THORLABS

Optical Power and Energy Meter

PM320E
Operation Manual

2017

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Contents

We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to live up to your expectations and improve our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hearing from you.

Thorlabs GmbH

Warning

Sections marked by this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully, before performing the indicated procedure.

Attention

Paragraphs preceded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

Note

This manual also contains "NOTES" and "HINTS" written in this form.

Please read these advices carefully!

1 General Information

The PM320E Benchtop Optical Power and Energy Meter is designed to measure the optical power of laser light or other monochromatic or near monochromatic light sources and the energy of pulsed light sources.

The dual channel design and compatibility to all Thorlabs “C-Series” Photodiode, Thermal, Pyroelectric sensors as well as common Photodiode detectors, thermopiles and pyroelctric elements, combined with a fast USB device interface open a wide range of applications in Manufacturing, Quality Control, Quality Assurance, and R&D.

The provided software, including drivers and applications for LabVIEW and C makes it easy to integrate the instrument in test and measurement systems.

1.1 Safety

Attention

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.

The PM320E must not be operated in explosion endangered environments!

Do not obstruct the air ventilation slots in the housing!

Do not remove covers!

Do not open the cabinet. There are no parts serviceable by the operator inside!

This precision device is only serviceable if properly packed into the complete original packaging including the plastic foam sleeves. If necessary, ask for replacement packaging.

Refer servicing to qualified personnel!

Only with written consent from Thorlabs GmbH may changes to single components be made or components not supplied by Thorlabs GmbH be used.

Attention

Prior to applying power to the PM320E, make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth ground contact of the socket outlet! Improper grounding can cause electric shock resulting in damage to your health or even death!

Ensure that the line voltage setting of the fuse holder at the rear panel agrees with your local supply and that the corresponding fuses are inserted. If not, please change the line voltage setting (see section Line Voltage Setting) and the mains fuses (see section Exchange Mains Fuses).

To avoid risk of fire, only the appropriate fuses for the corresponding line voltage must be used.

All modules must only be operated with duly shielded connection cables.

Attention

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.

Note: **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 and meets all requirements of the Canadian Interference-Causing Equipment Standard ICES-003 for digital apparatus. 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/T.V. technician for help.**

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

Thorlabs GmbH 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 GmbH. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

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

Attention

Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.

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).

Vous pouvez trouver les traductions françaises des paragraphes ayant trait à la sécurité d'utilisation de ce produit sur le lien suivant:

https://www.thorlabs.com/_sd.cfm?fileName=19380-D03.pdf&partNumber=PM320E

En outre, vous pouvez soit scanner le QR code, soit vous référer à la section "Documents" sur la page web du produit.

1.2 Ordering Codes and Accessories

Ordering Code	Description
PM320E	Dual Channel Benchtop Power and Energy Meter

Please visit our homepage http://www.thorlabs.com for various power and energy sensors, and accessories like fiber adapters, posts and post-holders, data sheets and further information.

2 Getting Started

2.1 Parts List

Inspect the shipping container for damage.

If the shipping container seems to be damaged, keep it until you have inspected the contents and you have inspected the PM320E mechanically and electrically.

Verify that you have received the following items within the package:

1. 1 PM320E
2. 1 Power cord, connector according to ordering country
3. 2 Replacement mains fuses
4. 1 USB cable
5. 1 Operation manual
6. 1 CD "Applications and Driver"

2.2 Preparation

Attention

Prior to switching on your PM320E please check if the line voltage setting (see voltage selector at the rear panel) corresponds to your mains voltage and make sure the correct fuses are inserted!

Therefore please see sections Line Voltage Setting and Exchange Mains Fuses.

Turn the unit on by pressing the power switch.

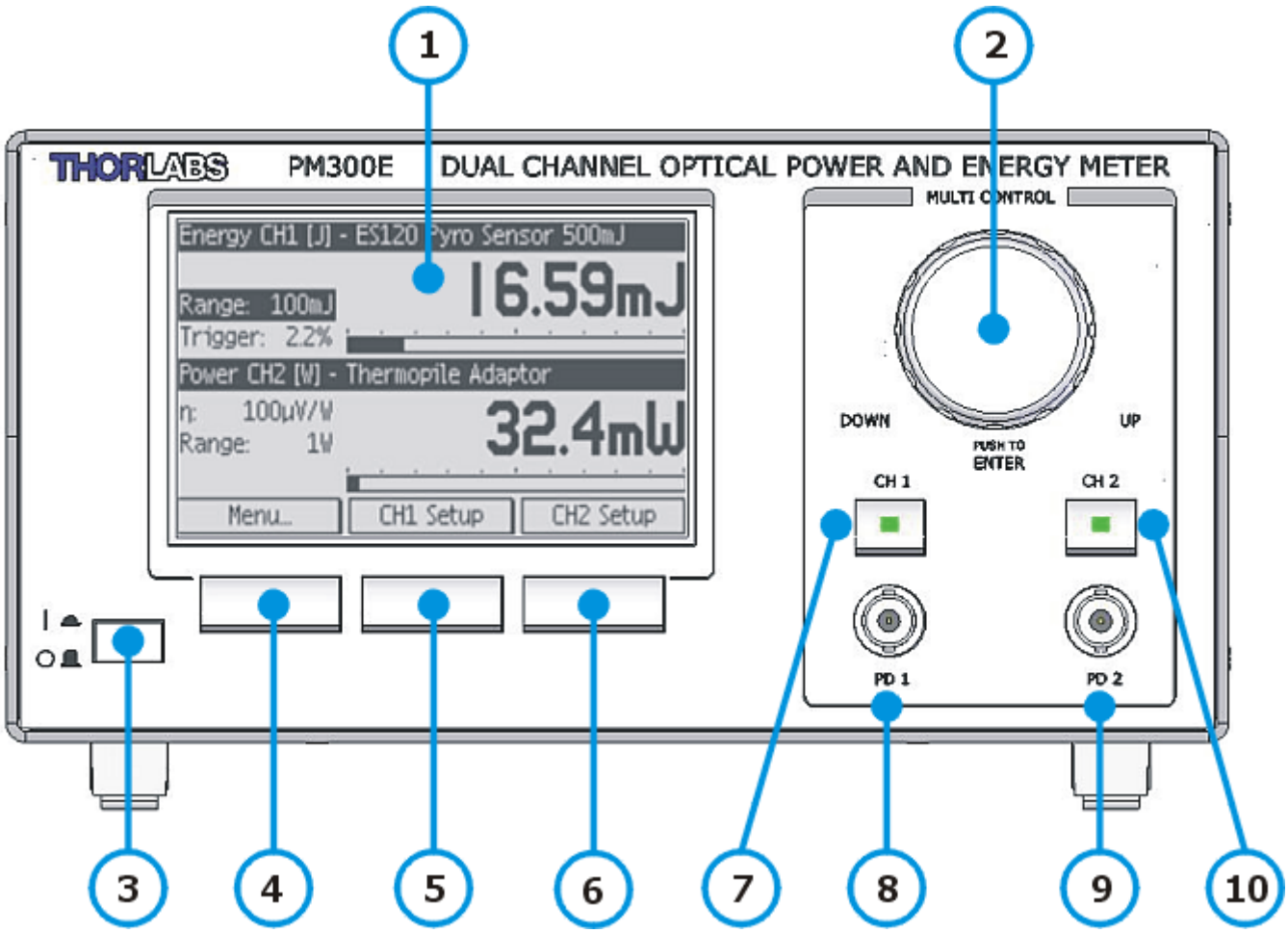
After switching on the unit, the graphics display will show the device status and then jump to the dual channel screen.

