PM100D2, PM100D3
Optical Power and Energy Meter Consoles

User Guide



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Chapter 1 Introduction

1.1 Intended Use

The PM100Dx optical power and energy meter consoles are designed for laboratory and field service use to measure the optical power from coherent and incoherent light sources in combination with compatible and suitable external optical power or energy sensors. The devices may not be used or integrated into equipment that is applied in pharmaceutical, medical, or military applications.

The product may only be used in accordance with the instructions described in this manual. Any other use will invalidate the warranty.

1.2 Explanation of Safety Warnings

⚠WARNING Warning indicates a hazard with a medium level of risk that, if not avoided, could result in death or severe injury.

NOTICE Indicates information considered important, but not hazard-related, such as damage to the product.

CE UKCA The CE marking on the product is the manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety, and environmental protection legislation.



The wheelie bin symbol on the product, the accessories or packaging indicates that this device must not be treated as unsorted municipal waste but must be collected separately.

1.3 Description

The PM100Dx Optical Power and Energy Meter Consoles are simple to use, fast tools that allow power measurements of optical signals and signal power trends. They also feature convenient data storage and remote connectivity. Each unit has a long-lasting rechargeable battery, which can be recharged via a USB-C connector or wirelessly (Item # PM100D3 only), ensuring the power meter can be operated continuously throughout an extended workday.

The housing features a foldable stand, rubber protective elements, a recessed connection plane, and a 1/4"-20 thread for mounting.

The PM100D3 device also supports thermal power and position sensors, features Bluetooth LE connectivity, and an embedded inductive wireless charging coil.

1.4 Technical Data

1.4.1 Specifications

All technical data are valid at 23 ± 5 °C and 45 ± 15% relative humidity (non-condensing).

Item #	PM100D2	PM100D3
Display and Operation		
Display Type	3.5" IPS 640 x 480 px (Full Color)	
Display Screens	Numerical with Bar Graph, Line Graph, Statistics, Simulated Analog Needle	Numerical with Bar Graph, Line Graph, Statistics, Simulated Analog Needle, Pass/Fail, Scope
Viewing Area	71.0 mm x 53.3 mm	
Refresh Rate	50 Hz	
Audio	Piezoelectric Speaker	
Sensor Interface		
Compatible Sensors	Thermal and Photodiode Power Sensors, Pyroelectric Energy Sensors	Thermal and Photodiode Power Sensors, Thermal Position & Power Sensors, Pyroelectric Energy Sensors
AD Converter	16-bit	
Sampling Speed	1 kS/s	1 kS/s, 100 kS/s in Burst and Scope Modes
Trigger	Adjustable, 3 - 90% of Each Measurement Range for Pyro and Photodiode in Peak Mode	Adjustable, 3 - 90% of Each Measurement Range for Pyro and Photodiode in Peak Mode, or External Trigger
Connector	DB9F - Left Side	
Temperature Control	NTC Thermistor	
Temperature Range	-10 to 80 °C	
Analog Outputs		
Signal	Amplified Input Signal or 12-bit DAC Corrected Input Signal	Amplified Input Signal, 12-bit DAC Corrected Input Signal, or 14-bit DAC Corrected X-Y Position
Voltage Range	0 to 2.5 V	0 to 2.5 V (Power), -2.0 to 2.0 V (Position)
Accuracy	±3%	
Bandwidth	Up to 100 kHz, Dependent on Sensor and Settings	
Connector	SMA - Left Side	SMA - Left Side, AUX Connector - Rear

Item #	PM100D2	PM100D3
AUX Input / Output		
Function	N/A	4 GPIO, AN OUT for Power (Analog Input Signal and 12-bit DAC) and Position Sensor (14-bit DAC), I2C, UART, and Analog and Digital Supply Voltages
Interfaces and Accessible Memory		
Data Storage	8 GB eMMC (Accessible via USB)	
Interfaces	USB 2.0 Full Speed	USB 2.0 Full Speed / Bluetooth Low Energy / UART
Connector	USB-C - Left Side	USB-C - Left Side, AUX Connector - Rear
Photodiode Sensor Measurement		
Measurement Ranges	21 Current Ranges: 2 nA - 10 mA	
	Ranges Selectable in W or A	
Accuracy	±0.2% of Full Scale (>400 nA - 10 mA)	
	±0.5% of Full Scale (2 nA - 400 nA)	
Digital Resolution	1 pA / Responsivity Value (A/W)	
Bandwidth	DC - 100 kHz, Dependent on Sensor and Settings	
Thermal Sensor Measurement		
Measurement Ranges	9 Voltage Ranges: 2 mV - 1 V	
	Ranges Selectable in W or V	
Accuracy	±0.5% of Full Scale (>4 mV - 1 V) ±1% of Full Scale (2 mV - 4 mV)	
Digital Resolution	1 µV / Responsivity Value (V/W)	
Bandwidth	DC - 10 Hz, Dependent on Sensor and Settings	
Pyroelectric Sensor Measurement		
Measurement Ranges	13 Voltage Ranges: 20 mV - 200 V	
	Ranges Selectable in J or V	
Accuracy	±0.5% of Full Scale (20 mV - 200 V)	
Digital Resolution	10 µV / Responsivity Value (V/J)	
Max Repetition Rate	50 kHz	
Thermal Position and Power Sensor Measurement		
Power Ranges	N/A	9 Voltage Ranges: 2 mV - 1 V
Position Accuracy	N/A	Sensor Dependent
Digital Position Resolution	N/A	1 µm

Item #	PM100D2	PM100D3
Power Management		
Battery	Li-Polymer, 3.7 V, 2300 mAh	
Charger / DC-Input	5 V / 1 A (USB-C)	5 V / 1 A (USB-C or Wireless Charging)
Dimensions and Mounting		
Dimensions (L x W x H)	163.0 mm x 98.4 mm x 35.0 mm (6.42" x 3.87" x 1.38")	
Weight	0.355 kg (0.783 lbs)	
Mounting Options	Fold-Out Stand, 1/4"-20 Thread	
Operating Temperature	0 to 40 °C	
Storage Temperature	-40 to 70 °C	

1.4.2 Main Features

Features	PM100D2	PM100D3
3.5" IPS Color Display	✓	✓
Capacitive Touchscreen	✓	✓
Physical Control Buttons	✓	✓
Rubber Protection, Foldable Stand, and 1/4-20" Post Mounting	✓	✓
Rechargeable Battery	✓	✓
Fast Charging via USB-C Connector	✓	✓
Embedded Wireless Charging Coil	×	✓
Data Storage to Internal Flash Memory	✓	✓
Internal Flash Memory Access via USB	✓	✓
Pass/Fail Analysis	×	✓
Scope Mode	×	✓
Admin / User Levels	×	✓
Physical Menu Button Configuration	×	✓
USB 2.0 Full Speed Interface	✓	✓
Bluetooth Low Energy Connectivity	×	✓
Compatible with OPM Remote Software	✓	✓
Firmware Updates via USB	✓	✓
Photodiode Power Sensors	✓	✓
Thermal Power Sensors	✓	✓
Thermal Power and Position Sensors	×	✓
Pyroelectric Energy Sensors	✓	✓
Smart Analog Output	✓	✓
Auxiliary Functions Connector	×	✓
USB Type C to Type A Cable, 2 m Long	✓	✓
Softshell Storage Bag for Console and Sensors	×	✓

1.4.3 Mechanical Drawings

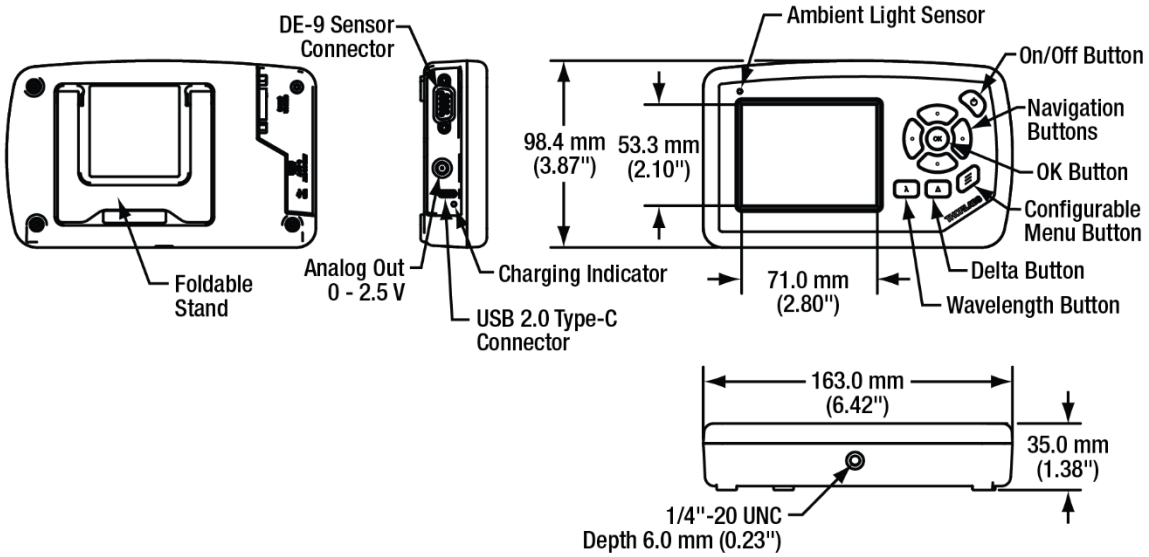


Figure 1 PM100D2 Mechanical Drawing

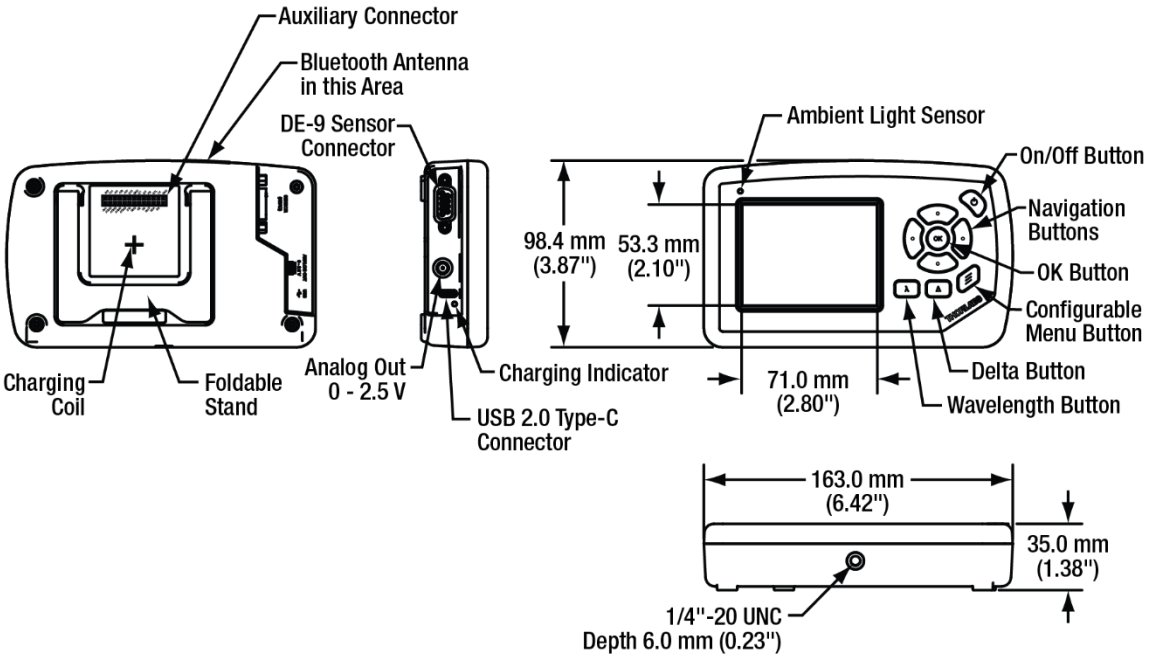


Figure 2 PM100D3 Mechanical Drawing

1.5 Pin Diagrams

1.5.1 Sensor Connector

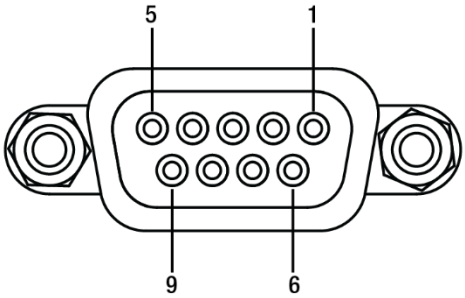


Figure 3 Pin Assignment of the Sensor Connector Jack (Female)

Pin Diagram	
Pin	**Connection**
1	+5 V. Provides a supply voltage with a 50 mA maximum drive current, protected by a self-resetting fuse.
2	EEPROM Digital I/O: Keep this pin not connected for custom sensors to avoid malfunction.
3	Photodiode Ground (Anode), Thermal and Pyro Sensor Ground, Analog Ground
4	Photodiode Cathode, Quadrant 3 for Position Sensors (PM100D3 Console Only)
5	Pyroelectric Sensor +, Quadrant 4 for Position Sensors (PM100D3 Console Only)
6	Digital Ground
7	PRESENT: NTC, 1 kΩ to 15 kΩ Resistor to Pin 3 (Analog Ground) to enable a custom sensor.
8	Thermal Sensor +, Quadrant 1 for Position Sensors (PM100D3 Console Only)
9	Quadrant 2 for Position Sensors (PM100D3 Console Only)

1.5.2 AUX Connector (PM100D3 Console Only)

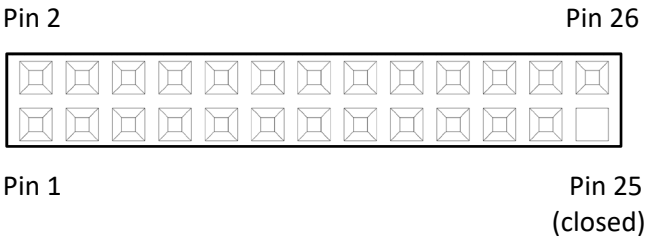


Figure 4 Pin Assignment of the AUX Connector

Pin Diagram	
Pin	**Connection**
1	-2V4: -2.4 V Negative Periphery Analog Voltage Supply, 50 mA Maximum
2	2V8: +2.8 V Positive Periphery Analog Voltage Supply, 50 mA Maximum
3, 5, 7, 9	AGND: Analog Ground
4	TH1: Configurable NTC Input
6	AO1: Analog Output, Parallel to AO SMA Connector, 0 - 2.5 V
8	AOX: DAC-Controlled Analog Outputs for X Position, ±2.0 V
10	AOY: DAC-Controlled Analog Outputs for Y Position, ±2.0 V
11	5V0: 5.0 V Digital Periphery Voltage Supply, 100 mA Maximum
12	3V3: 3.3 V Digital Periphery Voltage Supply, 100 mA Maximum, DIO, and Buses
13, 14, 19, 26	GND: Digital Ground
15, 16, 17, 18	IO1 - IO4: GPIO, or Trigger-Configurable Digital Ports, 3.3 V Logic, 5 V Tolerant
21, 22	SDA, SCL: User Accessible I2C Interface, 3.3 V Logic
23, 24	RX, TX: UART Remote Interface, 3.3 V Logic
25	Closed Pin for Polarity Protection with Extension Cable

