8.22.7 Flags

Returns the bitwise OR of the flags for all measurements that contributed to the statistics.

Query: STATistics:FLAG?
Reply: {4 hexadecimal digits}

This can be used to detect errors, such as over-range conditions that may affect the validity of results.

See CONFigure:READings:SEND for the definitions of each flag bit.

8.22.8 Max

Return the maximum measurement in the statistics interval.

Query: Query: STATistics:MAXimum?
Reply: {float}

8.22.9 Mean

Return the mean of all measurements in the statistics interval.

Query: STATistics:MEAN?
Reply: {float}

8.22.10 Min

Return the minimum measurement in the statistics interval.

Query: STATistics:MINimum?
Reply: {float}

8.22.11 Missed

Return the number of missed pulses during the statistics interval.

Query: STATistics:MISSED?
Reply: {long integer}

8.22.12 Range

Return the range of all measurements in the statistics interval. Range is defined as (maximum – minimum).

Query: STATistics:RANGe?
Reply: {float}

8.22.13 Standard Deviation

Return the standard deviation of all measurements in the statistics interval.

Command: STATistics:STDV?
Reply: {float}

8.22.14 Wait

Wait for statistics to complete.

Query: STATistics:WAIT? [timeout]
Reply: {0|1}

In buffer mode, this waits for the trend buffer to fill up.

In accumulate mode, this waits for the STATistics:LIMit to be reached.

This query takes an optional timeout argument in terms of milliseconds, which defaults to 10000 if not specified.

- Returns 1 when the requested limit has been reached, or 0 if a timeout occurs.
- Returns 0 immediately if STATistics:MODE is set to ACCumulate and STATistics:LIMit is set to INFinite.

8.23 System Commands

8.23.1 Battery

8.23.1.1 Health

Get the battery health as a percentage.

Query: SYSTem:INFormation:BATTery:HEALth?

Reply: {integer: 0-100}

8.23.1.2 Percent Remaining

Returns the remaining battery capacity as a percent of full charge.

Query: SYSTem:INFormation:BATTery:PERCent?

Reply: {integer: 0-100}

8.23.1.3 Status

Returns a list of tokens indicating the current battery status.

Query: SYSTem:INFormation:BATTery:STATus?

Reply: {PRESENT|LOW|CHARGING|ERROR}

8.23.2 Time

Set/get the time maintained within the meter.

Command: SYSTem:TIME {hour},{minute},{second}

Query: SYSTem:TIME?

Reply: {hour},{minute},{second}

This is always in 24-hour format, regardless of SYSTem:TIME:FORMat.

8.23.3 Time Format

Set/get the time format: either 12-hour time (AM/PM) or 24-hour time.

Command: SYSTem:TIME:FORMat {DEFault|12|24}

Default: 12

Query: SYSTem:TIME?

Reply: {12|24}

This setting only applies to the time displayed in the graphical user interface. The time returned by SYSTem:TIME? is always in 24-hour format.

8.24 Communication Settings

8.24.1 Ethernet

8.24.1.1 DHCP

This setting is read-only (can only be changed from the graphical user interface).

Default: ON
Query: SYSTem:COMMunicate:ETHernet:DHCP?
Reply: {ON|OFF}

where:

- ON -- the router automatically assigns network settings to the meter
- OFF -- the network settings can be assigned manually

8.24.1.2 Gateway

Read-only: the default gateway for network communications.

Default: {set by router}
Query: SYSTem:COMMunicate:ETHernet:GATeway?
Reply: {string}

If DHCP is on, this is set automatically by the router. Otherwise, this can only be changed from the graphical user interface.

8.24.1.3 Hostname

Read-only: Get the host name used for network communication. This can only be changed from the graphical user interface.

Default: LM{serial-number}
Query: SYSTem:COMMunicate:ETHernet:HOSTname?
Reply: {string}

8.24.1.4 IP Address

Read-only: the IP address the meter, used for network communications.

Default: {set by router}

Query: SYSTem:COMMunicate:ETHernet:IPADdr?

Reply: {string}

If DHCP is on, this is set automatically by the router. Otherwise, this can only be changed from the graphical user interface.

8.24.1.5 MAC Address

Read-only: Get the MAC address used for network communication.

Query: SYSTem:COMMunicate:ETHernet:MAC?

Reply: {string}

8.24.1.6 Port

Read-only: the port number on which the meter listens for connections from a remote host. This can only be changed from the graphical user interface.

Default: 58975

Query: SYSTem:COMMunicate:ETHernet:PORT?

Reply: {integer}

8.24.1.7 Subnet Mask

Read-only: the subnet mask for network communications.

Default: {set by router}

Query: SYSTem:COMMunicate:ETHernet:NETMask?

Reply: {string}

If DHCP is on, this is set automatically by the router. Otherwise, this can only be changed from the graphical user interface.

8.24.2 Handshaking

Enable handshaking to get immediate feedback on whether a command passed or failed.

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

Default: OFF

Query: SYSTem:COMMunicate:HANDshaking?

Reply: {ON|OFF}

If enabled, the meter either responds with OK or ERR{N} after each command, where N is an integer error code that identifies the type of failure. This can also be useful for synchronizing the host with the meter.

8.24.3 RS-232

8.24.3.1 Baud Rate

Set/get the speed of the RS-232 interface.

```
Command: SYSTem:COMMunicate:SERIal:BAUD
{DEFault|9600|19200|38400|57600|115200}
Default: 19200
Query:   SYSTem:COMMunicate:SERIal:BAUD?
Reply:   {9600|19200|38400|57600|115200}
```

8.24.3.2 Flow Control

Set/get the type of flow control for the RS-232 interface.

```
Command: SYSTem:COMMunicate:SERIal:PACE {DEFault|XON|NONE}
Default: NONE
Query:   SYSTem:COMMunicate:SERIal:PACE?
Reply:   {XON|NONE}
```

NOTE: Flow control cannot be used with CONFIGure:READings:MODE BINary

8.24.3.3 Parity

Set/get the parity for the RS-232 interface.

```
Command: SYSTem:COMMunicate:SERIal:PARity
{DEFault|EVEN|ODD|NONE}
Default: NONE
Query:   SYSTem:COMMunicate:SERIal:PARity?
Reply:   {EVEN|ODD|NONE}
```

8.24.3.4 Stop Bits

Set/get the number of stop bits for the RS-232 interface.

```
Command: SYSTem:COMMunicate:SERIal:SBITS {DEFault|1|2}
Default: 1
Query:   SYSTem:COMMunicate:SERIal:SBITS?
Reply:   {1|2}
```

8.24.4 Date

Set/get the date maintained within the meter.