The PM320E is immediately ready to use after turning on. The rated accuracy is reached, however, after a warming-up time of approx. 10 minutes.

If required, connect the chassis ground via the banana connector jack to ground potential of the external optical setup.

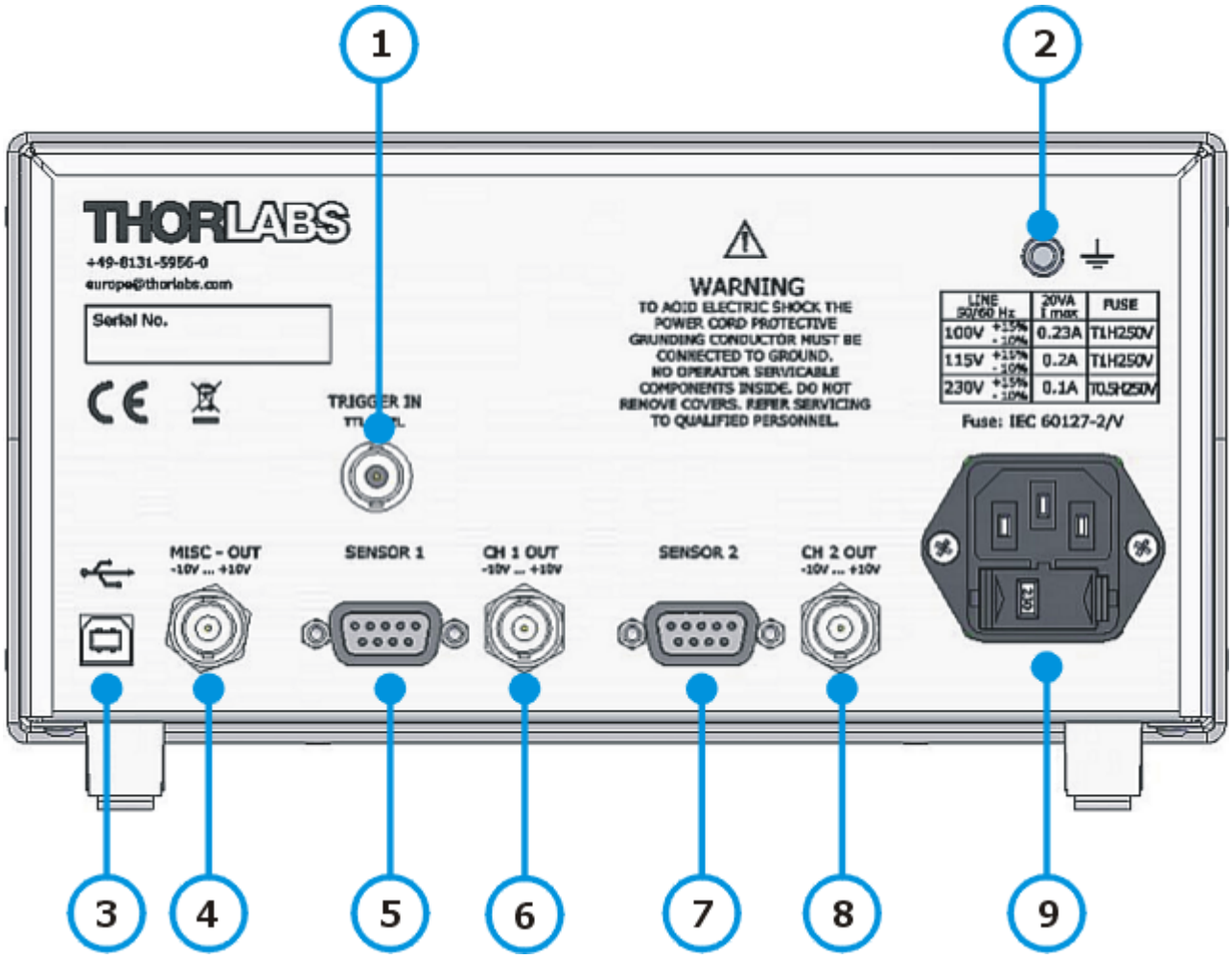
2.3 Operating Elements

2.3.1 Front Panel



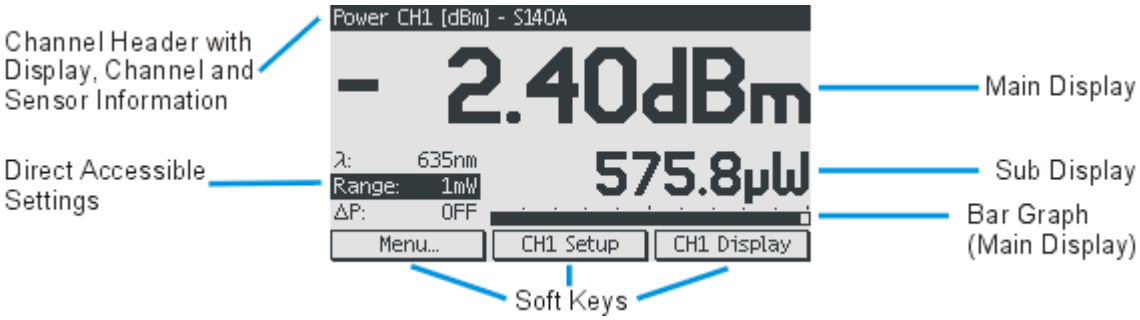
1	Display
2	Control Knob
3	Power Switch
4	
5	Soft Keys
6	
7	Display Selector CH1
8	Photo Diode Input CH1
9	Photo Diode Input CH2
10	Display Selector CH2

2.3.2 Rear Panel

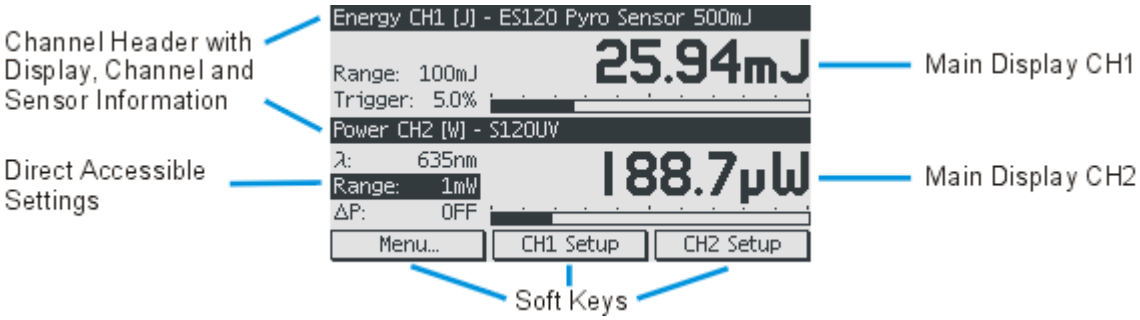


1 Trigger Input (BNC)
2 Ground Connector (Banana Jack, 4 mm)
3 USB Interface Connector (Type B)
4 MISC Output Connector (BNC)
5 CH1 Sensor Connector (DSUB 9 Pin female)
6 Analog Output CH1 (BNC)
7 CH2 Sensor Connector (DSUB 9 Pin female)