1.6 Components

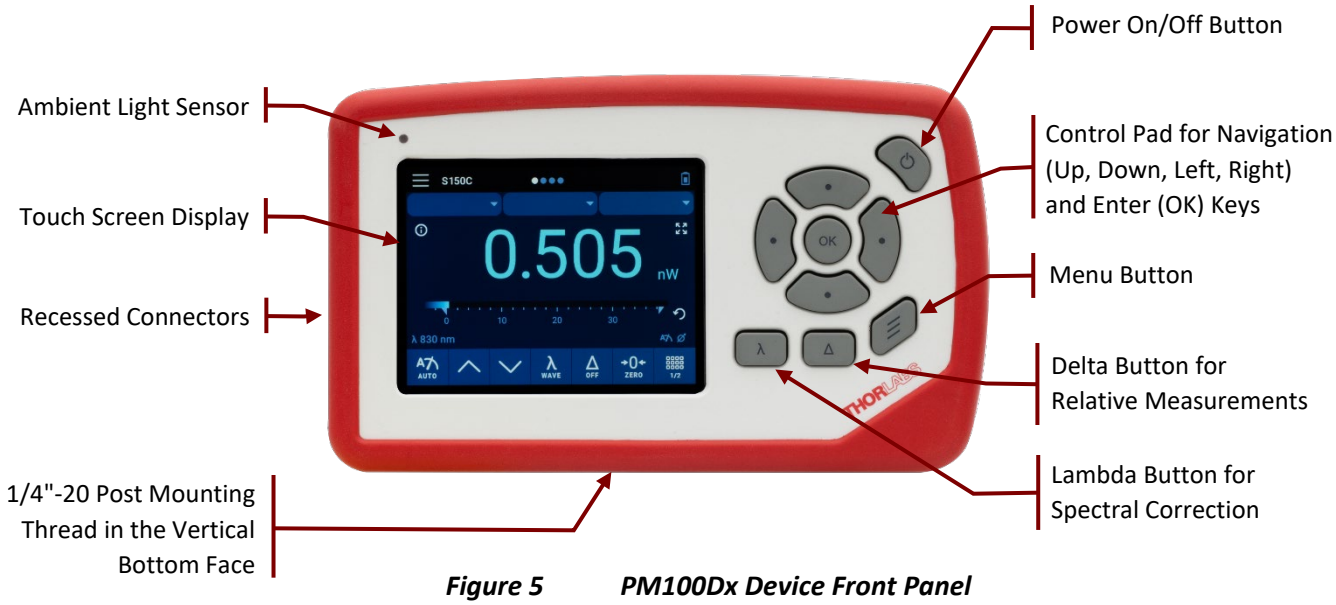


Figure 5 PM100Dx Device Front Panel

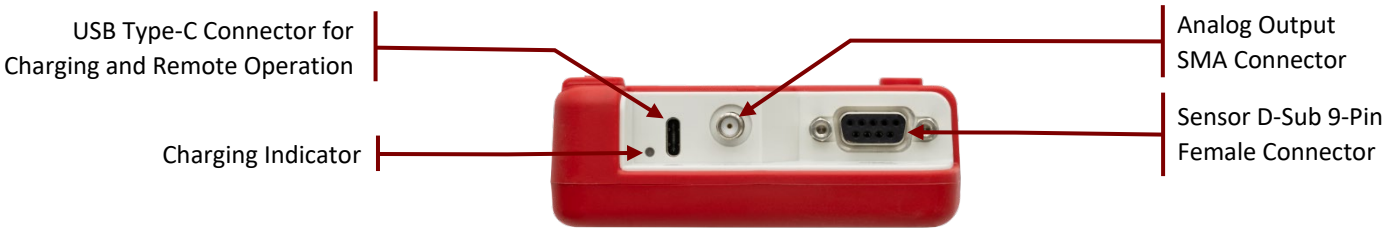


Figure 6 Recessed PM100Dx Device Connector Plane

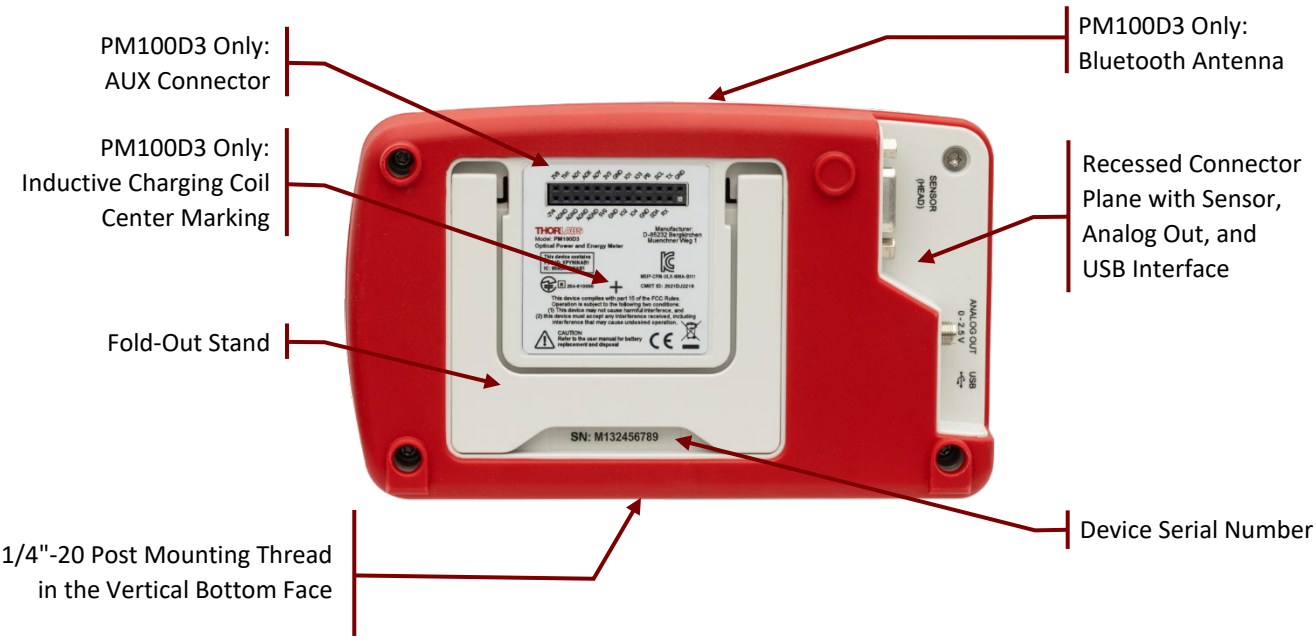


Figure 7 PM100Dx Device Back View (Picture Shows PM100D3 Device)

1.7 Simplified Declaration of Conformity

Hereby, Thorlabs declares that the radio equipment type u-blox NINA-B112 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: **https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=3341**

1.8 FCC Designation

Class B FCC Designation:
The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the respective accompanying documentation

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Users that change or modify the product described in this manual in a way not expressly approved by Thorlabs (party responsible for compliance) could void the user's authority to operate the equipment.

Thorlabs is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

Use of shielded I/O cables is required when connecting this equipment to all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

This product has been tested and found to comply with the limits according to IEC 61326-1 for using connection cables shorter than 3 meters (9.8 feet).

1.9 General Wireless Compliance Related Information

The PM100D3 device has an internal radio module with an integrated antenna to which the following information applies:

This product does not contain any wireless user serviceable components. Any unauthorized product changes or modifications will invalidate the warranty and all applicable regulatory certifications and approvals.

The module used is NINA-B112 from u-blox.

The device is designed to work in the Bluetooth® 2.4 GHz band.

The radio module can be deactivated by the user.

Hereby, Thorlabs declares that the radio equipment type NINA-B112 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: **https://www.u-blox.com/en**

US / Canada Registration Number and Labeling on the Device:

This device contains
FCC ID: XPYNINAB1
IC: 8595A-NINAB1

China Registration Number:

本设备包含型号核准代码(分别)为: CMIIT ID: 2021DJ2218的无线电发射模块。

Japanese Giteki Mark and Registration Number:

R 204-610006

Brazil Registration Number:

ANATEL
03882-16-05903

Korean KC Mark and Registration Number:

MSIP-CRM-ULX-NINA-B111

"Este equipamento opera em caráter secundário, isto é, não tem direito a proteção contra interferência prejudicial, mesmo de estações do mesmo tipo, e não pode causar interferência a sistemas operando em caráter primário."

Chapter 2 Safety

The safety of any system incorporating the equipment is the responsibility of the assembler of the system.

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly as it was designed for.

Changes to this device cannot be made nor may components not supplied by Thorlabs be used without written consent from Thorlabs.

WARNING **Explosion Warning**
The PM100Dx devices must not be operated in explosion endangered environments!

NOTICE Do not open the instrument. Apart from the battery replacement described in Section 5.6, there are no user-serviceable parts inside!

Chapter 3 Installation

3.1 Warranty Information

The precision PM100Dx devices are only serviceable if returned and properly packed into the complete original packaging including the complete shipment plus the cardboard insert that holds the enclosed devices. If necessary, ask for replacement packaging. Refer servicing to qualified personnel.

3.2 Packing List

- PM100D2 or PM100D3 Optical Power and Energy Meter Console
- USB Cable, Type-A to Type-C, 2 m Long
- Certificate of Calibration
- Quick Reference
- PM100D3 Console Only:
    - AUX Connector Extension Cable, 300 mm Long
    - Softshell Storage Bag for Console and Sensors

3.3 Installation Instructions

The PM100Dx optical power and energy meters are ready to operate out of the box. However, due to regulatory requirements, the unit will be shipped with a battery charge level of less than 25%, so it is advisable to fully charge the battery prior to first use. Connect the PM100Dx device to a compatible wall plug USB charging adapter or a PC with a USB power port using the supplied USB cable, and then allow the power meter to fully charge (usually within 2 hours).

If the PM100Dx power meter will be operated remotely, install the **Optical Parameter Monitor** software from the Thorlabs website. It comes with all of the required instrument drivers, examples, and an application to set all of the settings and to visualize or record the measurement results. It includes useful tools like a firmware update wizard, user calibration, and a laser calculator.

3.4 Connecting a Power or Energy Sensor

The PM100D2 console is compatible with any currently offered photodiode, thermal, or pyroelectric C-series power or energy sensor. The PM100D3 console, in addition, supports Thorlabs power and position sensors.

The sensor connector location is in a recess below the upper left corner of the device. Turn the device over and gently push the "C-Series" connector, with the Thorlabs logo facing out, into the D-Sub socket until it clicks into place. Sensors can be hot-swapped.

The meter will automatically detect the connected sensor and configure the best possible default setting after powering on.

3.5 First Measurements

Some hints to perform accurate laser power measurements:

- Press the power on/off button to turn on the PM100Dx power meter console.
- Navigate to the main measurement screen – this is the out-of-the-box default screen.
- Set the wavelength of your laser light source.
- Turn the unit to auto-ranging or select an appropriate measurement range.
- Perform a zeroing with the detector covered and any lasers switched off.
- Uncover the sensor, turn on the laser, and view the displayed measurement result.

Chapter 4 Operation

4.1 Switching the Device On and Off

The PM100D2 and PM100D3 devices power up after pressing the power button, indicated with this symbol (⏻), in the upper right corner of the device. Release the button when the keypad illumination lights up. The unit is ready to operate after a few seconds, needed for booting up and downloading and reading the sensor spectral calibration and information. For most standard measurement applications, no additional warm-up time is required.

To turn off the instrument, press and hold the power button (⏻) for longer than 0.3 seconds and release when the display shows "shutting down". In case the unit hangs up for any reason, keep the button pressed (>1 second) until the unit is forced to shut off.

The devices are equipped with a configurable shutdown timer to extend the battery lifetime; for more details, refer to Section 4.3.3.

There is also an emergency shutdown in case of a low battery. In this case, you should recharge the battery by connecting it to a USB power supply or, for the PM100D3 console only, by placing it on a wireless inductive charging station.

4.2 Navigation with the Touchscreen and Physical Buttons

The PM100Dx devices can be operated with the touchscreen or with the physical buttons, or any combination of the two.

All screens consist of a header with access to the menu (☰), different display pages, and information symbols for battery charging state, remote interfaces, and an indication for when the internal memory is mapped to a PC. Up to six circular dots at the center of the top of the screen show the screen position in the measurement screen carousel. Within the measurement views, the header can be expanded by touching it, or a down swipe will show the current date and time, battery State of Charge (SoC), and device item #.

All measurement screens consist of a menu footer that contains up to 12 buttons, arranged in groups of six buttons and a button to the right of those for changing the footer menu buttons shown.

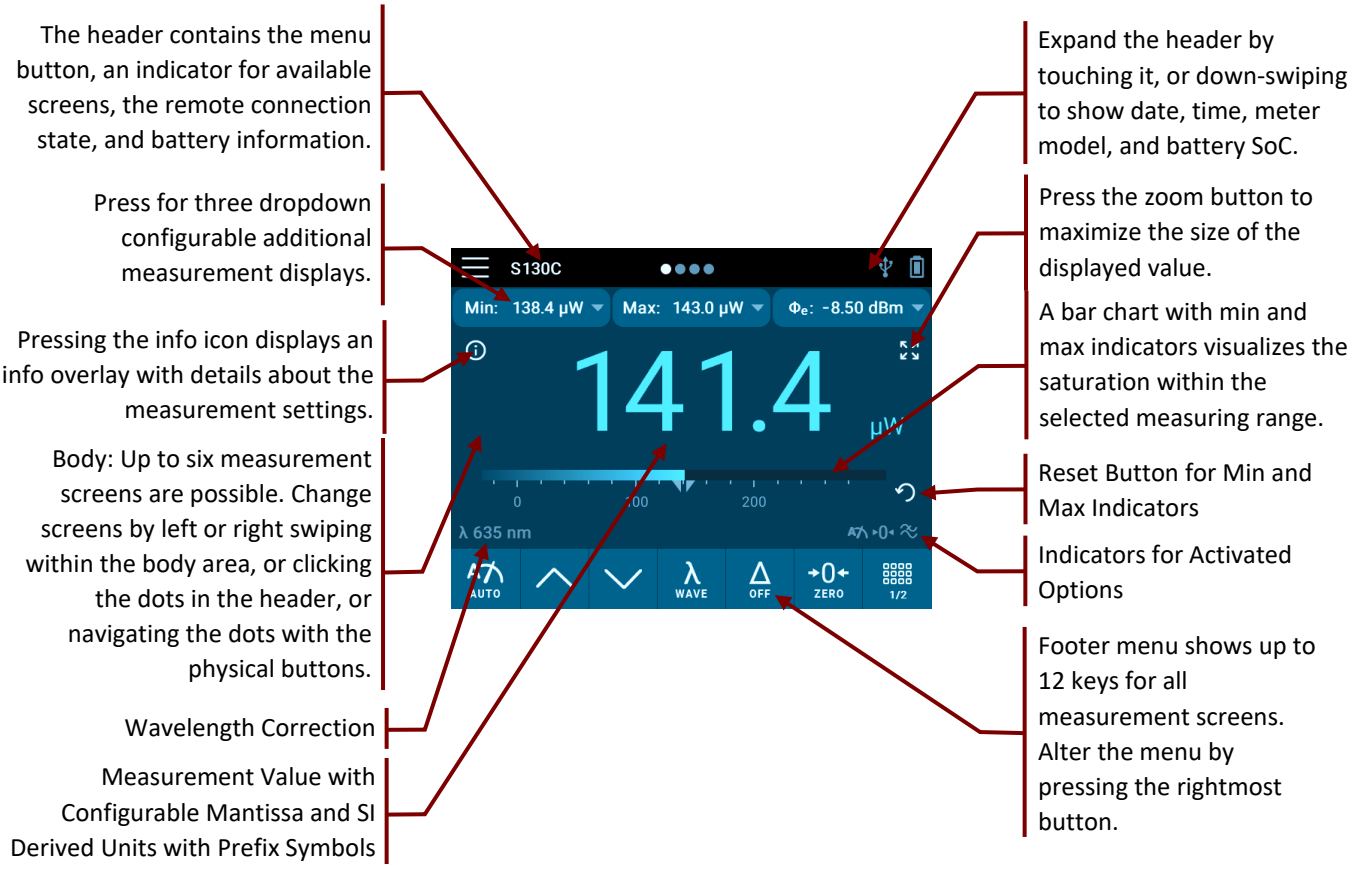


Figure 8 PM100Dx Device Numeric Measurement Screen

4.2.1 Button States

The touchscreen has multiple button styles, each with a color-coded state or behavior or frame indicator.