Command: `SYSTem:DATE {year},{month},{day}`

Query: `SYSTem:DATE?`

Reply: `{year},{month},{day}`

8.25 Instrument Information

8.25.1 Board ID

Returns the board ID.

Query: `SYSTem:INformation:INSTRument:BOARD?`

Reply: `{hex_int}`

8.25.2 CPU Temperature

Get the CPU temperature in degrees Celsius.

Query: `SYSTem:INformation:CPU:TEMPerature?`

Reply: `{float}`

8.25.3 Calibration Date

Get the system calibration date.(Read only.)

Query: `SYSTem:INformation:INSTRument:CDATE?`

Reply: `{string}`

8.25.4 FPGA Firmware Version

Get the FPGA firmware version.

Query: `SYSTem:INformation:FPGA:FVER?`

Reply: `{integer}`

8.25.5 FPGA Hardware Version

Get the FPGA hardware version.

Query: `SYSTem:INformation:FPGA:HVER?`

Reply: `{integer}`

8.25.6 Firmware Version

Get the meter firmware version.

Query: SYSTem:INFormation:INSTRument:FVER?
Reply: {string}

8.25.7 Instrument Type

Get the instrument type. (Read only.)

Query: SYSTem:INFormation:INSTRument:TYPE?
Reply: {TO|TOP}

8.25.8 Manufacture Date

Get the system manufacture date. (Read only.)

Query: SYSTem:INFormation:INSTRument:MDATE?
Reply: {string}

8.25.9 Part Number

Get the meter part number. (Read only.)

Query: SYSTem:INFormation:INSTRument:PNUMBER?
Reply: {string}

8.25.10 Serial Number

Get the meter serial number. (Read only.)

Query: SYSTem:INFormation:INSTRument:SNUMBER?
Reply: {string}

8.26 Power Management

8.26.1 Restart

Restart the meter.

Command: SYSTem:REStArt

8.26.2 Shutdown

Power off the meter.

Command: SYSTem:SHUTdown

8.27 Probe Information

8.27.1 Calibration Date

Get the probe calibration date.

Query: SYSTem:INFormation:PROBe:CDAte?

Reply: {string}

8.27.2 Code

Get the probe code.

Query: SYSTem:INFormation:PROBe:CODE?

Reply: {integer}

8.27.3 Diameter

Get the probe diameter in millimeters.

Query: SYSTem:INFormation:PROBe:DIAMeter?

Reply: {NA|float}

8.27.4 Model

Get the probe model.

Query: SYSTem:INFormation:PROBe:MODEl?

Reply: {string}

8.27.5 Responsivity

Get the probe responsivity.

Query: SYSTem:INFormation:PROBe:RESPonsivity?

Reply: {float}

8.27.6 Serial Number

Get the probe serial number.

Query: SYSTem:INFormation:PROBe:SNUMber?
Reply: {string}

8.27.7 Temperature

Get the probe temperature in degrees Celsius.

Query: SYSTem:INFormation:PROBe:TEMPerature?
Reply: {integer}

8.27.8 Type

Get the probe type.

Query: SYSTem:INFormation:PROBe:TYPE?
Reply: {string}

8.28 Remote Lockout

8.28.1 Local

Unlocks the meter and returns it to normal operation.

Command: SYSTem:LOCa1

8.28.2 Remote

Blanks the graphical user interface, displays a message that the meter is being controlled remotely, and locks the touchscreen and physical buttons.

Command: SYSTem:REMote

8.28.3 Self-Test

Run the self-test procedure, or query the status.

Command: SYSTem:TEST
Query: CALibration:TEST?

Reply: {NONE|RUNNING|PASSED|FAILED}

The command launches the self-test procedure. It returns an error if a probe is present or if the procedure is already running.

The query returns the status of the test. The first line shows the overall status, and the subsequent lines show the status of individual steps in the procedure.

The steps are listed in Table 8-10:

Table 8-10. Self-Test Procedure

Step	Description
Overall	The overall status is RUNNING while any of the steps are running. After all the steps have completed, the overall status is set PASSED if all the steps passed, or FAILED if one or more steps failed.
slowAdc	Slow ADC (U20)
fastAdc	Fast ADC (U3)
fpga	FPGA (U34)
stage1	1x/10x amplifier (U13)
stage2	2-stage amplifier (U45)
stage3	MDAC attenuator (U17/U18)

Each step has one of four possible states:

- NONE - the test has not been run yet
- RUNNING - the test is currently running
- PASSED - the test previously ran and passed
- FAILED - the test previously ran and failed

For example:

```

SYSTem:TEST
OK
SYSTem:TEST?
overall: RUNNING
slowAdc: PASSED
fastAdc: PASSED
fpga: PASSED
stage1: NONE
stage2: NONE
stage3: NONE
OK

```

8.29 Status

Get the systems status bit mask.

Query: SYSTem:STATus?

Reply: {8 hexadecimal digits}

Status bits are described in Table 8-11.