8 Analog Output CH2 (BNC)
9 Mains Connector including Line Voltage Switch and Line Fuses

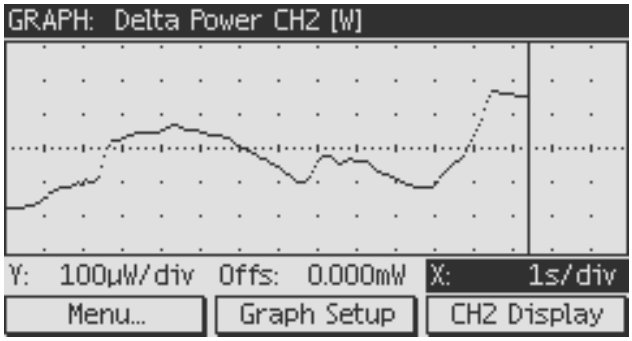
2.3.3 Main Displays



Main Display - Single Channel (CH1)

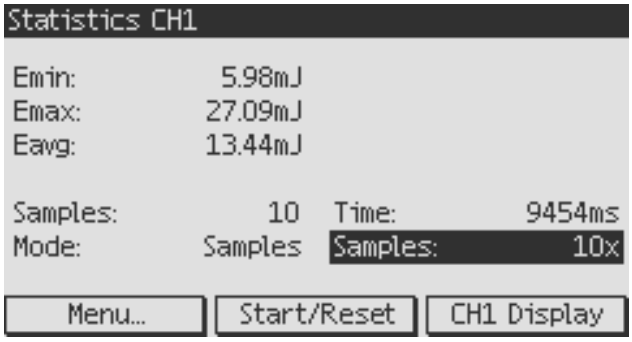


Main Display - Dual Channel

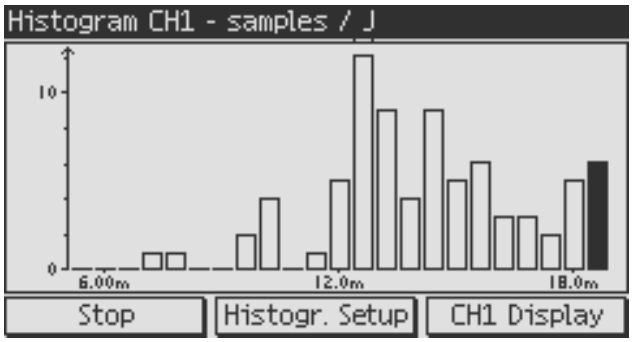


Display Power Trend Graph CH2

Display Power Statistics CH2



Display Energy Statistics CH2



Display Energy Histogram CH1

3 Operating Instruction

3.1 Sensor Independent Settings and Operation

3.1.1 Navigating the Menus

The PM320E is controlled by three display/menu dependent soft buttons below the graphics display and/or the multi-control knob (rotary knob with push button) that combines Selecting with an Edit / Enter functionality. All displays have directly accessible settings by navigating and clicking with the multi-control knob.