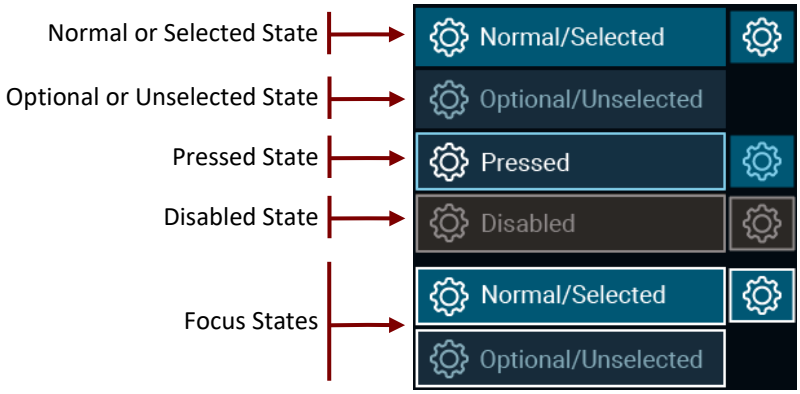


Figure 9 Button States

Focus status is only displayed when navigating with the physical buttons. The button you are currently pressing will be focused and displayed with a white border, or for the footer menu, change its color. The white frame, and/or the different color, disappears after three seconds of inactivity; it can be reactivated by pressing the OK button.

4.2.2 Navigating Measurement Screens

There are three ways to switch between the measurement views arranged horizontally in a carousel order.

- Perform a swipe gesture to the left or right within the measurement window body to navigate to the next view.
- Click on the horizontal dots in the header bar to change the screen to the next right view.
- Use the physical arrow buttons to navigate to the dots in the header and they will receive focus, indicated by a frame around them. Press the OK button and the frame will appear bold; then use the arrow left and right keys to swap the views. The frame will disappear after three seconds of inactivity.

4.2.3 Navigating the Footer Menu

For fast access to the most essential functions, there is a horizontal menu row at the bottom of the display. It consists of up to seven buttons; six buttons on the left, depending on the view, with a seventh button on the right that can be used to swap the six buttons shown on the left by touching or navigating the outermost right (seventh) button. An indicator on this button shows whether page one or two is currently active.

- Press the outermost right button to swap between the two menu button rows.
- Use the physical up or down buttons to navigate to the footer menu. The active button will get highlighted and can be operated with the OK button.

4.2.4 Expanding the Header Line

Touch, or swipe down the header line (or navigate to the battery symbol and press OK) to show the following additional information:

- Date and Time, Controlled by the Embedded Real-Time Clock.
- State of Battery Charge in Percent

- Device Type and, for the PM100D3 Console, the User Information
- Optional Information, such as Ambient Temperature and Humidity (PM100D3 Console Only, With Suitable Sensor)

Close the information window by swiping up or touching the additional information screen again.

4.2.5 Screen Lock

The touchscreen and physical button functions can be locked to avoid accidental inputs. Simultaneously press the physical menu and arrow right keys to lock the touchscreen and physical buttons from use. When the touchscreen and physical button functionality is deactivated, a touch lock sign will appear in the header row between the menu icon and the dot icons that indicates the number of available measurement views. Locking the screen in any menu will set the device to the last active measurement screen.

To re-activate the touchscreen and physical buttons, press the physical menu and arrow right keys simultaneously. The touchscreen lock will also be disabled after each restart of the device.

It is also possible to completely lock the touchscreen and physical buttons by simultaneously pressing the physical menu and arrow up keys – a lock sign is shown in the header – unlock by pressing the menu and up keys again, or restarting the instrument.

4.2.6 Screenshot Function

By simultaneously pressing the physical Down and Menu buttons, it is possible to capture an image of the current view and automatically store it to the device's internal memory. The bitmap file can be downloaded via USB connection, after mapping the internal flash memory to the connected PC. Browse to the SCREENSHOTS folder in the displayed PM100Dx device drive.

4.3 Device Menu Structure

Enter the top-level menu by pressing the physical menu button or the menu icon in the upper left corner of the touchscreen display. To exit the menu, press the physical menu button again, or, on the touchscreen, press the left arrow button at the top left (goes up one level) or the home button on the top right (exits to the last measurement screen).

The menu is divided into three sections: MEASURE, DEVICE, and TOOLS. Each section leads to sub-menu pages, partially grouped with tabs, providing a good overview and easy access to all settings, information, and tools. To browse to the next sub-menu page, use the arrow on the lower right side of the menu (see Figure 11)

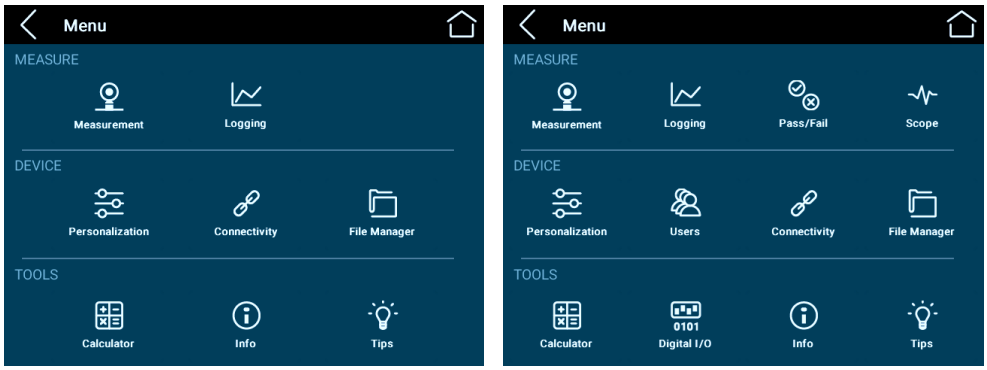


Figure 10 PM100D2 (Left) and PM100D3 (Right) Top-Level Menu Screens

4.3.1 Measurement

The measurement menu gives an overview of all the measurement settings that depend on the connected sensor. A complete configuration can be set up here, or on the measurement screens, using the footer menu buttons. For a better overview and to avoid scrolling, the menu is divided into two pages that can be navigated using the arrow keys in the footer of the menu window. The menu entries will vary with different sensors. When entering the menu, the sensor settings tab is shown. There are three more tabs to configure the beam parameters, the analog output, and the information on the connected sensor.

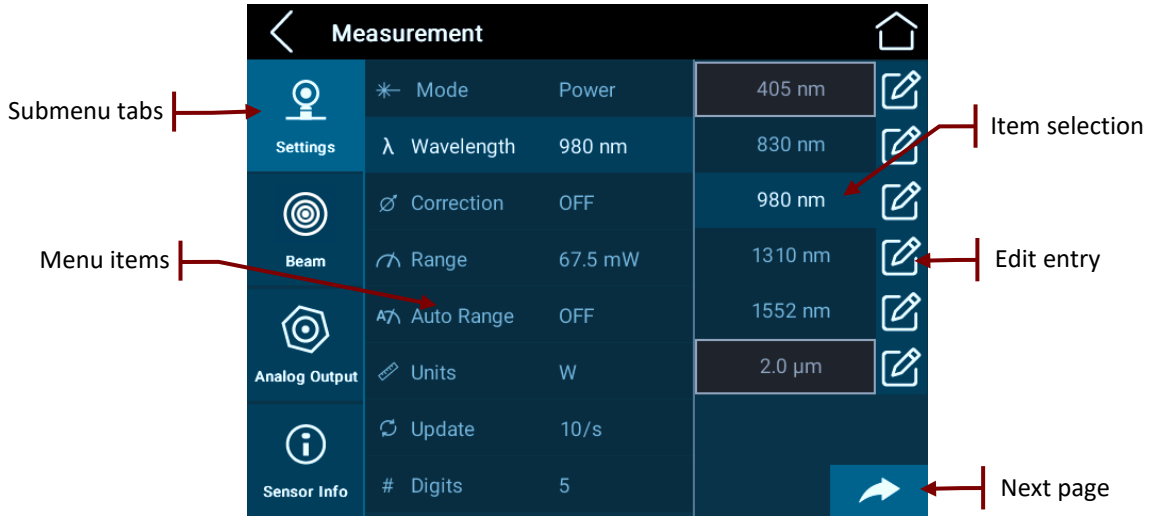


Figure 11 Measurement Menu – Sensor Settings Page 1

Sensor Settings Page 1

✳ Mode: Toggles between power and irradiance measurements.

λ Wavelength: Shows the selected wavelength setting. Pressing the entry will open a new column with up to six preconfigurable wavelength settings. Clicking on an entry that matches the sensor wavelength range will take this setting and return to the measurement screen.

By pressing the edit button, the correction wavelength can be adjusted within a number keypad window. Within this menu it is also possible to load a lamp spectrum that will be weighed with the spectral sensor response and to read the corrected power output for broadband sources.

⌀ Correction: Allows entry of a value in dB for attenuation or gain, and in percent for transmission, to compensate for external optical elements. It is also possible to load a complete transmission spectrum.

Range: Shows the actual measurement range. Press the option and a spinner-based control will open on the right side to select between up to 21 ranges.

Auto Range:	Toggle between manual and auto-ranging. Please note that auto-ranging might slow down the measurement, especially with modulated signals.
Units:	Select between a linear measurement representation in W or a logarithmic representation in dBm, or use the sensor base units of A or V.
Update:	Sets the update rate, in combination with an averaging of the displayed measurement value between 1/s with 1000 samples averaging, 3/s with 333 samples averaging, or 10/s with 100 samples averaging.
# Digits:	Sets the measurement value representation from three to five significant digits, related to the full-scale measurement range.

Sensor Settings Page 2

Δ Delta Mode:	Configures relative measurements in absolute power units or in percent.
Analog Filter:	The analog filter restricts the sensor's frequency bandwidth with an analog low-pass filter down to 16 Hz for all measurement ranges.
Acquisition:	The PM100Dx device can, in combination with a photodiode sensor, detect maximum power levels using a peak detection algorithm. The acquisition menu can be set for CW beams with permanent readout, or for two kinds of peak value detection: peak mode for pulsed signals down to several µs pulses, sinusoidal or triangular signals, or top mode for rectangular signals. Both peak and top mode get armed when the signal exceeds the trigger level set in the trigger menu.
Acceleration:	For thermal sensors, it is possible to deactivate the measurement value prediction from the exponential function and sensor time constant. This can be useful for low-noise long-term measurements.
τ Time constant:	Displays the thermal sensor time constant. In adapter mode, for thermal sensors without an EEPROM, it is possible to set a value in seconds that reflects the speed of the connected sensor.
Trigger:	For proper peak detection, the trigger level should be set between 50% and 90% of the expected peak power level.

Beam – Settings

In this sub-menu it is possible to set the geometrical parameters of the incident laser beam. These settings are important for irradiance measurements and to estimate whether the power and energy densities are within the permissible range.

Shape:	Select between a circular, square, or rectangular beam shape.
Profile:	Select the beam profile between flat top, Gaussian, or hot spots, to better predict the power densities in the beam center.
Size:	Add the dimensions of the incident beam.

An information window below the settings shows the calculated results of the beam area and the coverage on the sensor surface.

Analog Output



This sub-menu configures the SMA analog output to the amplified signal, or a DAC-controlled, corrected output voltage. Further, the PM100D3 device's additional X and Y position outputs to the AUX connector are configured in this menu.

$f_{(x)}$ Function: The SMA analog output can be configured with the following options:

1. Raw signal: Voltage converted sensor signal from 0 to 2.5 V for each measurement range without any spectral correction. The meter should be set to use a fixed measurement range (auto-range off) when working with this option.

2. DAC-controlled signal in W or J: The output voltage is calculated from the measured power or energy with the entered slope parameter. The output works in auto-ranging with an update rate of 1 kHz.

3. DAC-controlled signal in dBm: This setting provides a logarithmic representation of the measured power with an update rate of 1 kHz. The limits can be adjusted with the max. range and dynamic range settings.

⎍ Slope: Enter a slope value in V/W to configure the linear DAC-controlled output. Select a slope that makes the maximum output power just below the maximum analog output voltage for the best signal resolution.

For power and position sensors (PM100D3 console only), a slope value in mV/µm can be set for the X and Y position outputs in the rear AUX connector.

⏢ Max: Set the upper limit in dBm, representing a 2.5 V output voltage. This option is shown only when the function is set to dBm.

↕ Span: Set the dynamic range in dB, and the output voltage will range from 0 V to the maximum value. This option is shown only when the function is set to dBm.

Sensor Information



The sensor information tab shows the sensor name, serial number, type, wavelength range, and the last date of calibration of the connected power or energy sensor. There is also a graphical representation of the spectral response or absorption.

4.3.2 Logging, Pass/Fail, Scope, and Environment

To provide fast access, the menu hierarchy here offers up to three access points via the logging, pass/fail, and scope tiles directly to the corresponding tab. The pass/fail and scope mode functionality is exclusive to the PM100D3 device. In addition, this menu provides an environment tab, which, for the PM100D2 device, allows the user to set the temperature units, and, in addition, exclusive to the PM100D3 device, allows the administration and configuration of additional connectable temperature or temperature and humidity sensors.