Table 8-11. Status Bits

Bit Position	Hex Value	Description
0	00000001	Battery is low
1	00000002	Probe damage temperature exceeded
2	00000004	Valid probe is attached
3	00000008	USB flash drive is attached
4	00000010	Logging storage media is not able to keep up with the data stream, resulting in Missing Samples. Cleared when logging starts
5	00000020	Self-test in progress
6	00000040	A configuration change requires the meter to be zeroed out
7	00000080	Power switch state (always on)
8	00000100	Zero in progress
9	00000200	Logging stopped due to disk full. Cleared when logging starts.
10	00000400	Logging stopped due to disk error (e.g. USB drive removed). Cleared when logging starts.
11	00000800	Remote mode enabled (touchscreen/button lockout)
12	00001000	Host file copy in progress
13	00002000	reserved for future use
14	—	Internal Use Only
15-31	FFFF8000	Reserved

8.30 System Error Queue

8.30.1 All Errors

Return all errors in the error queue, and clear the queue.

Query: SYSTem:ERRor:ALL?

Reply: {error list}

Table 8-12 lists the system error codes.

Table 8-12. System Error Codes

Error Code	Quoted Error String	Description
-350	Queue overflow	Error queue is full.
-310	System error	Unexpected or unrecoverable hardware or software fault.
-254	Media full	No more storage available on the mass storage volume.
-240	Operation not allowed	Requested operation is not allowed in the current configuration.
-220	Timeout	A timeout expired while meter was waiting for data from the host.
-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.
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 not open for reading	Attempted to read from a file that is not open for reading.
206	File not open for writing	Attempted to write to a file that is not open for writing.

Table 8-12. System Error Codes (Continued)

Error Code	Quoted Error String	Description
207	File is busy or already open	File is already open by another process.
208	Destination is a subdirectory of the source	The destination is below the source in the directory hierarchy

8.30.2 Clear

Clear the error queue.

Command: SYSTem:ERRor:CLEar

8.30.3 Error Count

Return the number of errors in the queue.

Query: SYSTem:ERRor:COUNT?

Reply: {integer}

8.30.4 Next Error

Remove and return the next error from the queue.

Query: SYSTem:ERRor:NEXT?

Reply: {error list}

8.31 Trigger Commands

8.31.1 Force Trigger

Manually force a trigger event.

Command: TRIGger:FORCe

This command only applies when in snapshot mode; that is, when all of the following are true:

- A PMP sensor is attached
- The Selected Source is set to FAST
- The operating mode is set to WATTS
- The Acquisition Duration is 0.5 seconds or less

Furthermore, this command is only useful when Free-Run Mode is OFF. It can be used to manually refresh the trend view in the absence of trigger events.

8.31.2 Free-Run Mode

Set/get the free-run mode.

Command: TRIGger:FREE {DEFault|ON|OFF}

Default: ON

Query: TRIGger:FREE?

Reply: {ON|OFF}

This setting only applies when in snapshot mode; that is, when all of the following are true:

- A PMP sensor is attached
- The Selected Source is set to FAST
- The operating mode is set to WATTS
- The Acquisition Duration is 0.5 seconds or less

Free-run ON means the trend view refreshes periodically in the absence of trigger events. Free-run OFF means the trend view only refreshes when a trigger event occurs.

8.31.3 Pulsed Thermopile Joules Level

Set/get the trigger level for the Pulsed-Thermopile-Joules algorithm. This applies only when the Selected Source is set to SLOW and the operating mode is set to J (Joules).

Command: TRIGger:PTJ:LEVel {DEFault|LOW|MEDium|HIGH}

Default: LOW
Query: TRIGger:PTJ:LEVel?
Reply: {LOW|MEDIUM|HIGH}

8.31.4 Trigger Delay

Set/get the trigger delay in microseconds. This applies only when the Selected Source is set to FAST.

Command: TRIGger:DElay {DEFault|integer:0-1000}
Default: 0
Query: TRIGger:DElay?
Reply: {integer}

8.31.5 Trigger Level

Set/get the trigger level as a percent of the current range. This applies only when the Selected Source is set to FAST.

Command: TRIGger:LEVel {DEFault|integer:0-100}
Default: 5
Query: TRIGger:LEVel?
Reply: {integer}

8.31.6 Trigger Slope

Set/get the trigger slope. This determines whether the meter triggers on a rising or falling edge. This applies only when the Selected Source is set to FAST

Command: TRIGger:SLOPe {DEFault|POSitive|NEGative}
Default: POS
Query: TRIGger:SLOPe?
Reply: {POS|NEG}

8.32 Trigger Source

Set/get the trigger source. Internal means the meter triggers on the signal from the connected probe. External means the meter triggers on the external trigger input. This applies only when the Selected Source is set to FAST.

Command: TRIGger:SOURce {DEFault|INTernal|EXTernal}
Default: INTernal
Query: TRIGger:SOURce?
Reply: {INT|EXT}

8.32.1

Trigger Status

Get the trigger status.

Query: TRIGger:STATus?

Reply: {FREE|WAIT|TRIG}

Returns one of the following states:

- FREE -- the meter is free-running
- WAIT -- the meter is waiting for a trigger event
- TRIG -- a trigger event occurred within the last second

This command is always valid for all probes and modes.

- For pulse measurements, it returns WAIT when waiting for a pulse, or TRIG if a pulse occurred within the last second.
- In snapshot mode, it returns TRIG if a trigger event occurred within the last second, otherwise it returns WAIT or FREE, depending on the Free-Run Mode setting.
- For all other modes, it simply returns FREE.

9 Troubleshooting

This section provides information about how issues are reported by the LabMax Touch Meter to assist in troubleshooting.

For Technical Support assistance, see 'Service and Support' (p. 243) for information about various ways to contact Coherent.

9.1 Safe Mode

If there is an issue with startup of the LabMax Touch Meter, the unit can be started in Safe Mode. This could happen if the saved settings file is corrupt or from an incompatible firmware version.

To start in safe mode, power the device off and then on. When the startup screen displays with the Coherent logo, press and hold the Back button.

At startup, the meter then displays a message that indicates that Safe Mode is enabled and that all settings are reset to default values.