To select the channel, statistics and the graphics displays two buttons CH1 and CH2 with LED indicators are used (ON means lit LED; pressing the buttons toggles the channels):

CH 1	**CH 2**	**Display**
ON	OFF	Channel 1; Single Channel Screen, Graphics and Statistics
OFF	ON	Channel 2; Single Channel Screen, Graphics and Statistics
ON	ON	Channel 1 + Channel 2; Dual Channel Screen

To access the statistics and graphics displays select a single channel screen and toggle the right soft button <CHx Display>.

3.1.2 System Settings

To enter the system settings press the <Menu> button that is located at the left soft button position in the channel and graph screens. The following sub menus will appear:

- **Channel 1 Setup**
  Depending on the connected sensor, displays can be selected and sensor specific parameters can be set.
- **Channel 2 Setup**
  Depending on the connected sensor, displays can be selected and sensor specific parameters can be set.
- **User Wavelength**
  Allows to enter five correction wavelengths for quick access.
- **Miscellaneous Output Configuration**
  Configures the measurement value, sensitivity and offset of the programmable analog output (MISC OUT).
- **System Configuration**
  Contains hardware adjustments like LCD illumination, 50/60Hz line filter setting and system information.

3.1.3 Readout Configuration

The main display can be configured in terms of measurement units; further mathematical functions between the two channels can be configured. To configure the main display go to the <CHx Setup> and chose the 'Main Display' menu.

The sub display that is visible as small read out value in the single channel screen can be configured in the <CHx Setup> and the 'Sub Display' menu. For this display the power value can be set in linear (W) and logarithmic (dBm) mode.

The following read out displays can be selected, the channel headers show the information of the current display:

Sensor	Main Display (CH 1, CH2)	Sub Display (CH1, CH 2)
Photodiode	Power [W] Power [dBm] Delta Power [W] Delta Power [dB] Ratio CH1/CH2, CH2/CH1 [dB] Power Difference: CH1-CH2, CH2-CH1 [W]	Power [W] Power [dBm]
Thermal	Power [W] Power [dBm] Delta Power [W] Delta Power [dB] Ratio CH1/CH2, CH2/CH1 [dB] Power Difference: CH1-CH2, CH2-CH1 [W]	Power [W] Power [dBm]
Pyroelectric	Energy [J] Repetition Rate [Hz] Average Power [W] Power Density [W/cm²] Energy Density [W/cm²]	Energy [J] Repetition Rate [Hz]
PD Inputs	Current [A] Power [W] Power [dBm] Delta Power [W] Delta Power [dB] Ratio CH1/CH2, CH2/CH1 [dB] Power Difference: CH1-CH2, CH2-CH1 [W]	Current [A] Power [W] Power [dBm]
TH Adapter	Voltage [V] Power [W] Power [dBm] Delta Power [W] Delta Power [dB] Ratio CH1/CH2, CH2/CH1 [dB] Power Difference: CH1-CH2, CH2-CH1 [W]	Voltage [V] Power [W] Power [dBm]

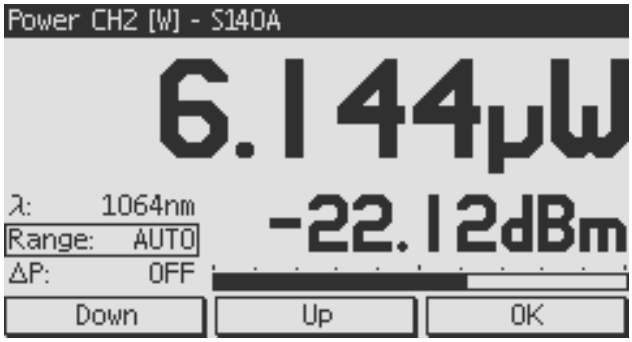
3.1.4 Range Setting

Depending on the used sensor, the PM320E provides:

- up to 6 current related power measurement ranges, selectable manually or in auto ranging mode
- up to 3 voltage related power measurement ranges, selectable manually or in auto ranging mode
- 4 voltage related energy measurement ranges, selectable manually only.

To select a range or switch to the auto-range mode, navigate to ‘Range’ button (single or dual channel display) or select in the Setup display the ‘Power Range’ menu and click the button to edit the range setting menu. Depending on the sensor type you can chose between several power ranges and the auto-range mode either by turning the control knob or using the <Down> and <Up> soft keys. The selected range is activated immediately. To leave the menu, press the control knob or the <OK> soft key.

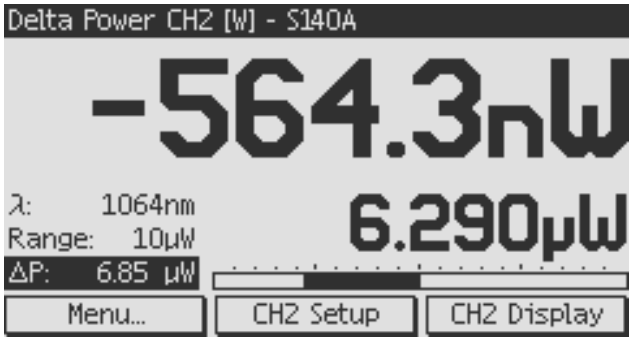
When power meter sensors are connected, the ranges will show in Watts, with energy sensors in Joules. For the photodiode inputs the ranges can additionally be set in Amperes, for the thermal head adapter and the pyroelectric head adapter in Volts.



3.1.5 Relative Power Measurement

This feature can be used to observe power drifts, adjust power to a certain level, or quickly subtract ambient light.