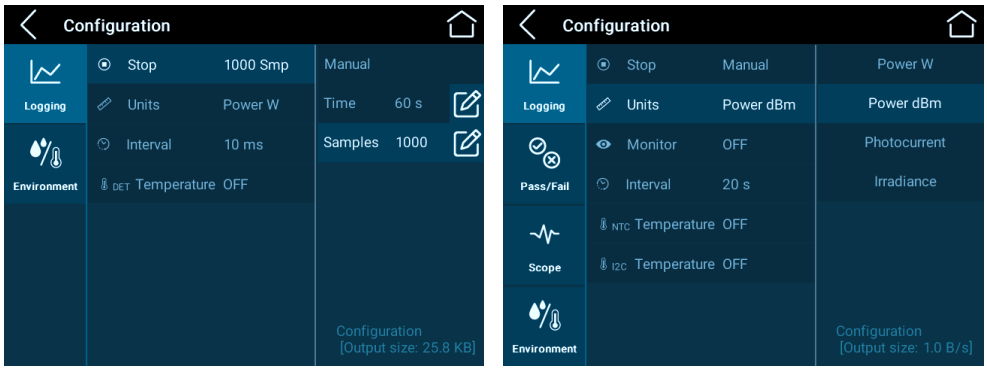


Figure 12 PM100D2 (Left) and PM100D3 (Right) Logging Configuration Menus

Logging

The PM100Dx devices allow data logging over time, and the results can be stored on the internal flash drive. The configuration of the stop criteria, time interval, and measurement units can be individually set for each user (PM100D3 device only).

Stop:	Configure the stop criteria in the number of samples, the time to record, or choose manual to stop the recording by hitting the stop button in the footer menu. The PM100D3 device also features logging control via the IO4 digital pin in the AUX connector.
Units:	Select between a linear measurement representation in W, J, the base units in A or V, irradiance or fluence units, or a logarithmic measurement representation in dBm.
Monitor:	Use the IO4 to monitor whether the logging is running (PM100D3 console only).
Interval:	The interval between data points can be set from 1 ms up to 1 second in increments of milliseconds.
Position X/Y:	Record the position reading of thermal power and position sensors (PM100D3 console only).
DET Temperature:	Record the sensor temperature along with the detector measurement.
NTC Temperature:	PM100D3 console only: Record the external NTC temperature along with the detector measurement. Selectable when an external NTC is connected and detected.
I2C Temperature:	PM100D3 console only: Record the external I2C sensor temperature along with the detector measurement. Selectable when an external I2C sensor is connected and detected.

Pass/Fail (PM100D3 Console Only)

The PM100D3 device's exclusive pass/fail analysis function allows the user to set limits for power or loss, within which the target power level should be. The absolute power limits can be set in W or dBm, while the relative loss limits always need to be set in dB or %. The settings can be individually configured for each user.

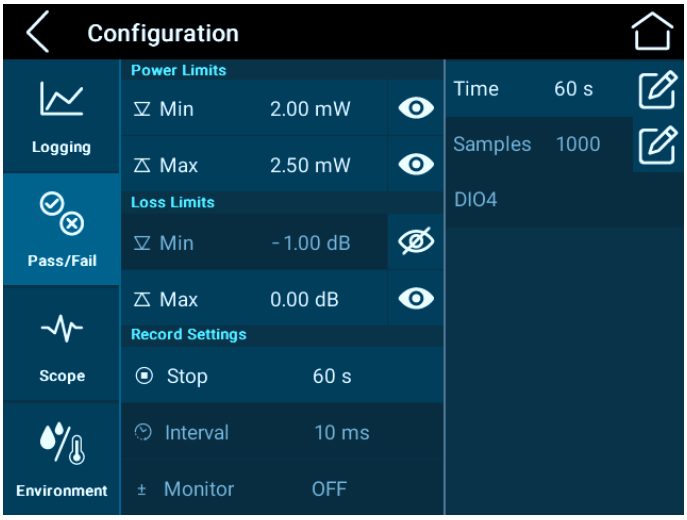


Figure 13 Pass/Fail Menu (PM100D3 Console Only)

▽ Min: Enter the minimum acceptable power level in W or dBm, or the minimum acceptable loss value in dB or %. Pressing on the value or icon will open the numerical input dialogue screen. Pressing the 👁/🚫 eye labels deactivates or activates the low limit.

△ Max: Enter the maximum acceptable power level in W or dBm; or the maximum acceptable loss value in dB or %. Pressing the value will open a numerical input dialogue window. Pressing the 👁/🚫 eye labels deactivates or activates the low limit.

For quality documentation purposes, it is possible to record the results to a file in the device's internal memory. The stop recording criteria and interval can be configured in the pass/fail menu.

⦿ Stop: Configure the stop criteria in the number of samples, the time to record, or choose manual to stop the recording by hitting the stop button in the footer menu.

Interval: The record interval can be set from 1 ms up to 1 second in millisecond increments.

Scope Mode (PM100D3 Console Only)

The PM100D3 device's exclusive feature of scope mode allows oscilloscope-like live data monitoring by displaying triggered events. This feature is only supported for photodiode-based and thermal power sensors.

↔ Time Base: Set the horizontal axis time base from 10 µs/div up to 100 ms/div; the maximum displayed time is one second.

Horizontal: Move the trigger point on the horizontal axis; the default is 0 (left side).

↕ Amplitude: Set the vertical axis from 10 nW/div to 50 W/div (sensor dependent).

Δ Offset: Move the zero line on the vertical axis; the default is -1.0 div.

Trigger

TRG Source: Select the trigger source between the sensor-generated signal and external triggering via the IO2 digital pin in the AUX connector (AUX connector is on the PM100D3 console only).

TRG Mode: Select between the trigger modes Auto and Normal. The latter will only react to real hardware trigger events, either from the sensor signal, or an external digital signal on IO2 (IO2 is on the PM100D3 console only).

TRG Level: Adjust the trigger level in percentage of the full-scale measurement range.

TRG Monitor: Link the trigger monitor signal to the IO4 digital pin in the AUX connector (AUX connector is on the PM100D3 console only).

Environment

Set the measurement units and configuration for connected temperature and/or humidity sensors. The PM100D2 display is then limited to showing the embedded sensor NTC measurements.

The PM100D3 device can handle one individual NTC or two different preconfigured I2C temperature and humidity sensors, connected to the AUX connector.

Units: Select the displayed temperature units of °C, °F, or K.

NTC

R_{25}: Enter the nominal resistor value at 25°C of the connected NTC.

β Beta: Enter the thermistor β value in K of the connected NTC.

4.3.3 Personalization

The personalization menu is divided into three tabs and allows individual preference settings, setting date and time, and the configuration of various power savings options.

Device Settings

The device settings allow the configuration to personal preferences and needs.

Language:	The device language can be set between English (default), German, Chinese (simplified), Spanish, French, and Japanese.
Scheme:	Switches the GUI display between dark, bright, and black.
Brightness:	Set the display brightness level in five steps, or put the display into auto brightness mode. The brightness level has a significant influence on the battery's operating time. To help the battery last longer, it is advisable to use the brightness dimming function in the power-saving settings. The auto brightness mode is controlled by the ambient light sensor, located above the left upper corner of the IPS TFT display.
Key tone:	When activated, each physical button operation will be confirmed with a beep sound. There is no tone on touchscreen events.
Touchscreen lock:	To prevent accidental operation, it is possible to deactivate the touchscreen. The device can then only be operated using the physical button keypad. To unlock the touchscreen, either navigate to this menu setting using the physical arrow keys or press the right arrow key and the menu button simultaneously.

Date/Time

The PM100Dx devices have a built-in real-time clock that is constantly powered as long as the battery has enough charge to provide the extremely low operating current required.

The correct date and time can be set with the date and time spinner-based controls in the menu shown below. Choose between country-specific date and time representations.

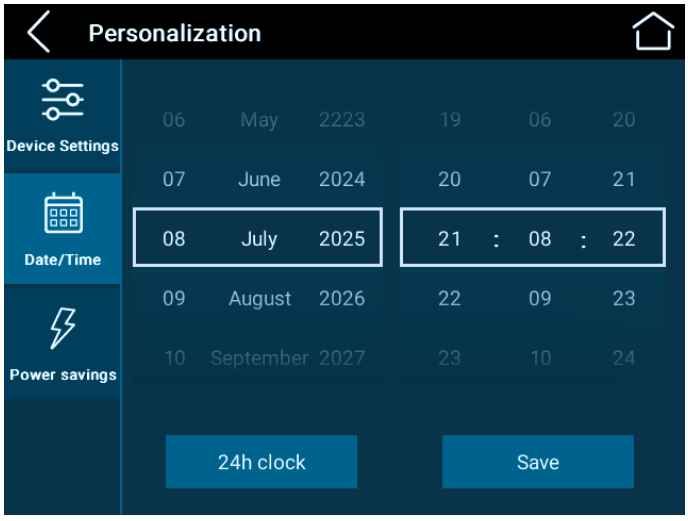


Figure 14 Date and Time Selection

Power Savings



There are individual timers for the display dimming function and the auto shut-down function. Both timers can be individually set for battery operation and external power supply operation. The timer restarts with any user interaction.

Dim Time:	Set the time until the display dims when externally powered.
Dim Time:	Set the time until the display dims for battery operation.
Shutdown:	Set the shutdown timer when the unit is externally powered.
Shutdown:	Set the shutdown timer for battery operation.

4.3.4 Users (PM100D3 Console Only)



This PM100D3 console's exclusive feature allows a unique configuration for three individual users. This is useful to tailor the instrument to specific applications, for example, preventing accidental misalignment on the production floor, or to quickly jump between predefined settings.



Admin user. This is the factory default user with all privileges enabled by default.



Ordinary users (1/2). These can be additionally activated and configured with individually set restricted settings and application views.



Edit button. Use the edit button to configure the admin and ordinary users. The edit button is protected with a 4-digit password; the factory default is 0000.

Functions with Activated Edit Mode:



Change the administrator password. A factory reset, which can only be performed by the admin user, will reset the password to the factory default 0000.



Export / Import all device settings to a JSON file (Java script object notation). This feature can be used after entering the password to apply the same settings to multiple devices.



Close the edit mode.



Activates or deactivates a user or a function.



Rename a user. Pressing the button opens an alphanumeric data entry window.



Edit Settings opens a column where the measurement, logging, pass/fail, and scope functions can be configured or deactivated.

Configure the physical menu button to a predefined action. It can be configured for one-time auto-ranging or for starting/stopping the data logging. By default, the button is configured to access the menu.

Resets a user's settings to the factory settings.

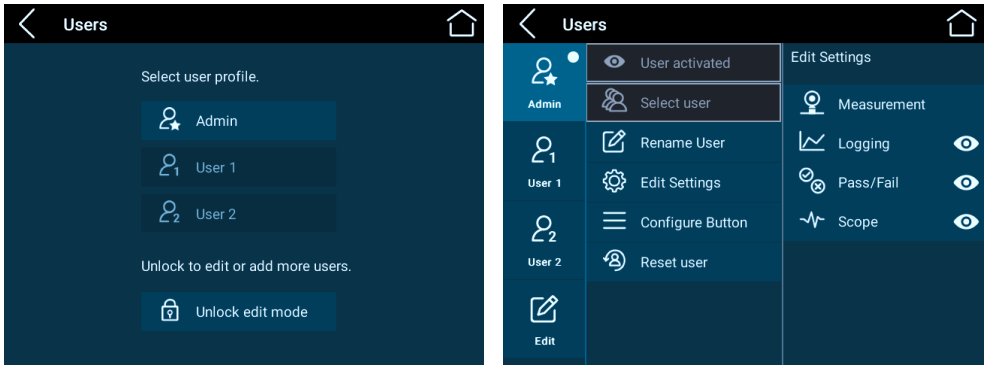


Figure 15 User Administration: Overview (Left) and Configure Users (Right)

The overview window can be used to quickly change between predefined settings. To edit the users, unlock edit mode by selecting and entering the password, then users can be activated, deactivated, renamed, or set as default (indicated with a white dot). It is further possible to configure all desired application features and measurement settings.

The two ordinary users deliberately have a very limited range of functions to avoid incorrect operation. Therefore, all important settings, such as wavelength correction, must be preset by the admin user.

4.3.5 Connectivity

The connectivity settings menu contains the configuration and information about remote control capabilities and the USB connection to the internal flash memory.

SD Memory:

By default and after each restart, the built-in NAND flash memory (eMMC) is mapped to the power meter file system to allow measurement data storage.

To access the eMMC, the PM100Dx device must first be connected to a computer via a USB cable (provided with purchase). After pressing the SD Memory menu, the icon will switch to “PC” and the connected computer will detect a flash drive with folders for data records, screenshots, and device logs. The data can be moved to the PC by dragging and dropping. After data exchange, press the SD Memory menu again to switch the memory back to the PM100Dx device.

When pressing the SD Memory menu without a connected PC, a warning will appear, and the memory will remain in possession of the power meter.

Further, a dialogue appears to switch back to the PM100Dx device memory when trying to start data logging while the memory is mapped to a PC.

Baud rate: Set the baud rate for the PM100D3 UART interface that is accessible via the AUX connector. It supports the complete remote interface command range to operate and monitor the device.

Bluetooth On/Off: For the PM100D3 device, the Bluetooth transmitter can be permanently switched off in the interface menu, for example, for radio-critical environments. The Bluetooth function is activated by default and will also be activated again after a factory reset.

QR Code: Open the OPM Mobile App and scan the QR code to connect to the PM100D3 device.

Go to Local: Press this button to lock out from remote operation and return to device operation.

USB-ID: The USB-ID consists of a vendor ID (0x1313 for Thorlabs), the device ID (0x8099 for PM100Dx device), and the device serial number.

4.3.6 File Manager

The file manager administers all user-accessible data stored in the 8 GB embedded eMMC memory.

The file manager contains all device-generated files and saved user files. The memory can be mapped to a PC via a USB connection in the connectivity menu (see Section 4.3.5). It will then be detected as a connected drive by the PC, containing all PM100Dx device folders and files. Please don't change the folder names, as they are automatically generated by the instrument.

Folders and files can be sorted in alphanumeric order or reverse alphanumeric order by clicking the "Name" field in the header.

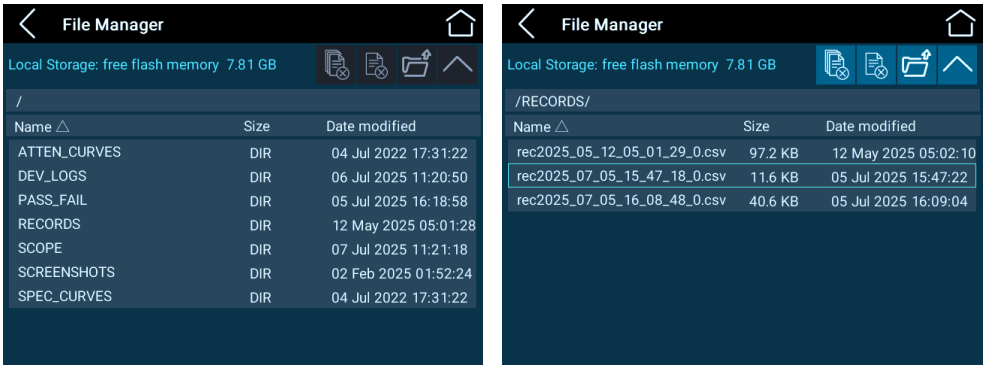


Figure 16 File Manager: Route Level and RECORDS Folder



Move one level up in the file browser.