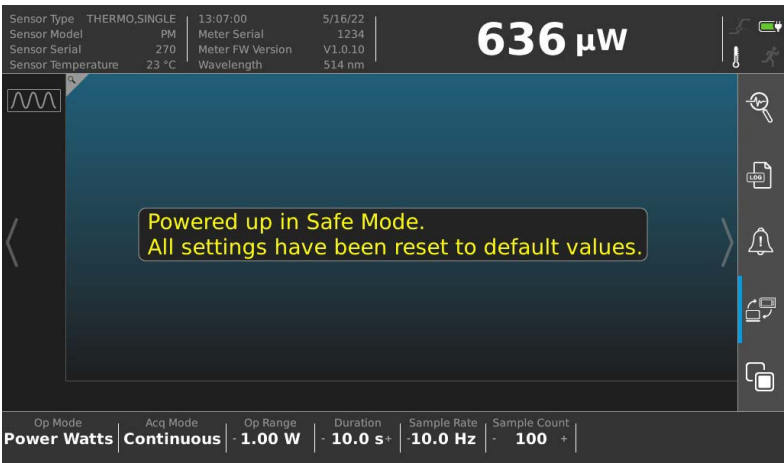


Figure 9-1. Startup in Safe Mode

9.2 Measurement Errors

The touchscreen user interface displays information in certain temporary conditions via indicators, visible here in the Measurement View in the Title Bar. For more information, refer to 'Indicators' (p. 85).



Figure 9-2. Error Indicator Types

9.3 Zero the Meter

Pressing the ZERO button clears all data and resets all values to zero. For information on the Zero mode, refer to 'Set Meter to Zero' (p. 87).



NOTICE

It is recommended that the meter is set to zero after first setting it on and before beginning any new set of power measurements. It should be the first thing that is done when using a thermopile or PmP sensor.

Appendix A: Parts and Accessories

This section describes parts and accessories for the LabMax Touch Meter. This section also describes how to replace the battery in the meter.

A.1 Shipped with Meter

Table A-1 lists the cables that are shipped with the LabMax Touch Meter. For more information about cables, see 'Product Description' (p. 11).

Table A-1. Cables for the LabMax Touch Meter

P/N	Component
2237381	Cable, Trigger Input, LabMax Touch
2237382	Cable, Multi-Output, LabMax Touch (analog out, trigger out, flag out)
2237377	Cable, RS-232
1108906	Cable, USB A-to-USB B Mini
1256370	Power Supply 2.08A, 12V (24W)
1106344	Cord, Power Supply, 10A, 125V, NEMA5-15P/320-C13, 8' Black SJT, PVC Jacket, 18 AWG, Lead-Free
2257698	Carrying Case
—	Certificate of Calibration

A.2 Optional Accessories

Optional Accessories for the LabMax Touch Meter are shown in Table A-2.

Table A-2. Accessories for the LabMax Touch Meter

P/N	Description
2213123	Replacement Battery Pack, LI-ION (Lithium Ion); see 'Replace the Battery' (p. 227) for instructions.
2269910	Meter Mounting Accessory Kit, with two (2) 20 mm-wide brackets and (4) screws - see 'Mount the Meter' (p. 31) for details about the Kit and instructions for mounting.

The following cables may also be used, but are customer-supplied and not included nor shipped with the LabMax Touch Meter. Contact a local vendor for these cables.

- CAT5 Ethernet cable
- Mini HDMI cable

A.3 Shop.Coherent

These accessories or product bundles can be ordered on the Shop.coherent.com website.

SHOP COHERENT

Shop.coherent is the official e-commerce website for Coherent lasers, energy meters and sensors, fiber optics, and accessories. Available for US customers, the e-commerce service offers product search, product-specific filtering, and fast-and-easy checkout with prompt order and shipping confirmations.

Appendix B: Replace the Battery

This section describes how to replace the Lithium Ion (7.2V 5.2Ah LI-ION) battery in the LabMax Touch Meter. Learn more about the battery in the section, 'Battery' (p. 15).



WARNING!

Improper handling of Li-ion cells can lead to loss of efficiency, overheating, electrolyte leakage, ignition, or even hazardous explosion.

Read all safety and handling precautions carefully before testing or using the battery; see 'Safety for Lithium Batteries' (p. 236).

B.1

Remove the Old Battery

The door to the battery compartment on the back panel is the only user-accessible hardware of the LabMax Touch Meter.



NOTICE

Other than the Battery compartment, do NOT open the case. Tampering with the case voids the Warranty.

1. Figure B-1 shows the kickstand on the back cover over the battery compartment.
2. Swing the kickstand out of the way, so the cover on the battery compartment can be removed.
3. Using the appropriately sized Phillips-head screwdriver, unscrew the battery door on the back panel of the meter.
4. Remove and set aside the battery door and the screws.
5. Remove the old battery, gently pressing the clip to remove the cable from the mating connector inside the case.
6. Set aside the used battery for proper disposal; see 'Dispose of the Used Lithium Battery' (p. 230).



Figure B-1. Swing Kickstand and Remove Battery Cover Screws

B.2 Prepare the Replacement Battery

To prepare the replacement battery:

1. Remove any packaging material or wrapping from the new battery.
2. Place the new battery on a flat, non-flammable surface.
3. Gently uncoil and straighten the connecting cable, as shown in Figure B-2:



Figure B-2. Unpack the Battery

B.3

Insert the New Battery

1. Holding the cable in one hand, insert the cable for the battery and line up with the mating connector at one end of the battery compartment, as shown in Figure B-3.

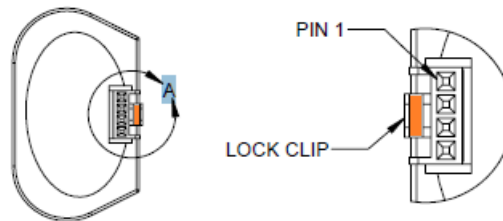


Figure B-3. Connect Battery Cable

2. Gently push to connect the cable to the mating connector.
3. Slide the battery into the compartment, lining up the clips with the mating connector. Gently push to connect.
4. Tuck the battery cable inside the battery compartment, as shown in Figure B-4.



Figure B-4. Tuck In Battery Cable

5. Replace the battery door and attach screws.
6. Return the kickstand to its original position over the battery compartment.
7. Connect the power supply to the LabMax Touch Meter; this charges the battery after it is installed.