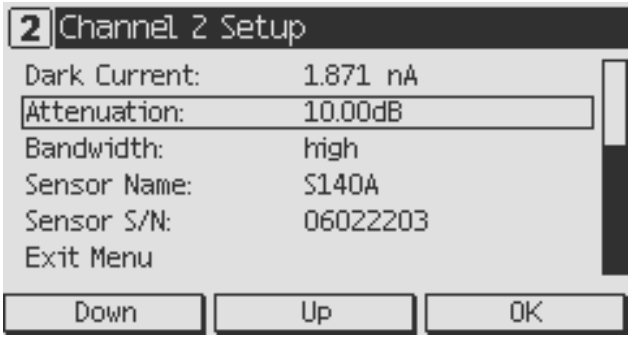
Navigating to the direct access ‘ΔP’ button and clicking the multi-control knob toggles between relative and absolute power measurement. When the relative power measurement is activated, the header changes to ‘Delta Power’, the current power reading gets zeroed, the bar graph goes to a zero middle position, the subtracted value gets indicated in the ‘ΔP’ menu. From now on the main display and the bar graph are showing the difference to the subtracted power in W or dBm with a one digit higher resolution. The sub display still shows the absolute power level. A Range setting is still possible as described in the paragraph above.



3.1.6 Setting an Attenuation Factor

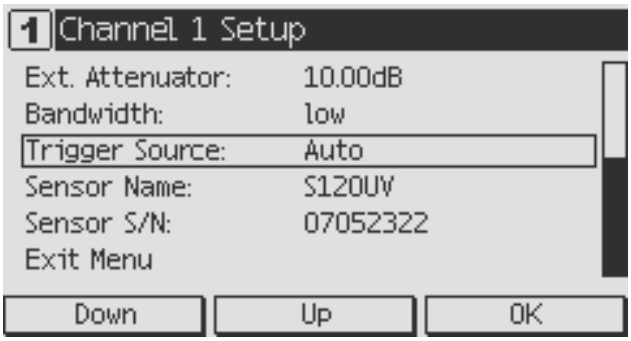
The Attenuation Menu allows to set a user correction factor to the power reading. This is very convenient, for example, to compensate the measurement result for the attenuation of a filter or beam splitter in the system.

To enter an attenuation factor, press the <CHx Setup> soft button, navigate and click the 'Attenuation' button. Set the desired attenuation in dB, then press <OK> or click the control button. Exit the setup menu.



3.1.7 Trigger Input

For power and energy measurements the PM320E has two trigger modes that can be selected for each channel in the CHx Setup under <Trigger Source>:



Depending on the connected sensor the selected trigger source has the function shown in the table below.

Sensor	Trigger Source Auto	Trigger Source Extern
Photodiode / Thermal	continuous power measurement with fixed sampling rate	A rising edge TTL signal at the rear BNC trigger input will trigger a single measurement
Pyroelectric	All pulses that exceed the trigger threshold will be measured automatically	A rising edge TTL signal resets the peak detector, the system is waiting for the next incoming pulse to measure

3.2 Photodiode Power Sensor Operation

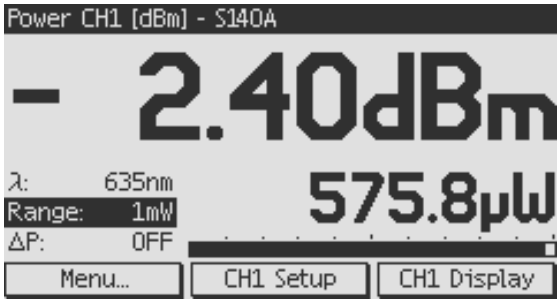
Photodiode sensors of the Thorlabs S1xxC series can be connected to each of the Sub-D jacks in the rear panel. The sensor will be recognized immediately after plugging. With a power meter sensor plugged-in at the rear panel, the related photo-diode input in the front panel is disabled.

Attention

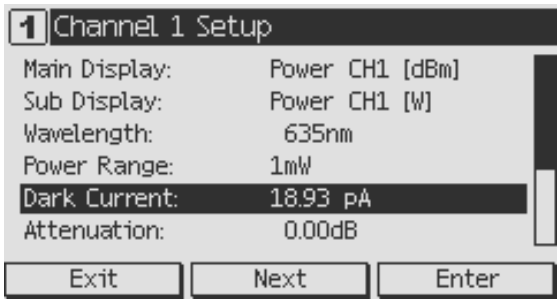
Refer to the sensor data sheet and pay attention to the optical damage threshold! Exceeding these values will permanently destroy the sensor!

For the measurement of small power levels up to approximately 1-2 W, photodiode sensors have a lot of advantages against thermal sensors. The sensors are built up in a combination of a photodiode and a neutral density filter or a photodiode in combination with an integrating sphere. They provide linearity over several decades and show a very good sensitivity for very small power levels down to the nW range. Handling fairly small power levels, the form factor can be held small, further the response time of such a sensor is very fast in the ns to µs range.

Photodiodes, neutral density filters and also integrating sphere materials show a wavelength dependent behavior and therefore each sensor is individually calibrated over the spectral working range in 5 nm steps. The individual sensor spectral responsivity data are saved to a non-volatile memory inside the DB-9 sensor connector and downloaded to the PM320E when plugged to the unit. To perform an accurate measurement it is necessary to enter the operating wavelength so that the PM320E can calculate the laser power from the measured photo current and the right responsivity value from the wavelength calibration table.