Open the selected file – works only for specific files that are supported by the data viewer, like the logging data files, or the PM100D3 console exclusive pass/fail and scope records.



Delete the selected file after confirmation.



Delete all files within one folder after confirmation.

The following folders will automatically be generated by the PM100D2 and PM100D3 devices. In alphabetical order:

- ATTEN_CURVES CSV files with user-provided transmission data: wavelength, transmission.
- DEV_LOGS CSV files with a timestamp in milliseconds from start and device information.
- PASS_FAIL CSV files with timestamp, measurement value, and pass/fail information.
- RECORDS CSV files with timestamp and measurement value.
- SCOPE CSV files with timestamp and measurement value of one scope screen.
- SCREENSHOTS BMP files with PM100Dx screenshot images, captured by pressing the physical <Down> and <Menu> keys simultaneously.
- SPEC_CURVES CSV files with user-provided spectrum data: wavelength, relative intensity

The units come with a sample curve in each ATTEN_CURVES and SPEC_CURVES folders.

4.3.7 Calculator



There are two practical tools to calculate sensor-relevant laser beam impact parameters and to convert between physical units.

Laser Calculator



The laser calculator is useful for estimating irradiance or fluence values to prevent exceeding the maximum allowed sensor damage specifications. It supports CW and pulsed lasers; with the data wizard, the actual measurement value will be loaded and used for the calculation.

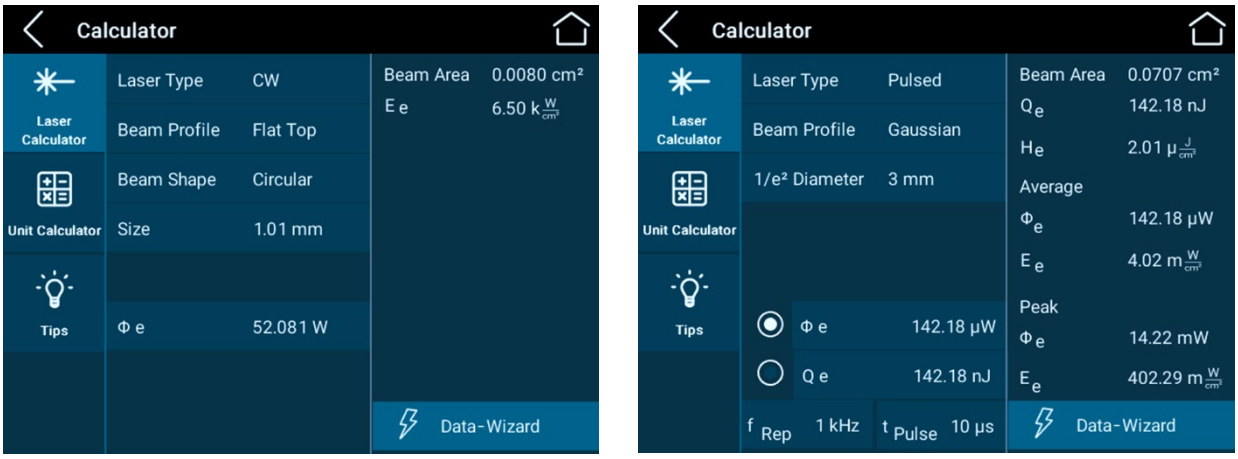


Figure 17 Laser Calculator for a CW Laser (Left) and a Pulsed Laser (Right)

Input Parameters

Laser Type: Select between CW and pulsed laser operation.

Beam Profile: Flat top will use a factor of one, Gaussian (typical laser) will use a factor of two, and hot spots profile will use a factor of three in the irradiance and fluence calculation.

Beam Dimension: Enter the incident beam dimensions; use the $1/e^2$ diameter for Gaussian beams.

Φ e: Optical (Average) Power (W)

Q e: Pulse Energy (J)

f_{Rep}: Laser Repetition Rate (Hz)

t_{Pulse}: Pulse Width (s)

Calculation Results

Beam Area: Beam area, calculated from the input parameters (cm^2).

E_e: Irradiance (W/cm^2) – only for CW laser type.

Q_e: Pulse Energy (J)

H_e: Fluence (J/cm^2)

Φ_e: Optical (Average or Peak) Power (W)

E_e: Optical (Average or Peak) Irradiance (W)

Unit Calculator

The unit calculator converts physical units for optical power, wavelength, and photon flux. Use the data wizard to load the actual measurement conditions and values.

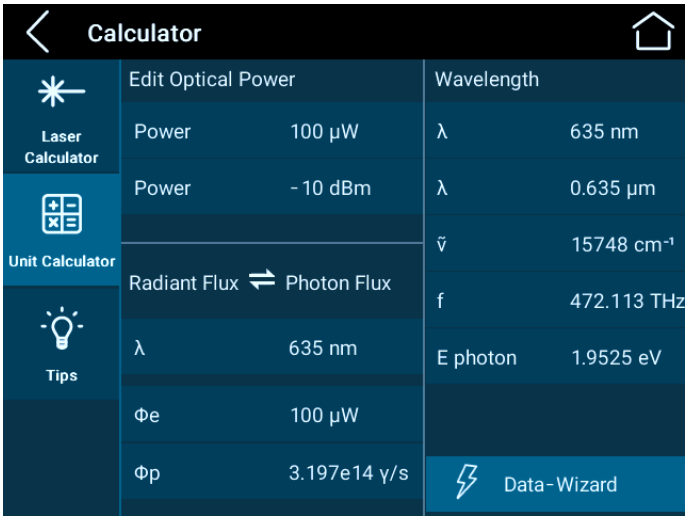


Figure 18 Unit Calculator

Input Parameters

Power:	Enter the optical power in either W or dBm. The logarithmic or linear representation will automatically update with the entry.
λ:	Enter the operating wavelength in nm or µm.
Φe:	Optical Power / Radiant Flux (W)
Φp:	Photon Flux (γ/s)

Calculation Results

ṽ:	Wavenumber (cm^{-1})
f:	Frequency (THz)
E photon:	Photon Energy (eV)

4.3.8 Digital I/O (PM100D3 Console Only)

The PM100D3 console features four free configurable digital pins, located in the AUX connector on the rear of the instrument.

These pins can be used to control periphery devices like interlocks, but also to monitor or control device-specific operations. The IO pins work with 3.3 V logic, are 5 V tolerant, and have internal pull-up resistors.

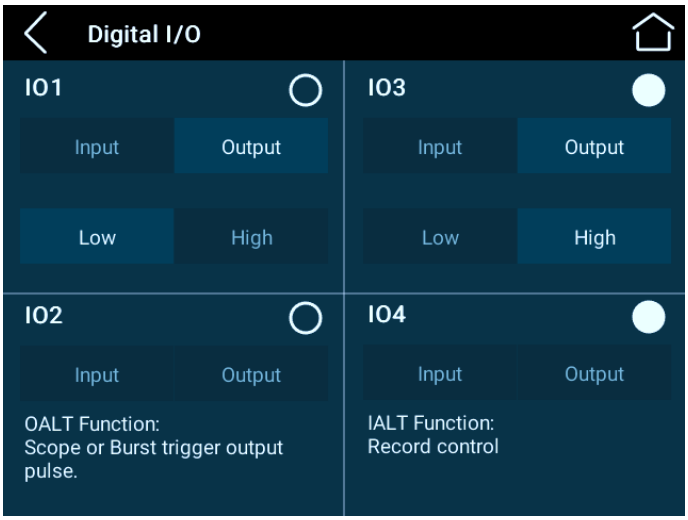


Figure 19 Digital I/O Menu

IO Functions

IO1	Toggle between Input and Output, toggle states Low and High for Output. Alternative functions settable in the scope configuration menu: Scope or burst Trigger Input.
IO2	Toggle between Input and Output, toggle states Low and High for Output. Alternative function settable in the scope configuration menu: Scope or burst trigger output pulse.
IO3	Toggle between Input and Output, toggle states Low and High for Output. Alternative functions settable in the pass/fail or analog output configuration menus: Pass/Fail Monitor (Output), Set DAC-controlled analog out to zero (Input).
IO4	Toggle between Input and Output, toggle states Low and High for Output. Alternative functions settable in the logging configuration menu: Record monitor (Output), Record control (Input).

The circle at each IO in the digital IO menu shows the current state, whether the pin is low (○), or high (●). The IALT and OALT special functions can be configured in the corresponding menus or via the remote interface.

4.3.9 Information

The Information menu shows all device and sensor-specific parameters and additionally offers device log functionality. For quick access, it is separated into three tabs.

Device

Contains the model's name, serial number, and date of last calibration, firmware and hardware revision state, battery information, free user accessible memory, and, for the PM100D3 device only, the selected user. Calibration dates older than two years are indicated in red.

There is also a button to reset the device to factory settings. (PM100D3 console: only accessible for the admin user)

Sensor



Displays all relevant data of the connected sensor, including a graphical representation of the responsivity curve(s). Calibration dates older than two years are indicated in red.

Device Log



The device records all hardware-relevant configuration events that can be stored in a log file and used to identify and track communication errors.

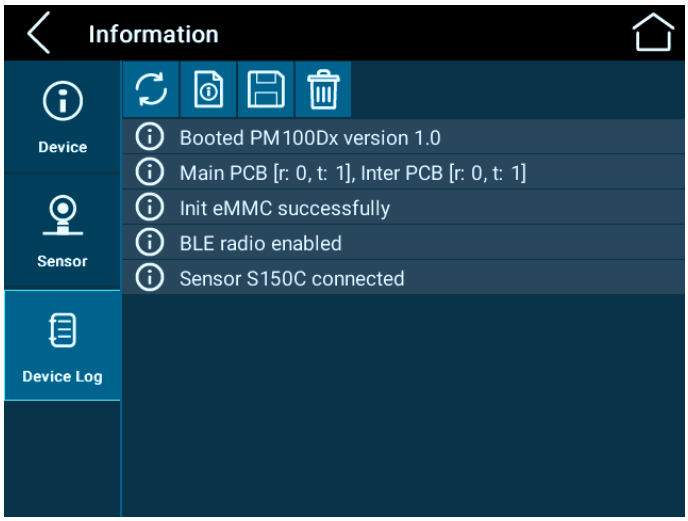


Figure 20 Device Log



Configures the device log from info log mode to debug and info mode.



Save button. Save info or debug log to internal memory.



Delete button. Delete current info or debug log.



Enter the device settings.



Enter the device information menu.



Reset button. Reset device log.

4.3.10 Tips



This menu gives useful information on some best practices for the best use of the PM100Dx devices.

It describes how to navigate the instrument, how to use the controls, and gives hints about specific functions.
There is further basic information about data recording and controlling the device via a remote interface.

4.4 Measurement Screens – Header Line

4.4.1 Navigation



Menu button. This icon is on the left side in the header line and on the physical menu button.



Back button. In submenus, the “Menu” icon swaps with an arrow pointing to the left side. The meaning is “go back” or go one level higher.



Home button. Pressing this button quits the menu and jumps to the last measurement screen.



Quit button. Quit submenu.



Scroll to the next view by touching this dots icon; or swiping the window to the left or right; or navigate to the dots icons with the arrow keys (thin outline), press OK (thick outline) is shown, use the physical left and right keys to select the desired view and hit again the OK button. The number of dots shows the number of views, arranged in a carousel order.

4.4.2 Information Symbols



The battery symbol shows the state of charge (≤15%, >15 - 35%, >35% - 75%, >75% - 95%, >95%) or charging.



Device connection to the computer USB port; green indicates active communication and data transfer, a red USB icon indicates a programming error.



The device is paired and connected via Bluetooth; the icon turns green after receiving a valid command and red when there is a programming error.



PM100D3 device only. The device is connected via the UART interface; the icon turns green after receiving a valid command and red when there is a programming error.



Device error. The error description can be found in the device log. See chapter 0



Sensor temperature error.



The touch screen is locked. Release by simultaneously pressing the physical right arrow and menu buttons.



Touch screen and physical buttons are locked. Release by simultaneously pressing the physical up arrow and menu buttons.

4.5 Numeric and Needle Measurement Screens

4.5.1 Overview

The numeric measurement screen shows a large digit numerical representation of the measured power value, supported by a bar graph display indicating the level within the selected measurement range. Above the main readout, there are three places for additional measurement values that can be configured in drop-down menus.

The analog needle representation is useful for laser tuning, fiber coupling, and all other applications for finding the maximum signal.

All settings and configurations can be set on these screens with the button carousel in the footer menu.

Clicking or navigating with the physical arrow buttons and confirming with the OK button on the information icon (ⓘ) will add an overlay with all relevant measurement configurations. Clicking the sign again will close the dialogue. There is also a zoom function that enlarges the reading to a maximum and additionally shows the configuration overlay.



Figure 21 Numeric Views With Linear (Left) and Logarithmic (Right) Representations

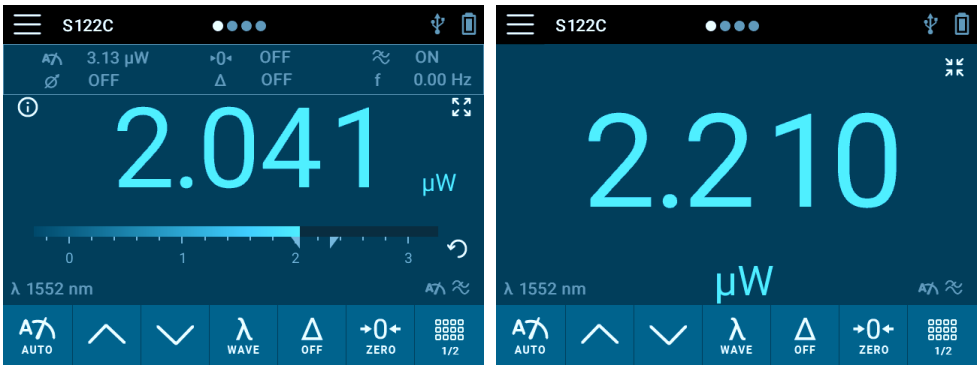


Figure 22 Numeric Views With Info Overlay (Left) and Zoom (Right)

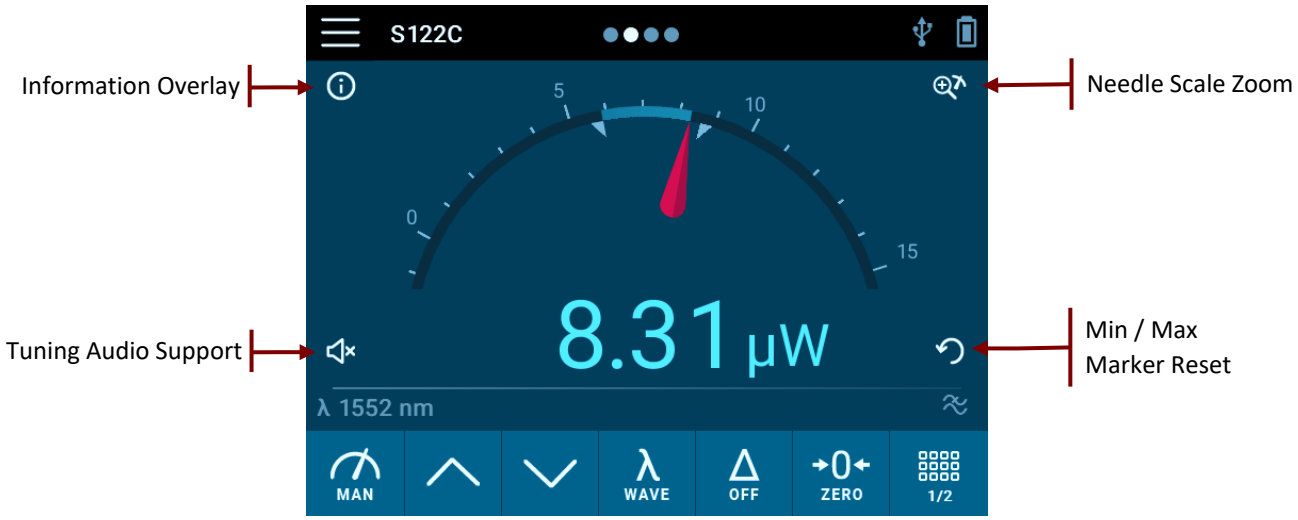


Figure 23 Needle View

4.5.2 Numeric and Needle View Footer Menu Icons and Onscreen Controls



Toggling the ranging function button. Switches between auto-ranging and manual ranging.