The charge time for the battery is less than 6 hours (including a safety circuit and automatically stop-charge when full).

B.4 Dispose of the Used Lithium Battery

Coherent products conform to all applicable requirements of the EU Waste Electrical and Electronic Equipment (WEEE)- Directive (2012/19/EU).



CAUTION!

Do not dispose of the used battery as unsorted municipal waste. Contact Coherent or a local distributor to recycle the battery.

Any packaging used for disposal should contain a label that indicates it contains a Lithium ion battery, as in the example shown in Figure B-5:



Figure B-5. Label for Lithium Ion Battery

Appendix C: Safety

This section describes general requirements for safety for persons when using Coherent meters, sensors, and software in any environment where lasers are present. This section includes:

- 'Laser Safety Hazards' (p. 231)
- 'Electrical Safety' (p. 235)
- 'Safety for Lithium Batteries' (p. 236)

These laser safety sections must be reviewed thoroughly BEFORE you begin. Carefully follow all safety instructions presented throughout this manual.



CAUTION!

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

C.1 Laser Safety Hazards

The safety precautions listed below are to be read and observed by anyone working with or near a laser.

Hazards associated with lasers generally fall into the following categories:

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

This list is not intended to be exhaustive. Anyone operating a laser must consider the interaction with its specific working environment to identify potential hazards. Hazards vary with the input angle and the laser beam.



CAUTION!

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

C.1.1

Optical Safety

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

At all times, ensure that all personnel who operate, maintain or service the laser are protected from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits defined in the laser safety standards.



CAUTION!

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

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

Laser beams are powerful enough to burn skin, clothing, or combustible materials, even at some distance. They can ignite volatile substances such as alcohol, gasoline, ether, and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers, and photodiodes. Follow the control measures listed in 'Precautions for Laser Safety' (p. 234).

C.1.1.1

Laser Safety Eyewear

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

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



CAUTION!

Laser safety eyewear protects from accidental exposure to laser radiation by blocking light at the laser wavelengths. However, laser safety eyewear may also prevent the operator from seeing the beam or the beam spot. Exercise extreme caution even while wearing safety glasses.

C.1.1.2**Viewing Distance**

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

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

C.1.1.3**Maximum Accessible Radiation Level**

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

C.1.2**Laser Back Reflection**

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

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

C.1.3 Precautions for Laser Safety

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

- Read and follow all safety precautions in the associated product manuals (whether Installation, Set-Up, Quick Start, Operator's or User Manuals).
- Set up the laser so that the beam height is either well below or well above eye level.
- Never look directly into the laser light source or at scattered laser light from any reflective surface, even when wearing laser safety eyewear. Never sight down the beam.
- Always wear appropriate eyewear for protection against the specific wavelengths and laser energy being generated. See 'Laser Safety Eyewear' (p. 232) for more information.
- Watch where the reflections from objects are returning to make sure the reflections are not at or near the laser exit aperture. Change the objects to add an angle so the object is less reflective whenever possible. Add an optical isolator to those applications with laser exit aperture back reflections that cannot be corrected by angling the optics.
- Review any objects in front of the laser and make a note of which surfaces are a possible hazard for back reflections. Keep precautions in mind when moving objects that can create a back reflection in front of the laser.
- Avoid wearing watches, jewelry, or other objects that may reflect or scatter the laser beam.
- Block the beam before applying tools such as Allen wrenches or ball drivers to external optics.
- Provide enclosures for beam paths whenever possible.
- Stay aware of the laser beam path, particularly when external optics are used to steer the beam.
- Use appropriate energy-absorbing targets for beam blocking.
- Terminate the laser beam with a light-absorbing material. Laser light can remain collimated over long distances and therefore presents a

potential hazard if not confined. It is good practice to operate the laser in an enclosed room.

- Decrease the power from any possible back reflections by starting the laser at lower output power—for example, 10% output power—before opening the laser shutter.
- Exercise extreme caution when using solvents in an area with any laser.
- Post laser warning signs in the area of the laser beam to alert those present.
- Limit access to the laser to trained and qualified users who are familiar with laser safety practices. When not in use, lasers should be shut down completely and made off-limits to unauthorized personnel.

Advise all those working with or near the laser of these precautions.

C.2 Electrical Safety

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

C.2.1 Electrical Safety Precautions

Following are recommended electrical safety precautions:

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



CAUTION!

Normal operation of the sensor should not require access to the power supply circuitry. Removing the power supply cover gives exposure to potential electrical hazards.

3. When possible, keep one hand away from the equipment to reduce the danger of current flowing through the body if a live circuit is touched accidentally.

4. Always use approved, insulated tools.

C.2.2

ESD Protection

The most common Electrostatic Discharge (ESD) damage occurs when handling a device during installation or use. Dry air and carpet also create a higher potential for ESD.

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



CAUTION!

Electrostatic charges as high as 4000 volts easily collect on the human body and equipment and can discharge without detection. Although the electronics features have input protection, permanent damage can occur on devices subjected to high-energy electrostatic discharges.

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

C.3

Safety for Lithium Batteries

The LabMax Touch Meter includes a 7.2V 5.2Ah LI-ION (Lithium Ion) battery.



WARNING!

Read these safety precautions carefully before testing or using the battery. Improper handling of Li-ion cells may lead to loss of efficiency, overheating, electrolyte leakage, ignition, or even explosion.

Do not use the cell in an environment that may cause problems. The following conditions may reduce the cycle life of the cell:

- Static electricity
- Vibration
- Humid environment
- An area of high-frequency microwave or ultrasonic wave

C.3.1 Battery Operating Temperature

Do not use the battery in high or low temperatures. For example, do not use or store the battery in direct sunlight or near heat sources (such as heaters) where the temperature could exceed 60°C.



WARNING!

If the battery generates excessive heat, emits a smell, changes color, becomes deformed, or shows any other abnormalities during use or testing, IMMEDIATELY stop use. The battery may fail and ignite.