PD Sensor Read-Out Display



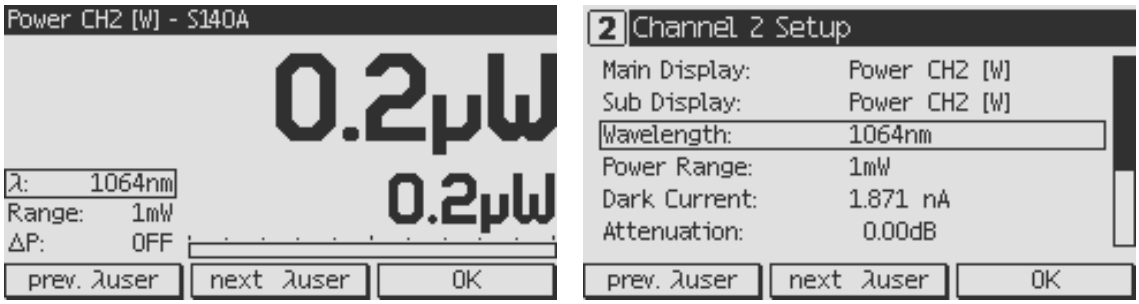
PD Sensor Setup Display

3.2.1 Wavelength Correction

As described above, for an accurate absolute measurement it is necessary to enter the wavelength of the incident to the sensor light.

The wavelength setting can be edited by navigating to the direct access 'λ' setting in the measurement displays or the channel setup and clicking on the control knob. The set value gets a blinking frame and can be increased or decreased by turning the control knob. Further two soft buttons with <prev. λuser> and <next λuser> appear; pressing these buttons the correction wavelength can be toggled between the 5 preconfigured wavelengths from the systems menu 'User Wavelengths'.

The new wavelength setting gets active when pressing the control button or the <OK> soft key.

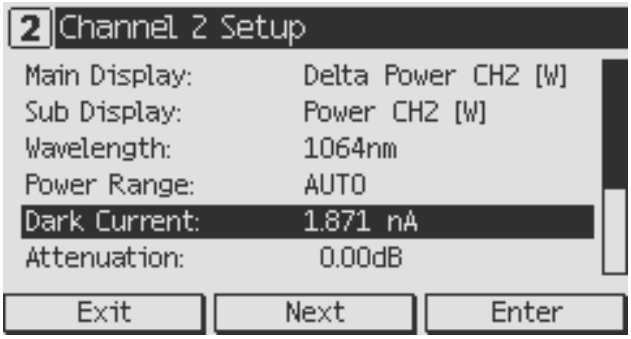


3.2.2 Dark Current Adjustment

Photodiode sensors emit very small current levels, even when no photons hit the active area - the so called dark current - that is temperature dependent and in the region of some nA for Silicon and InGaAs sensors and up to some µA for Germanium sensors.

When measuring very small power levels this dark current can have an influence on the measurement result and must be compensated by the dark current adjustment. This function that can be reached by entering the <CHx Setup> and navigating to the 'Dark Current' menu, can also be used to subtract ambient light.

To perform the adjustment, cover the sensor with the metal protection cap or when a fiber connector is assembled, plug a fiber (laser switched off) and press the Control knob or press the <Enter> soft button. The PM320E will automatically switch down to the smallest possible measurement range, measure the photo current and take in account this value when calculating the power reading. Press <Exit> to return to the measurement screen.



Display Dark Current Adjustment

3.2.3 Bandwidth Setting

The analog bandwidth setting mainly influences the analog outputs, for example in order to subtract noise from the mains. The analog bandwidth can be set in the channel setup to 'high' (range dependent bandwidth) and 'low' (15 Hz bandwidth). The digital power readings and the bar graph have a digital filtering (including a selectable 50/60Hz line filter); this combined bandwidth approximately corresponds to the 'low' bandwidth setting.

3.3 Thermal Power Sensor Operation

Thermal sensors of the Thorlabs S3xxC series can be connected to both CH1 and CH2 Sub-D jacks in the rear panel. The sensor will be recognized immediately after plugging in. With a power meter sensor plugged-in at the rear panel, the related photo-diode input in the front panel is disabled.

Attention

Refer to the sensor data sheet and pay attention to the optical damage threshold! Exceeding these values will permanently destroy the sensor!

Thermal sensors absorb the incident laser power, whereby the developing heat gets turned into a small voltage caused by heat flow through thermocouple elements between absorbing area and sensor heat sink. The Thorlabs S3xxC series thermal sensors contain black broadband coatings or hard coatings as absorber and show a nearly flat response from the UV to the mid-IR. The sensors have stored a wavelength dependent response curve, that is used to adjust the power reading to the specific operating wavelength.

The output voltage of a thermal sensor is linear to the incident laser power, as long the thermal system is properly zeroed. The main use of thermal sensors are high power applications from 100mW and up.

3.3.1 Zeroing

Thermopile sensors need to be zeroed when thermal differences appear between the active area (thermal disk) and the sensor heat sink with no light incident to the active area or when the heat sink gets hot under light exposure. An indicator that the sensor needs to be zeroed is when with a switched off laser either a strong 0.000W reading (negative thermal voltage) or a reading much greater than zero is displayed.

To perform the zero adjustment press the <CH1 Setup> button, navigate to the ‘Zero Voltage’ menu and press the Control knob or the <Enter> soft key. A new zero value will appear in the menu.

The zero value will be negative when the heat sink is hotter than the active area and positive, when the active area is hotter than the heat sink. When both heat sink and active area are at room temperature a zero voltage of some µV is normal.

3.3.2 Wavelength Correction

To adjust the operating wavelength proceed as described in section Wavelength Correction.

3.3.3 Readout Acceleration

Thermal sensors show a fairly slow response. When laser power hits the active area, it takes up to some 5 to 10 seconds until the system has settled and the power reading shows the right value.

This settling time can be shortened to approximately 1 second using a special circuitry that 'predicts' the final power value. As a downside, in this ‘High Speed’ mode the resulting power reading is more noisy.

To select the response behavior, enter the <CH1 Setup> and navigate to the ‘Mode’ menu. Toggle between ‘Low Noise’, where the acceleration circuit is switched off, and ‘High Speed’ with enabled acceleration circuit.