Up / down buttons. Turns the measurement one range more insensitive (up) or less sensitive (down). After pressing one of the arrow icons, the unit switches to manual ranging.



The auto-set function can perform a "one-time-auto-ranging" and then the instrument remains in manual ranging, or in peak or top mode, it finds the optimal measurement range and trigger level setting.



Switches the measurement units between a linear representation of the measurement value in W or a logarithmic representation in dBm.



The measurement units are the base units in A or V without spectral correction.



This is the default unit, J, for pyroelectric energy sensors.



Irradiance is in units of W/cm².



Fluence in units of J/cm².



Wavelength button. Opens a dialogue for the spectral correction to change the user wavelength.



When working with sensors without EEPROM (adapter mode), a dialog opens to enter a responsivity value used to calculate the spectrally corrected power or energy value.



Toggling the delta button. Turns on and off the relative measurement view by taking the measurement value at the time of pressing the button as the reference value.



Zero button. Zeroes the measurement value to compensate for dark current or stray light.



Position offset button. Sets the current position values of thermal power and position sensors to the target center (PM100D3 console only).



Correction button. Opens a dialogue to make a gain or attenuation correction of the measurement value. It is also possible to load a filter transmission curve.



Toggles the filter button. Applicable to photodiode power sensors. Limits the analog bandwidth from up to 100 kHz down to 16 Hz for noise reduction.



Toggles the acceleration button. Applicable to thermal sensors. Calculates a predicted value from the sensor time-constant, approximately one second after light exposure.



Toggling the trace button. Applicable to thermal position sensors. Draws a trace line for position tuning. Button toggles the trace on and off (PM100D3 console only).



Update button. Along with the display update rate, which can be set between 1/s, 3/s, and 10/s, there is a dynamic averaging for digital filtering.



Precision button. Configure the displayed measurement value to a 3-, 4-, or 5-digit mantissa.





Toggling the Mode button. Switches the measurement mode from repeatedly measuring and updating CW mode to peak or top mode, where the measurement value update is triggered by exceeding a predefined trigger level and waiting for maximum detection. The difference between peak and top is that top mode ignores overshoots and measures the level of the rooftop, while peak mode detects the maximum value.



Trigger button. Set the trigger level in the opening number keypad for peak and top mode between 3% and 90% of the measurement range.



Pops out the measurement information overlay.



Zoom in/out for larger digits in the numeric representation. Zooming hides the configurable measurement values.



Zoom in/out in the needle view to approximately +/-10% of the current needle position by toggling the button.



Turns on and off audible support for laser tuning by toggling the button.



Reset minimum and maximum markers and values.

Symbols for Information Without Touch Function:



Indicators for activated features. The auto-ranging, analog filter, acceleration, zeroing, and attenuation icons are shown.



Peak mode and energy measurement trigger state indicators. White icon for waiting for a trigger, yellow icon for a valid trigger condition.

4.5.3 CW Power Measurement

This is the basic power measurement with photodiode sensors or thermal sensors, where the measurement value continuously gets updated. Enabled options like attenuation, zeroing, filtering, or auto-ranging are indicated with icons on the opposite side of the set wavelength indicator.

For best readability, the measurement value can be limited to a certain resolution; further analog bandpass or digital averaging filtering can be set.

4.5.4 Peak Power Measurement with Photodiode Sensors

To perform peak power measurements, browse to the second page of the footer menu by clicking the rightmost button on the touchscreen footer or navigating and entering with the physical buttons. Then change the setting of the left menu button from CW to either top or peak, set the trigger and measurement range, or perform an "auto-set". The measurement units will get the suffix PK. There is also a trigger indicator that turns yellow when pulses or levels that exceed the trigger threshold are detected.

The measurement values will only get updated on successful trigger conditions in top or peak mode. It is advisable to use the AUTO PEAK function to automatically find the appropriate measurement range and trigger level.

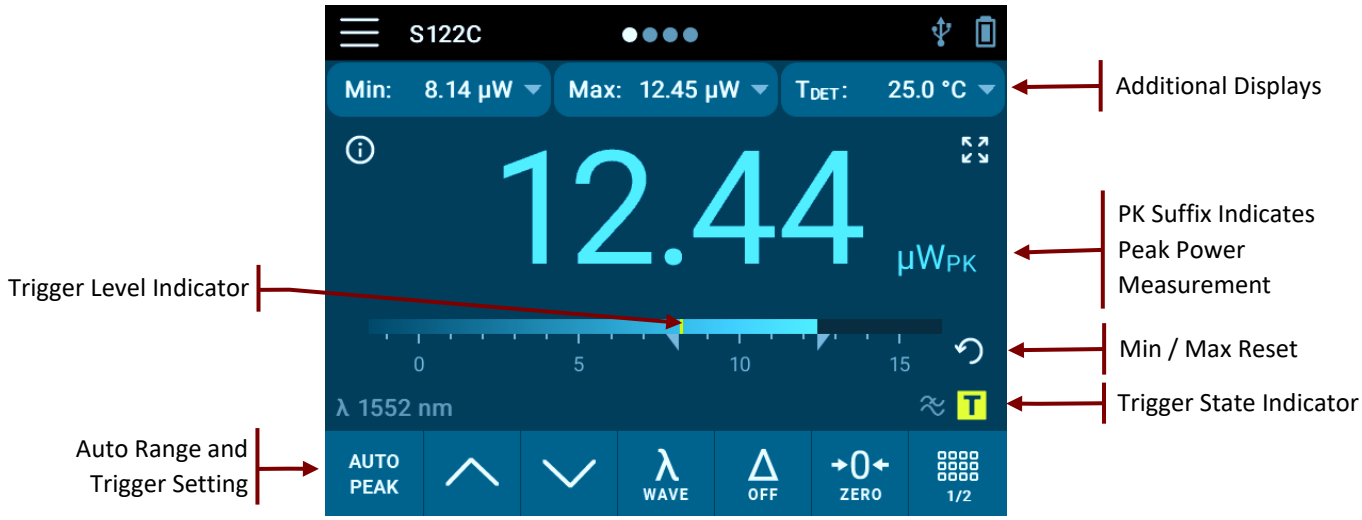


Figure 24 Measurement Screen in Top or Peak Mode

4.5.5 Energy Measurement with Pyroelectric Sensors



Figure 25 Energy Measurement

4.5.6 Position Measurement (PM100D3 Console Only)



Figure 26 Position Tuning View (PM100D3 Console Only)

4.6 Logging and Statistics

4.6.1 Overview

The data logging function allows recording of the measured power, energy, temperature, or position (PM100D3 console only) over time. After pressing the start button (icon with the red circle), the device starts recording the data to a file on the internal flash memory using the configured time interval. The stop condition can be set automatically after a certain number of samples or after a certain time, but logging can also be stopped manually by pressing the stop button. During the recording, the graph can be shown from the beginning with a time axis that extends to fit the new data, or with a rolling 10-second time axis by pressing the toggling 0...t / Δt button.

The captured data is automatically stored in the RECORDS folder on the internal flash drive with the record date and time in the file name in csv format. The files can be accessed by mapping the memory to an external PC via a USB connection (see Section 4.3.5). The files include all relevant device and sensor information, the most important settings, the start time, and a csv sign-separated relative time and measurement values table. Please note that the separator is a comma, and the decimal separator is a period, as is usual in many countries. When loading the file into an Excel spreadsheet, consider this in the language settings or make the adjustment in a text editing software like Notepad in advance.

By pressing the cogwheel icon, the record settings can be modified. PM100D3 console only: The admin user can directly access the configuration menu. The ordinary users do not have the cogwheel icon and must be pre-configured by the admin user.

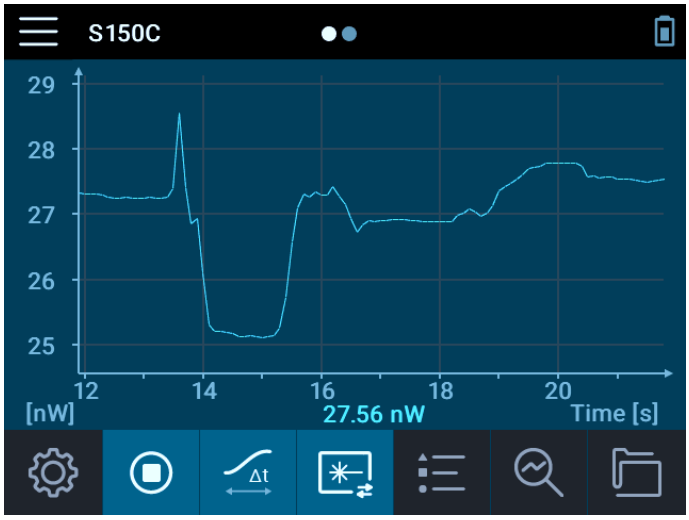


Figure 27 Data Logging

In combination with the graphical representation of data logging, there is a statistics view of the same set of data. During and after the recording, it is possible to switch between both views by swiping right or left in the body or navigating to the dots in the header line.

The statistics view offers, along with the number of samples, the elapsed time, the interval time, the mean value, the ratio, the minimum, and maximum values of the logged data in an overview.

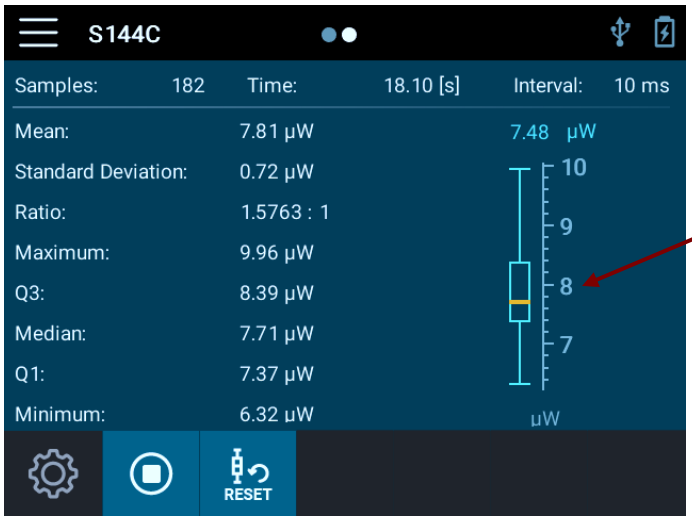


Figure 28 Statistics View

4.6.2 Logging and Statistics Footer Menu Icons



Opens the logging configuration menu.



Toggle the Record/Stop button. Starts and stops the recording of data. The measurement data is automatically stored to the internal memory.



Toggle the graphical representation between showing a rolling ten-second time axis or the complete graph from the start with an extending time axis.



Displays the legend of the recording.





Toggle between power, temperature, or position records. Applies only to the accordingly configured record settings.



Analyze button. Opens the last record in the data viewer for zooming or scrolling the graph.



Load button. Opens the file browser to open a record in the data viewer for zooming or scrolling.



Zoom out to show the complete record.



Resets the boxplot in the statistics view.

4.6.3 Analyzing Recorded Data

There is a data viewer that allows you to analyze the data that was just recorded or load a data record from the internal memory.

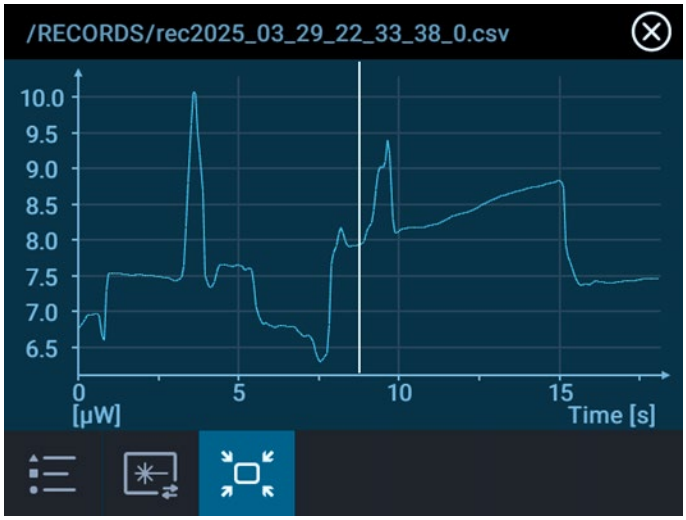


Figure 29 Saved Logging Data Viewer

4.7 Pass/Fail Analysis (PM100D3 Console Only)

4.7.1 Overview

The pass/fail analysis function is an extremely useful tool for quality control in production and service. It gives visual attention to whether the measurement value is within a predefined power range, without the need to read the exact power value. The limits can be configured for absolute power or relative loss measurements by the admin user for themself and the ordinary users.



Figure 30 PM100D3 Pass/Fail Analysis for Absolute Power Levels

The loss pass/fail analysis can be used to check fiber connections or other fiber components, like attenuators, splitters, couplers, or circulators. Perform a measurement with a reference fiber and without the component to be analyzed by pressing the toggling Φ_{ABS} / Φ_{LOSS} button. The reference measurement can be retaken with the Φ_{REF} update button. The loss measurement can be viewed like a delta measurement; a power loss is displayed with a negative sign and a power gain with a positive sign.