Storing cells at or more than 80% for a long time leads to loss of capacity and life cycle; it is recommended to use replacement batteries within 90 days.



IMPORTANT!

Other than opening the Battery compartment to replace a battery, do NOT open the case. Tampering with the case voids the Warranty.

Table C-1 lists the operating and storage temperatures for the battery:

Table C-1. Lithium Ion Battery Operating Temperatures

Operating Temperature	Temperature	Maximum Continuous Rate
Operating Temperature: Charge	$0^{\circ}\text{C} \leq T \leq 15^{\circ}\text{C}$	0.2C (500 mA)
	$15^{\circ}\text{C} < T \leq 30^{\circ}\text{C}$	0.5C (1250 mA)
	$30^{\circ}\text{C} < T \leq 50^{\circ}\text{C}$	1C (2500 mA)
Operating Temperature: Discharge	$-20^{\circ}\text{C} \leq T \leq 0^{\circ}\text{C}$	0.2C (500 mA)
	$0^{\circ}\text{C} < T \leq 20^{\circ}\text{C}$	1C (2500 mA)
	$20^{\circ}\text{C} < T \leq 45^{\circ}\text{C}$	3C (7500 mA)
	$45^{\circ}\text{C} < T \leq 60^{\circ}\text{C}$	1C (2500 mA)

Always adhere to operating temperature. Using batteries outside of its operating temperature leads to reduced performance and increased safety risk.

Table C-2 lists the recommended Storage Temperature:

Table C-2. Lithium Ion Battery Storage Temperature

Time	Temperature	Relative Humidity
One month	-20°C ~ 50°C	≤ 80%
Three months	-20°C ~ 45°C	≤ 80%
One year	-20°C ~ 25°C	≤ 75%

C.3.2 Battery Safety Precautions

Do not store the battery without proper isolation, nor connect the positive and negative electrodes directly with conductive materials. Doing so may short-circuit the battery.

Do not place the battery in packaging or bags with any metal objects, such as tools, screws, coins, keys, or watches.

Do not get the battery wet or throw it into water. When the battery is not in use, place it in a dry environment with a relatively low temperature.

If the leaking electrolyte from the battery gets into your eyes, do not rub your eyes. Rinse the eyes with clean water and seek medical attention if problems remain. If the electrolyte gets onto the skin or clothing, immediately flush with clean water.

C.3.3 Battery Long-Term Storage

When delivered, cells are charged to a voltage of 3.60V ~ 3.80V. Storing cells at/more than 80% SOC for a long time leads to loss of capacity and cycle life. Put cells into use within 90 days when the capacity is more than 80%.

Cells may have lower capacity than expected due to the self-discharge when cells are to be delivered at 30% SOC.

C.3.4 Packing or Recycling the Battery

If for any reason the LabMax Touch Meter is to be shipped, you must first remove the Lithium Ion battery. Cells area required to be in a half-charged state when packed.

The surface of the packing boxes must contain the following information:

- Product name
- Type
- Nominal voltage
- Quantity
- Gross weight
- Date
- Capacity
- Impedance

Mark the shipping box with a label that indicates it contains a Lithium ion battery, as in the example shown in Figure C-1:



Figure C-1. Label for Lithium Ion Battery

C.3.5

Transportation

During transportation, do not subject the cells or the boxes to violent shaking, bumps, rain or direct sunlight.

When properly prepared, cells can be transported by truck, train, ship, and airplane.

Appendix D: Compliance

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

For additional information about Coherent Compliance, please visit:

<https://www.coherent.com/company/environmental>

D.1 CE Marking

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

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

D.2 Electromagnetic Compatibility

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

The European requirements for Electromagnetic Compliance (EMC) are specified in the EMC Directive (published in 2014/30/EU).

Class A:

Conformance (EMC) concerning emission and immunity is achieved through compliance with the harmonized standard EN 61326-1_Ed2:2013 (IEC 61326-1_Ed2:2012 for Electrical Requirement for Measurement, Control and Laboratory for Class A.

Class B:

Conformance to the EMC requirements is achieved through compliance with the harmonized standards EN55011:2009 for emission and EN61000-6-2:2006 for immunity.

D.3 Coherent Corp. Global Product Environmental Compliance Statement

Coherent is committed to delivering products that meet or exceed global regulatory requirements for safety, environmental responsibility, and ethical sourcing. Our comprehensive compliance program supports international frameworks including:

- RoHS, REACH, WEEE, and other regional substance and waste directives
- Battery, packaging, and energy efficiency regulations
- Conflict minerals, PFAS, and supply chain transparency initiatives
- Export control, trade compliance, and product stewardship obligations

To support transparency and facilitate access to product-specific documentation, Coherent provides a centralized online portal where customers and partners can:

- Search for declarations and certificates by part number or product family
- Download regulatory statements, safety datasheets, and environmental disclosures
- Contact our compliance team for product-specific questions or documentation requests

Compliance Portal: www.coherent.com/company/environmental

Compliance Contact: productstewardship@coherent.com

Coherent continuously monitors global regulatory developments and updates its documentation accordingly. For region-specific requirements or additional support, please contact us through the portal or the email listed above.

Appendix E: Service and Support

This section provides information about technical support, service and shipping instructions.

E.1 Technical Support

Coherent provides telephone and web-based technical assistance as a service to its customers and assumes no liability for any injury or damage that can occur at the same time with such services.

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

Be prepared to provide the following information to the Product Support Engineer responding to the request:

- The unit model or part number
- Laser head serial number
- A description of the problem
- Any corrective steps that have been attempted

E.1.1 Support in the USA and North America

Should any difficulties with the unit be experienced or for product or technical information, contact Coherent as follows:

- By email: LSMservice@coherent.com
- Website: www.Coherent.com

For further assistance, please contact Coherent Technical Support:

- By phone: (800) 343-4912 or 1-(503)-454-5700 outside the U.S.

Telephone coverage is available Monday through Friday (except U.S. holidays and company shutdowns). Inquiries received outside of normal office hours will be captured by our automatic answering system and calls will be quickly returned the next business day.