3.3.4 Custom Thermal Elements

Beside Thorlabs thermal power meter sensors, any thermal elements with an output voltage up to 1V can be connected to the PM320E:

- Connect the thermal element to one of the DB-9 connectors (CH1 or CH2); with pin 8 to plus pole and pin 3 to ground.
- Connect a resistor (1 kΩ to 10 kΩ) between pin 7 (PRESENT) and 3 (GND).

The PM320E will recognize a ‘Thermal Head Adapter’. The read-out will be in Volts or - if a responsivity factor in V/W has been entered - also as power value in Watts or dBm.

Further, the time constant of the thermal element can be entered in order to adjust the read-out acceleration.

3.4 Pyroelectric Energy Sensor Operation

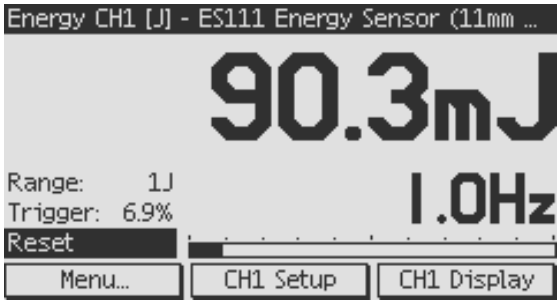
With pyroelectric sensors the PM320E measures laser pulse energy of single and continuously repeating laser pulses (short pulse). Pyroelectric sensors of the Thorlabs ES1xxC and ES2xxC series can be connected to both CH1 and CH2 9 pin DSUB connectors on the rear panel. The sensor will be recognized immediately after plugging-in. With a power meter sensor plugged-in at the rear panel, the related photo-diode input in the front panel is disabled.

Attention

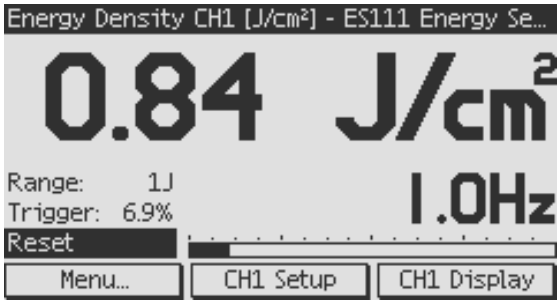
Refer to the sensor data sheet and pay attention to the optical damage threshold!
Exceeding these values will permanently destroy the sensor!

A pyroelectric sensor permits the direct transformation of a radiation energy pulse into a voltage pulse independent of the wavelength of the incident radiation. The peak value of this voltage pulse is proportional to the laser pulse energy and is measured by a peak detector circuit.

When a pyroelectric sensor is connected, the PM320E cannot be switched to auto-range mode. The measurement value will be updated with each incoming pulse. When no pulses appear the measurement display will be held on the last measured value. To reset the reading scroll to the <Reset> setting and press the multi-control knob. The measurement value will show ---.- until the next pulse appears.



Pyroelectric Sensor - Energy Readout



Pyroelectric Sensor - Energy Density Readout

3.4.1 Trigger Level

For laser pulse measurements the PM320E generates an artificial trigger from the incoming pulse signal. When an incoming pulse exceeds the set trigger level, the peak detector circuit gets armed and is waiting until the pulse peak is reached. After finding the maximum voltage, this level is kept and the microprocessor reads the AD converted voltage for displaying the pulse energy. Finally, the peak detector circuit gets a reset and is ready for the next pulse.

The trigger level can be adjusted between 1% and 70% of each energy range. Only pulses that are higher than the adjusted trigger level are recognized by the PM320E. The trigger level should be set between the noise level and the expected pulse height.

3.4.2 Wavelength Correction

To adjust the operating wavelength proceed as described in section Wavelength Correction.

3.4.3 Display Features

Average Power Measurement

With continuously repeating pulses, the PM320E calculates the average power from the pulse energy and the repetition rate. For displaying the average power enter the CHx Setup and set the Main Display to Average Power.

Repetition Rate

The repetition rate can be displayed in both main and sub display by selecting ‘Freq. [Hz]’ in the CHx Setup. The measurement value will be updated with each incoming pulse.

Area Calculation

When the diameter of the incident beam is entered, this function returns either the average power density or the energy density. To display this measurement value enter the CHx Setup and chose power or energy density in the Main Display. For entering the beam diameter navigate the CHx Setup to ‘Beam Diameter $1/e^2$ '.

3.4.4 Custom Pyroelectric Sensors

Beside Thorlabs pyroelectric energy sensors, any pyroelectric elements with an output peak voltage up to 100 V can be connected to the PM320E:

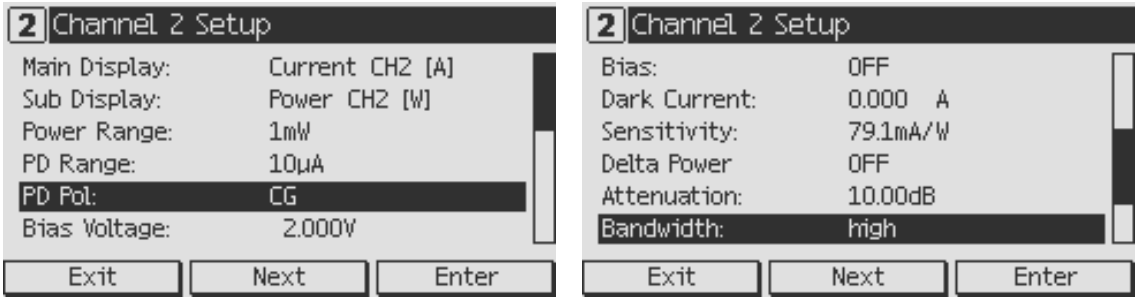
- Connect the pyroelectric element to one of the DB-9 connectors (CH1 or CH2); with pin 8 to plus pole and pin 3 to ground.
- Connect a resistor (1 kΩ to 10 kΩ) between pin 7 (PRESENT) and 3 (GND).