In the pass/fail settings menu, which can be entered with the cogwheel button, see also Figure 13, it is also possible to omit one of the limits by pressing the eye label 👁 to unselect the Min or Max markers. The corresponding line in the menu will then be shown as disabled, and the eye label shows 👁‍🗨.

The limit not considered is then displayed in the measurement window as "------".

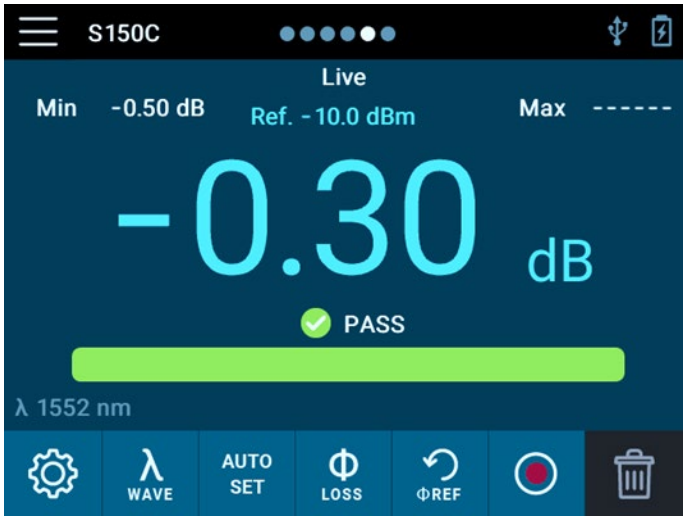


Figure 31 PM100D3 Pass/Fail Analysis for Relative Power Levels (Loss)

It is possible to record the measurements to a file on the internal flash memory. Therefore, the admin user can configure the stop condition and the measurement interval in the logging menu for themself and for the ordinary users. During and after the recording, the screen will change and show the minimum and maximum levels and the analysis result. The data will automatically be stored in the PASS_FAIL folder on the flash memory. The last record can be deleted right after recording. To access the files in csv format, connect the PM100D3 console to a computer via a USB connection and allow access to the internal memory (Menu\SD Memory), see Section 4.3.5. The files include all relevant device and sensor information, the most important settings, the start time, and a csv sign-separated relative time, measurement value, and pass/fail results table. Please note that the separator is a comma, and the decimal separator is a period, as is usual in many countries. When loading the data to an Excel spreadsheet, consider this in the language settings or make the adjustment in a text editor like Notepad in advance.



Figure 32 PM100D3 Pass/Fail Record for Absolute Power and Loss

4.7.2 Pass/Fail Analysis Footer Menu Icons

Opens the configuration menu.

Wavelength button. Opens the dialogue for the spectral correction to change the user wavelength.

The auto-set function can perform a “one-time auto-ranging,” and then the instrument remains in manual ranging.

Pass/Fail mode buttons. Toggles the pass/fail analysis between absolute and relative measurement. The reference value is also set for loss measurement.

Reset the reference value in loss mode.

Toggling Record/Stop buttons. Starts and stops the pass/fail analysis record. The measurement data is automatically stored to the internal memory.

Live button. Turns back from record mode to live mode.

Delete button. Deletes the last record.

4.8 Scope Mode (PM100D3 Console Only)

4.8.1 Screen Overview

The scope measurement screen is a convenient way to acquire signal measurements from alternating or CW power signals. With a sampling rate of up to 100 kS/s, a resolution of 10 µs can be achieved. Figure 33 shows the scope measurement screen as it appears while running a measurement.

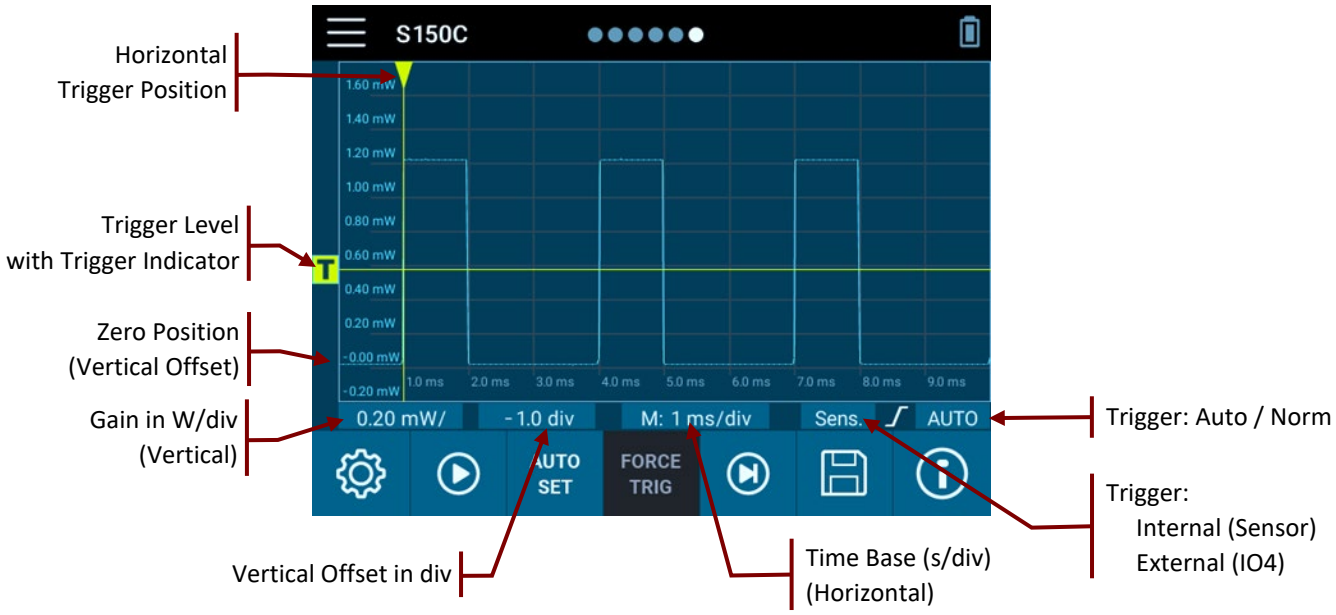


Figure 33 Scope Mode with Scope Window Controls

4.8.2 Scope Mode Footer Menu Icons



Opens the configuration menu.



Toggling Run / Stop buttons. While the scope mode is running, the dots in the header disappear, and it is not possible to change the measurement view.



The auto-set function can perform a “one-time auto-ranging,” and then the instrument remains in manual ranging.



Force trigger button for Normal operation.



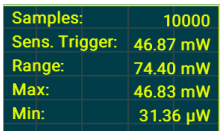
Single trigger button. Arms the trigger and waits for the next event.



Save screen data to a file.



Expand an information overlay in the upper right corner of the screen:



4.8.3 Scope Mode Operation

All settings can be configured in the scope mode menu by pressing the cog-wheel icon; however, it is more practical to adjust the settings directly on the scope screen.

By clicking or navigating to and confirming one of the controls in and under the scope window, the setting detail will appear in a box in the upper right corner of the screen. As long as the setting is visible, it is possible to adjust it with the up and down keys. In addition, the horizontal position and the trigger level can be moved by dragging them to the desired levels on the touchscreen.

In general, the auto set function with the trigger in auto-mode gives a good starting point. After that, adjust the gain and time base according to the desired view.

By default, the trigger is automatically generated from the measurement signal; it is possible to apply an external trigger to the digital pin 4 in the auxiliary connector in the rear of the instrument.

The scope data on a screen can be saved to a file and either analyzed directly on the PM100D3 console or downloaded to a PC via a USB-connected computer (see Section 4.3.5).

4.9 Input and Selection Dialogues

For entering numbers or renaming text strings, numerical or alphanumeric dialogues are used. In the numerical input windows, usually there is a standard number pad and additional buttons for selecting between different units. The entry limits are shown in a header line. To delete numbers, use the backspace button (⌫), and to confirm the entry, use the (OK) button.

The alphanumeric display keyboard has a backspace button (⌫) to delete single characters, or when held down, to delete all the characters. The (OK) button is to confirm the entry, and there is a three-state button to switch between upper- and lower-case characters and numbers.

To exit the dialogue screen without changes, press the quit button (⊗) in the header line.

In some dialog screens it is possible to load data from .csv (comma separated value) files, in this case, the file manager will open the folder with the expected file location. For details, see Chapter 5.5.

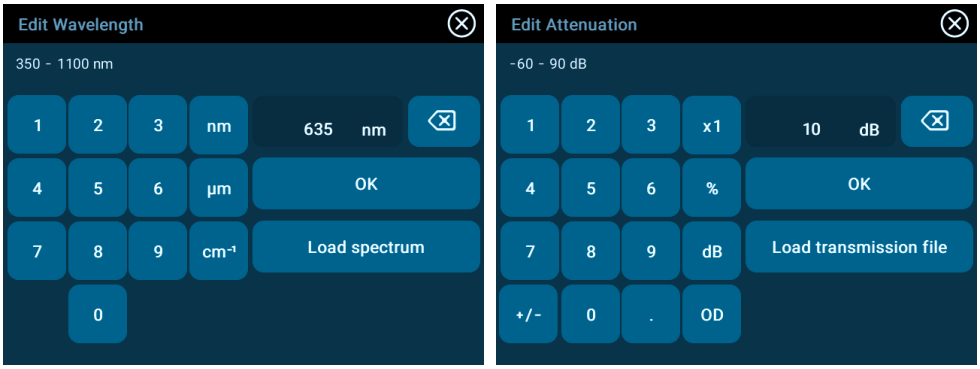


Figure 34 Wavelength and Attenuation Numerical Entry

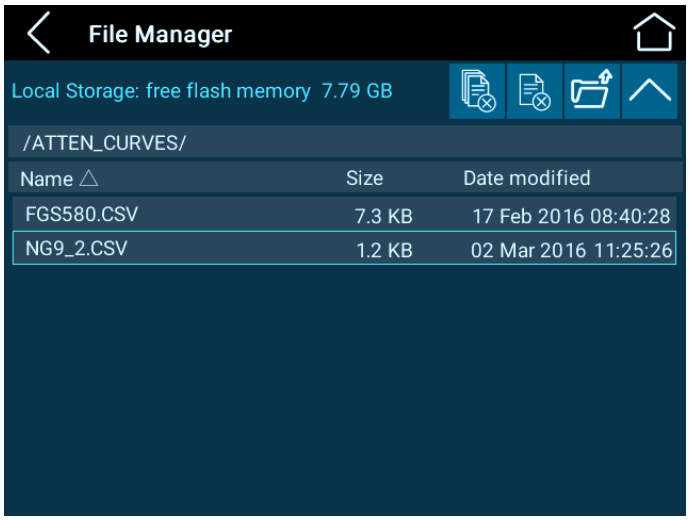


Figure 35 File Selection for Spectral Correction, or Spectral Filtering

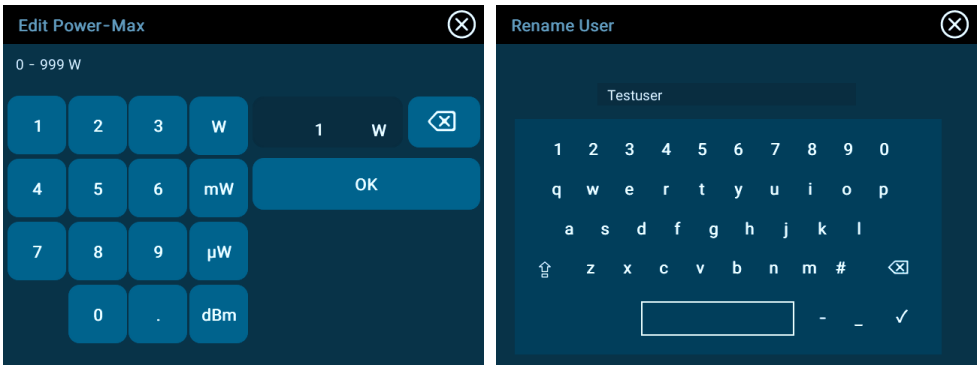


Figure 36 Pass/Fail Limit Entry and Alphanumerical Entry

4.10 Battery Usage and Charging

The PM100Dx power meters are powered by a lithium-polymer (LiPo) rechargeable battery, which has sufficient capacity for a long working day with continuous instrument use. The operating time can be extended by keeping the backlight on a medium level and using the display dimming and shut-down timer functions.

The instrument's battery can be recharged by using the provided USB Type-C to Type-A cable and connecting it to any USB power supply or computer USB port; the smart charging circuit automatically configures the charging to the available and optimum charging voltage and current. To protect the battery, the maximum charging current is limited to 1 A, which results in the fastest possible 5% - 100% charging time of approximately 2.5 hours.

There is also an automatic shutdown when the state of charge goes below approximately 6%. In addition to avoiding a deep discharge of the battery, it also keeps the real-time clock running with sufficient capacity.

The PM100D3 console also features a wireless charging coil integrated into the foldable stand. It can be charged with any compatible wireless charging transmitter rated at 5 W with up to 1 A. Place the instrument with the cross mark on top of the wireless charging transmitter and check if the charging LED on the PM100D3 starts flashing green.

The charging LED can signal the following states:

- Off: Device runs on battery. If turned on, you can check the battery state in the display or in the device info menu.
- Flashing green: Device is connected to an external power source and the battery is charging.
- Permanently green: Device is fully charged and connected to an external power supply.
- Red: Battery is overheated, or there is a problem with the connected power supply. The battery will not get charged. Please see Chapter 6 for more information.

4.11 Remote Operation

4.11.1 USB 2.0 Interface

The PM100Dx power meters can be controlled remotely via the USB 2.0 interface. The straightforward way is to download the Optical Parameter Monitor software - **OPM** - from the Thorlabs website. It comes with all required instrument drivers, programming examples, a command reference, and several useful tools, like the firmware update, driver switcher, and laser calculator tools.

After starting the software, it automatically scans for connected Thorlabs power meters and other supported devices, lists them, and connects to the first found instrument. The range of functions of the software covers most of the possibilities for individual device functions.

All Thorlabs optical power meters are devices that follow the USBTMC (test & measurement class) protocol. This is a USB device class that allows communication with testing and measuring devices, using SCPI (Standard Commands for Programmable Instruments) commands. The specification is based on USB 2.0 and was approved at the end of 2002 by the IVI (Interchangeable Virtual Instrumentation) foundation. USBTMC is supported by the VISA (Virtual Instrument Software Architecture) standard and defines a USB488 subclass for devices that transmit messages based on IEEE 488.1 and IEEE 488.2 (GPIB).

To integrate a USBTMC device VISA must be installed. VISA is a widely used application programmable interface (API) in the test and measurement industry and is available for most operating systems. The most common options are **NI-VISA™** or **PyVISA**, but to avoid installing third-party software packages, Thorlabs developed a version of

VISA that uses the Thorlabs standalone TLPMX drivers; it automatically installs with the Thorlabs OPM software package.

It is important to note that both the NI-VISA™ and TLPMX drivers can be installed at the same time, but only one of them can be assigned to an instrument at a time. Switching the drivers requires administrators' rights; it can be performed in the device manager, or more conveniently, with the Thorlabs Driver Switcher App, which is embedded in the Thorlabs OPM software package.