E.1.2 International Support

If located outside the U.S., visit www.Coherent.com for technical assistance, or contact your local Service Representative directly:

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

On the Coherent website, contact information (telephone numbers and addresses) for Service Representatives worldwide is provided.

E.2 Obtain Service

To obtain product 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) as instructed in "Product Shipping Instructions" next.
- Ship it to the address specified by the Company, with shipping prepaid. back to Coherent in conjunction with recalibration and recertification.
- Coherent shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve (12) months of time of sale or during an extended 12-month warranty period.

E.3 Product Shipping Instructions

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

To prepare a product for shipping to Coherent:

1. Contact Customer Service 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 that was received from Coherent Customer Service. Pack this tag inside the box.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. Using the original shipping and packaging materials, pack the product.
5. Seal the shipping carton with shipping tape or an industrial stapler.
6. Add the RMA number that was received from Coherent Customer Service to the shipping label on the outside of the box. Ship the product to one of the following addresses:

USA

Coherent Laser Measurement and Control Service Center
Attn: (your RMA number)
27650 SW 95th Avenue
Wilsonville, OR 97070

Europe

Coherent Shared Services B.V.
Dieselstr. 5 b
D-64807 Dieburg
Germany

Asia

Coherent, Inc. Japan
Atsugi Technical Center
Toda 1042-4
Atsugi, Kanagawa Prefecture
243-0023, Japan

Appendix F: Warranty

Coherent Corp. warrants the LabMax Touch Meter to the original purchaser (the Buyer) only, that the laser system, that is the subject of this sale, (a) conforms to Coherent's published specifications and (b) is free from defects in materials and workmanship.

Laser systems are warranted to conform to Coherent's published specifications and to be free from defects in materials and workmanship for a period stated in the sales agreement.

F.1 Responsibilities of the Buyer

The buyer is responsible for providing the appropriate utilities and an operating environment as outlined in the product literature. Damage to the laser system caused by failure of buyer's utilities or failure to maintain an appropriate operating environment, is solely the responsibility of the buyer and is specifically excluded from any warranty, warranty extension, or service agreement.

The Buyer is responsible for prompt notification to Coherent of any claims made under warranty. In no event will Coherent be responsible for warranty claims made later than seven (7) days after the expiration of warranty.

F.2 Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from:

- components and accessories manufactured by companies, other than Coherent, which have separate warranties
- improper or inadequate maintenance by the buyer
- buyer-supplied interfacing
- operation outside the environmental specifications of the product
- unauthorized modification or misuse
- improper site preparation and maintenance or

- opening the laser head housing

Coherent assumes no responsibility for customer-supplied material. The obligations of Coherent are limited to repairing or replacing, without charge, equipment which proves to be defective during the warranty period. Replacement sub-assemblies may contain reconditioned parts. Repaired or replaced parts are warranted for the duration of the original warranty period only. Our warranty does not cover damage due to misuse, negligence or accidents, or damage due to installations, repairs or adjustments not specifically authorized by Coherent.

Warranty applies only to the original purchaser at the initial installation point in the country of purchase, unless otherwise specified in the sales contract. Warranty is transferable to another location or to another customer only by special agreement which will include additional inspection or installation at the new site. Coherent disclaims any responsibility to provide product warranty, technical or service support to a customer that acquires products from someone other than Coherent or an authorized representative.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED, AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Appendix G: Extended Warranty

G.1 Extended Warranty

Coherent, Inc. (the “Company”) offers original purchasers (the “Customer”) purchasing laser power and energy meters and sensors products (“Products”) an extended twelve (12) month Warranty program, which includes all parts and labor.

To qualify for this Warranty, a Customer must return the Product to the Company for recalibration and recertification.

- The Company will re-certify the Product, provide software upgrades, and perform any needed repairs, and recalibrate the Product, for a fixed service fee (as established by the Company from time to time and in effect at the time of service).
- If the product cannot be re-certified due to damage beyond repair, parts obsolescence, or other reasons, the Customer may be informed that an Extended Warranty program is not available for the Product.

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

Glossary

°C	Degrees Centigrade or Celsius
°F	Degrees Fahrenheit
Ω	Ohm(s)
μ	Micron(s)
μm	Micrometer(s) = 10 ⁻⁶ meters
μrad	Microradian(s) = 10 ⁻⁶ radians
μsec	Microsecond(s) = 10 ⁻⁶ seconds
1/e ²	Beam diameter parameter = 0.13534
AC	Alternating current
Amp	Ampere(s)
APC	Angle physical contact
Application Protocol	A set of application defined commands and replies used to implement a system of cooperative devices
Automatic Send Data Control	An optional hardware feature that is useful to control enable/disable of transmit enable line of RS-485 transceiver
BNC	Type of connector
Broadcast Message	Message sent by a master device and received by all connected slave devices
BUSMGMT	Message is a bus management message.
CCB	Coherent Connection Bus, a RS-485 communication bus
CDRH	Center for Devices and Radiological Health
cm	Centimeter(s)
CW	Continuous wave
DC	Direct current
DDL	Direct diode laser
Destination Address	Address of the recipient device for a message
DHCP	Dynamic Host Configuration Protocol. A protocol that provides a means to dynamically allocate IP addresses to computers on a local area network.
DLE	Data link escape
EOM	A two-byte sequence indicating the end of a message packet
ESD	Electrostatic discharge
ETX	End of message data
FC	Fiber-connector
FP	Fiber pigtail

LabMax Touch Meter Operator's Manual

g	Gram(s) or earth's gravitational force (gravity)
GUI	Graphical user interface
Hz	Hertz or cycles per second (frequency) (= 1/pulse period)
IEC	International Electrotechnical Commission
IR	Infrared (wavelength)
I/O	Input/output
IP	Internet Protocol Address
PTJ	Pulsed-Thermopile-Joules
kg	Kilogram(s) = 10^3 grams
kHz	Kilohertz = 10^3 hertz
kOhm	Kilohm(s) = 10^3 ohms
LCD	Liquid crystal display
LED	Light emitting diode
m	Meter(s) (length)
mA	Milliamp(s) = 10^{-3} Amperes
mAmp	Milliampere(s)
Master	Controlling device which manages bus direction, assigns device addresses, and generally the source for all application protocol command initiation
MHz	Megahertz = 10^6 hertz
mm	Millimeter(s) = 10^{-3} meters
mrاد	Milliradian(s) = 10^{-3} radians (angle)
ms	Millisecond(s) = 10^{-3} seconds
mV	Millivolt(s)
MVP	Modulation and variable power
mW	Milliwatt(s) = 10^{-3} Watts (power)
NA	Numerical aperture
nm	Nanometer(s) = 10^{-9} meters (wavelength)
Nm	Newton meter (torque)
OEM	Original equipment manufacturer
OPSL	Optically-pumped semiconductor laser
oz·in.	Ounce inches
PIP	Port Identification Pin, a signal pin located on the cable connecting the slave device to the CCB
PMP	PowerMax Pro
PPS	Pulses per second
rms	Root mean square (effective value of a sinusoidal wave)
RMA	Return material authorization
SCPI	Standard commands for programmable instruments. This standard, developed by Hewlett-Packard, complements IEEE 488.2 and is promoted by the SCPI Consortium .
SDR	Shrunk delta ribbon. This connector type is used on the back panel of the OBIS Laser for the full-feature I/O cable.

Slave	Device which receives and interprets messages and responds as required
Source Address	Address of the device transmitting a message
Standard Message	Message sent from the master device to a specific slave device address
SRCCCB	Message originated from CCB stack.
SRCCONT	Message originated from master device (controller).
STX	Start of message data
System Protocol	A set of predefined bus management commands and responses used by CCB protocol stacks for set-up and management of the bus
TEC	Thermoelectric cooler
TEM	Transverse electromagnetic mode (cross-sectional laser beam mode)
TTL	Transistor-transistor logic
UART	Universal asynchronous receiver/transmitter
UFC	Ultra-flat contact
UV	Ultraviolet
V	Volt(s)
VAC	Volts, alternating current
VDC	Volts, direct current
W	Watt(s) (power)

Index

Symbols

74, 170, 202, 208

A

Acquisition Settings 49
 Analog Output 92
 Analysis
 Pulse Analysis 145
 Analysis Settings 57

B

Battery 15
 Dispose 230

C

Commands
 Trigger 219
 Communications
 Settings
 Ethernet 47
 Communication Settings
 RS-232 210
 Cursors 122
 Manage display cursors 122
 Show tracking cursor 126

D

Data
 Capture Log File 118
 Description
 Accessories 10
 Back panel 13
 Battery 15
 Dimensions 21
 Features 8
 Front Panel 12
 Measurement ranges 24
 Ports 16
 Specifications 23

E

Electromagnetic Compliance (EMC) 242
 Erase
 Secure Erase Data 74
 Errors
 Measurement 224
 Ethernet
 Communication Settings 208
 Export
 Log File 118
 Export Control Laws 4
 External
 Trigger input 89

 Trigger output 91
 External Control 157
 Alarms and Limits 179
 Binary Data Transfer 172
 Buffers and Data Flow 173
 Channels 157
 Communication Settings 208
 Ethernet 208
 Data Commands 170
 Demo Source 177
 Handshaking 170
 Instrument Information 211
 Power Management 212
 Probe Information 213
 Protocol 158
 Remote Lockout 213, 214
 SCPI Common Commands 202
 Statistics Commands 203
 System Commands 207
 Trigger Source 220
 external trigger 17, 89

F

Firmware
 Update 73, 74
 Upgrade, host command 202

H

Hardware
 External trigger input 89
 External trigger output 91
 Hazards 231
 High-speed
 Measurement 100
 Histogram 75
 Settings 69
 View 75
 Host Commands
 Alarms and Limits 179
 Results 204
 Table of Host Commands 158

I

Indicators
 Trigger 41
 Input, external trigger 89
 internal trigger 17, 89

L

Laser safety 231
 Log file
 Capture Data 118
 Export 118

Save 117

M

Measurement Ranges 24

Measurements

 Touchscreen 94

 Basic 95

 High-speed 100

 Pulse Analysis 105

 Pyroelectric 111

 With Software

 Basic Power 126

 Capture Pulses 148

 Display Statistics 150

 High-speed 134

 Pulse Analysis 145

 Pyroelectric Energy Measurement 152

 Snapshot 138

N

Nominal Ocular Hazard Distance (NOHD) 233

O

Optical Safety

 NOHD 233

Output

 Analog 92

 External trigger 91

P

Power Management 212

Probe Information 213

Protocol

 External Control 158

Pulse Analysis 58, 145

 Perform 105

 Settings 58

Pulses

 Capture 148

Pyroelectric

 Measurement 111

R

Remote Lockout 214

Reset

 Restore Default Settings 74

Restore

 Default Settings 74

Results

 Host Commands 204

RS-232 210

S

Safe Mode 223

Safety

 electrical 231

 Hazards 231

Laser 231

safety 231

Settings

 Acquisition 49

 Communication 47

 Configure Settings 44

 General Settings 47

 Histogram 69

 Statistics 68

 System Information 63, 64

 Trend View 65

 Tuning View 68

Signal words used in this manual 4

Snapshot

 Measurement 138

Specifications 23, 24

Statistics

 Display 116, 150

 Host Commands 203

 View 76

Statistics Settings 68

System Information 71, 72

T

Temperature 24

Trend View 65

 Settings 65

Trigger

 Commands 219

 Indicators 41

 Source, external control 220

Troubleshooting 223

 Measurement Errors 224

 Safe Mode 223

Tuning View 77

 Settings 68

U

User Interface 39

 Information Bar 40

 Quick Access Toolbar 42

W

Warranty

 Extended warranty 249

 Responsibilities, of the buyer 247

Warranty, Limitations of 247

Wavelength 54

 Select 54

Z

Zero

 Zero the Meter 224



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