During an active remote session, it is not possible to perform settings with the device's touchscreen interface or physical buttons that may influence the measurement result, like changing the wavelength or measurement range.

Please refer to the resources on the Thorlabs **OPM** Optical Parameter Monitoring software page for an overview of the features and a link to download the OPM Software Manual, for more information and a full command reference.

4.11.2 Bluetooth Interface (PM100D3 Console Only)

The PM100D3 console has a built-in Bluetooth module, following the Bluetooth Low Energy (BLE) standard. When activated, it is possible to establish a wireless connection to computers or mobile devices.

Prior to a connection with data transmission, it is necessary to pair the PM100D3 console with the target device. Therefore, open the Bluetooth settings on the target device and perform a scan for Thorlabs Bluetooth devices in the vicinity. On Windows PCs, as well as on mobile devices, it will be shown as “PM100D3”. Connect to the PM100D3 device found.

Communication is then possible via SCPI commands, using the drivers, or using an app. The Thorlabs Optical Parameter Monitor software can also be used to communicate via Bluetooth low energy.

Check out the "Thorlabs OPM Mobile" **iOS®** and **Android™** applications that support communication with Thorlabs BLE devices.

4.12 AUX Connector (PM100D3 Console Only)

The PM100D3 console features a 26-pin female header, accessible in the rear instrument shell. This header provides useful functionality that extends the functional scope of the instrument with additional remote interfaces, analog outputs, environmental monitoring, controlling device functions, or embedded electronics.

Refer to Section 1.5.2 AUX Connector (PM100D3 Console Only) for the pin assignment.

Function	Pin(s)	Description
TH1:	(4)	NTC thermistor for supporting temperature measurements. Configure the thermistor R_0 and B_0 values in the environment menu (see Section 4.3.2).
AO1:	(6)	Analog Output, parallel to AO SMA connector; 0 - 2.5 V.
AOX, AOY:	(8, 10)	DAC-controlled analog outputs for X and Y position; +/-2.0 V.
IO_{1-4}:	(15 - 18)	GPIO, or trigger configurable digital ports; 3.3 V logic, 5 V tolerant (LVTTL, TTL).
SDA, SCL:	(21, 22)	User accessible I2C interface; 3.3 V logic. Supports commercially

		available temperature and humidity sensors from Texas Instruments (HDC1080 and HDC3020), whose measurement values can be displayed in the measurement window or recorded with the power logging.
RX, TX:	(23, 24)	UART remote interface; 3.3 V logic (RS232 can be provided as an option with +/-5 V). Supports the command range of the PM100D3 device. Connect RX with the RX terminal and TX with the TX terminal.
PB:	(20)	Push Button Controller, latch to digital ground (GND) to turn on and off the device remotely. The function is like the physical ON / OFF button in the front panel.
2V8	(2)	+2.8 V positive periphery analog voltage supply, 50 mA max.
-2V4	(1)	-2.4 V negative periphery analog voltage supply, 50 mA max.
3V3	(12)	3.3 V digital periphery voltage supply, 100 mA max., DIO, and buses.
5V0	(11)	5.0 V digital periphery voltage supply, 100 mA max.
AGND	(3, 5, 7, 9)	Analog Ground
GND	(13, 14, 19, 26)	Digital Ground

All provided periphery voltages are protected with self-resetting fuses. Pin 25 is closed as polarity protection when using the extension cable.

4.12.1 Extension Cable

The PM100D3 console comes with a 12-inch (300 mm) long 1:1 extension cable that translates the AUX connector to a female double row, 26-pin IDC style connector.

Chapter 5 Maintenance and Cleaning

5.1 General Guidelines

- Maintain a dust-free environment for the unit.
- Wipe the unit casing and front panel with a slightly damp cloth.
- For cleaning the touch screen, a commercial screen cleaner is acceptable.
- When storing the unit, keep it in a clean and dry area at room temperature, avoiding direct sunlight.
- Steer the unit clear of high humidity and substantial temperature fluctuations.
- Avoid exposure to unnecessary shocks and vibrations.
- The unit is not waterproof! In the event of liquid spillage, power off, disconnect from external sources, and allow the unit to thoroughly dry before use.

5.2 Handling Power, Energy, or Position Sensors

NOTICE Always cover sensors with protective caps when the devices are not in use.

1. Inspect the filter surface and blow off any dust with compressed air.
2. Polished filter surfaces, like the absorptive ND filters on some of the C-series power sensors, can be cleaned with a swab, moistened with alcohol, or other optical cleaning fluids.
3. For most sensors, special care must be taken for diffused surfaces – please see below.

NOTICE Do not mechanically rub on any diffused surfaces, as this may lead to changes in the sensor responsivity!

5.3 Recalibration

Thorlabs recommends a calibration interval of 12 months. Please contact the Thorlabs technical support team for submitting a calibration request to issue an RMA number along with the item number and the serial number of your PM100D2 or PM100D3 device.

Please use the following items for either factory, or ISO 17025 accredited calibration services:

- **CAL-PM1** Manufacturer Recalibration of Single-Channel Power and/or Energy Meter Electronics
- **CAL-PM1D** ISO 17025 Accredited Calibration for Single-Channel Power and/or Energy Meter Electronics

Or fill out the following form to submit a calibration request:

https://www.thorlabs.com/rma/request.cfm

5.4 Building Custom Sensors

The PM100D2 and PM100D3 optical power and energy meter consoles support custom sensors, using the "adapter functionality".

Properly connected sensors that don't have a one-wire EEPROM with valid data will be automatically recognized as an adapter when the PRESENT pin is connected to ground via any resistor link between 1 kΩ and 15 kΩ.

Any kind of supported sensor can be realized, using the correct pins at the sub-D connector. It is necessary to set the detector route (adapter type) manually in the devices' measurement settings to either photodiode, thermal, pyroelectric, or 4-quadrant detectors (PM100D3 console only).

Use shielded cables that are as short as possible to your sensor elements to avoid noise or other measurement influences like wire resistance.

Refer to Section 1.5.1 Sensor Connector for the pin assignment.

NOTICE Pin 2 is uniquely used for the memory in the sensor head and may not be used. Connecting this pin may cause a malfunction of the PM100Dx device.

5.5 Spectral Correction and Spectral Transmission Files

Instead of setting a specific (laser) wavelength to ensure the correct power reading, it is possible to load the spectrum of the light source to measure. The device then calculates a weighted set value for the wavelength correction from the loaded spectrum and the spectral sensitivity of the sensor.

It is also possible to load transmission curves of optical elements placed in the beam path to calculate and display the original laser power.

These files can easily be created and loaded into specific folders under SPEC_CURVES or ATTEN_CURVES in the device's user accessible file section. The folders already contain examples that can be used as template. The files need to be stored in .csv format with a line separated spectral or transmission information for each wavelength. The data points do not necessarily have to be equidistant; intermediate values are interpolated. The data can be entered as integer, float, or engineering notation.

Spectral Curve for a Light Source

Wavelength, Relative Intensity Value

```
500,0.19
520,0.4
540,0.7
560,0.88
580,0.98
600,1.0
620,0.92
640,0.8
```

Filter Transmission Curve

Wavelength, Transmission Value

```
500,3.25e-2
520,3.18e-2
540,3.01e-2
560,2.89e-2
580,2.41e-2
600,2.12e-2
620,1.87e-2
640,1.66e-2
```

5.6 Battery Replacement

⚠WARNING

The PM100Dx meters use smart lithium-polymer (LiPo) batteries. These batteries with built-in protection have been verified with Thorlabs optical power meter instruments. For this reason, only Thorlabs-approved batteries of the same type and model (2P/LPP 503562) can be used.
Depending on country-specific policies, please contact your local Thorlabs technical support for assistance.

NOTICE

Dispose of used batteries appropriately by recycling them in accordance with local regulations. Refrain from placing them in regular garbage receptacles.

1. If applicable, disconnect any attached USB cables and optical fibers.
2. Turn off the unit.
3. Place the unit on a level and tidy surface, positioning the display facing downward.
4. Remove the four screws in the rear shell by using a Torx© TX10 driver, turning counterclockwise.
5. Raise the rear shell and lay it out in front of you.
6. Disconnect the battery and remove it from the holder in the rear shell.
7. Take a battery of the same type and rating and place it in the rear case bracket with the cables facing upwards.
8. Plug in the battery.
9. Carefully put the rear shell in place, insert the screws, and tighten them gently.

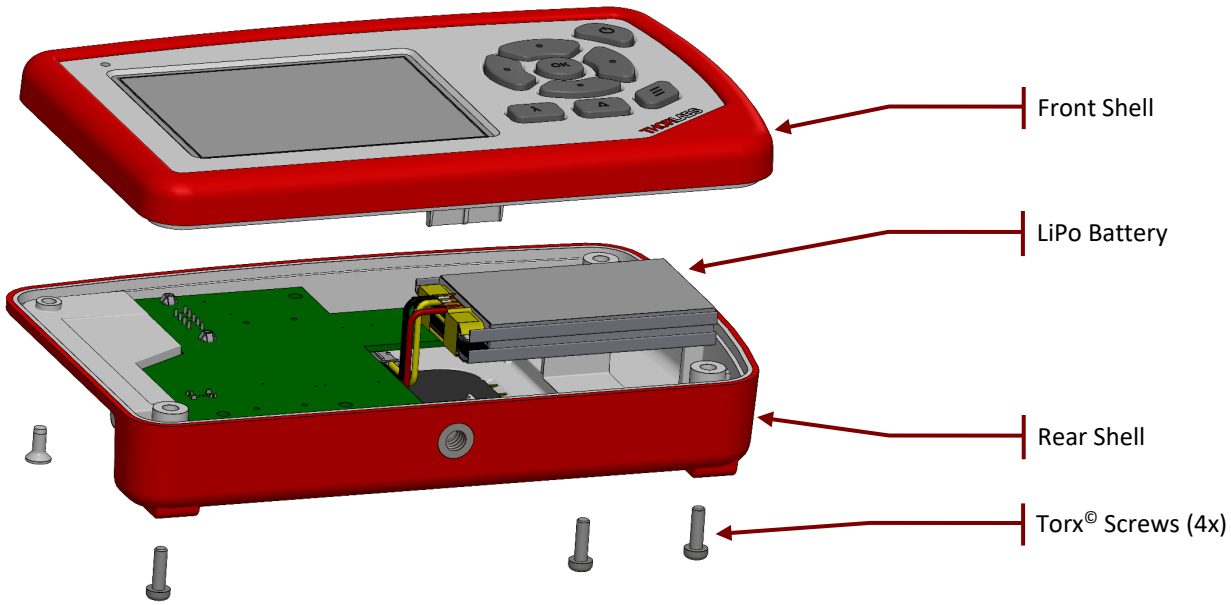


Figure 37 Battery Replacement

5.7 Firmware Update

1. Turn on the unit.
2. Connect the USB cable to a free port of the computer and to the PM100Dx device.
3. Download the new firmware package from the Thorlabs website to your local drive.
4. Open the **OPM** Optical Parameter Monitor software.
5. Browse to Help\Tools\Firmware Update Tool
6. Browse to the new firmware file (.dfu) and follow the instructions.
7. Wait until the installation is complete; do not turn off the unit during installation!
8. Restart the instrument with the updated firmware.

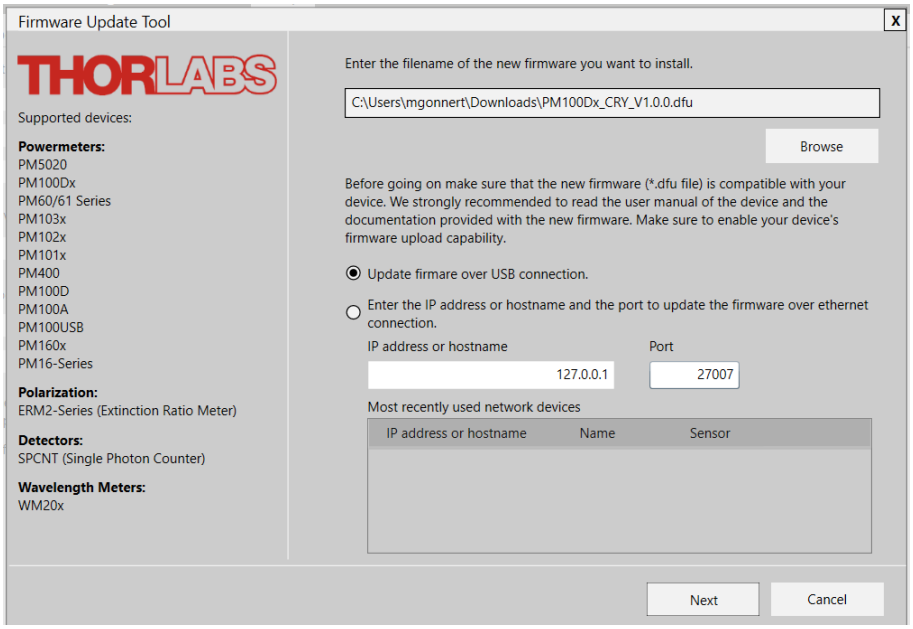


Figure 38 Firmware Update Tool

Chapter 6 Troubleshooting and Repair

Below are a few checks to help with troubleshooting problems that may arise. Please contact your local Thorlabs Technical Support office with any questions.

Failure	Troubleshooting
Unit Does Not Turn On	Ensure that the battery is sufficiently charged; otherwise, connect the device to an external power supply. The device may not have shut down properly, in this case press the power On/Off button for >3 seconds, and try to start the device again by short-pressing the standby button.
Display Shows "No Sensor Connected"	Check that a "C-series" power or energy sensor is connected properly. When the error occurs after a sensor "hot-plug", try restarting the instrument.
Display Shows "Sensor Not Supported"	This message will appear when trying to connect a thermal power and position sensor to the PM100D2 console.
Battery Does Not Charge	Check for the charging LED; it must blink green during charge. In case the LED is red, check the power supply or check for abnormal heating of the device.
Unit Automatically Switches Off	Check the battery status. The unit turns off to protect the battery below 6% SOC. Also, check the automatic switch-off feature in the device settings.
Measurement Value Does Not Update	Check if the unit is in peak mode or top mode. The measurement will only update on valid trigger conditions. Otherwise, restart the instrument.
Unit is Frozen and Does Not React to Any Interaction	Press the power button until the device powers down. Restart the device.
Wireless Charging Function Does Not Work	Check that the orientation of the charging transmitter is correct. Check that the transmitter has power and is turned on. The PM100D3 console charging LED should flash to indicate charging or be solid when fully charged.

Chapter 7 Disposal



Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return “end of life” Annex I category electrical and electronic equipment sold after August 13, 2005, to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out “wheelie bin” logo (see right), were sold to and are currently owned by a company or institute within the EC and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. “End of life” units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site. It is the user’s responsibility to delete all personal data stored on the device prior to disposal.

Chapter 8 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at **www.thorlabs.com/contact** for our most up-to-date contact information.



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