The PM320E will recognize a ‘Pyro Head Adapter’. The read-out will be in Volts or - if the responsivity factor in V/J has been entered - also as energy value in Joules or average power value in Watts.

3.5 Power Measurement Using Photo Diodes

Common photodiodes or Thorlabs packaged photodiodes of the SM05PD and SM1PD Series can be connected to both BNC jacks in the front panel. The BNC input is automatically enabled when no power meter sensor or adapter is connected to the related 9 pin DSUB connector in the rear. The photodiode input supports both anode ground and cathode ground polarities. Further, a bias voltage can be applied to the connected photodiode.

For adjusting the dark current and setting the measurement bandwidth, please refer to the corresponding chapters in the photodiode sensor section.



3.5.1 Photodiode Polarity

The polarity of the photodiode must be set in such way that the measured current shows a positive reading, otherwise the display will show '------' when switching to the power display in mW or dBm. To set the polarity, enter the <CHx Setup> and navigate to the 'PD Pol' menu. Change the value between AG (anode grounded) and CG (cathode grounded).

The polarity can be changed only with the Bias voltage switched off.

3.5.2 Setting the Photodiode Responsivity

The photo current can be displayed as a power level in Watts or dBm only if

- the polarity has been set in such way that the current reading is positive and
- the responsivity value (η) has been adjusted to the current setup conditions (default is 1 A/W).

To change the responsivity value, navigate to the direct access 'η' setting and press the control knob to edit the value. Set the responsivity according the desired wavelength and the photodiode data sheet. Confirm with <OK> or clicking the control knob.

The current range and the power range can also be changed in the <CHx Setup> under the corresponding menus.

3.5.3 Bias

A bias voltage between 0 and 10 V can be applied to the photodiode. The voltage can be set in the <CHx Setup> under the 'Bias Voltage' menu. To switch the bias voltage, navigate to the 'Bias' menu in the channel display or in the channel setups.

Attention

Make sure of a positive current reading prior to applying a bias voltage. Refer to the diode data sheet for the maximum bias voltage.
The photo diode can be permanently damaged when applying a wrongly poled or too high bias voltage.

3.6 Statistics Mode

The statistics mode can be accessed by toggling the ‘CHx Display’ button (right soft key) in a Single Channel screen.

Three modes can be selected to acquire the measurement data:

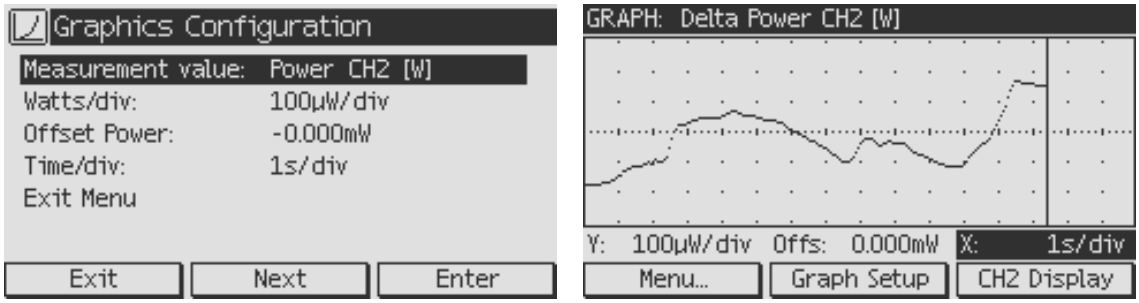
- Continuous: Data will be acquired until the <Stop> button is pressed
- Time: Data will be acquired for a pre-selected time
- Samples: Data will be acquired for a pre-selected number of samples

The measurement gets triggered either automatically or externally via the BNC trigger input in the rear panel. To start the data acquisition press the <Start/Reset> button.

Statistics Mode for Power / Energy Measurements

3.7 Chart Mode (Power Sensors)

The chart mode can be accessed by toggling the ‘CHx Display’ button (right soft key) in a Single Channel screen. The read-out type, gain, offset and time-base can be configured either by the soft buttons or by accessing the ‘Graphics Configuration’ in the main ‘Menu’.



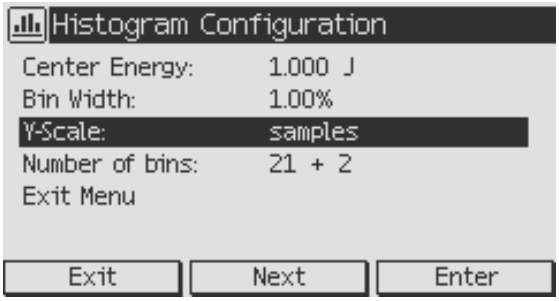
Changing of the ‘Y’, ‘X’ and ‘Offs’ parameters get immediately active in the editing mode. Clicking the control button resets the graph.

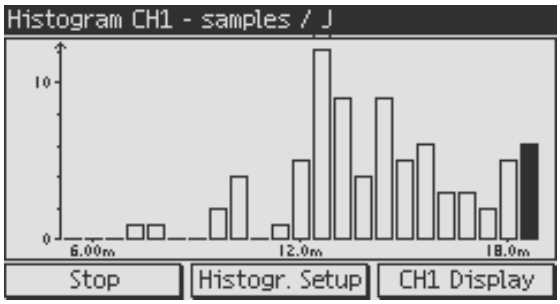
The time base can be set from 100ms/div up to 1h/div so that up to 16 hours can be monitored on one screen.

This screen can be accessed only with power sensors or photodiodes.

3.8 Histogram Mode (Energy Sensors)

The histogram mode can be accessed by toggling the 'CHx Display' button (right soft key) in a Single Channel screen when an energy sensor is connected. This screen can be accessed only when an energy sensor connected.





To initialize a histogram perform an energy measurement in the standard display and optimize the measurement range and the trigger level. Toggle the 'CHx Display' button until the histogram screen appears. Press the 'Histogram Setup' button and adjust the center energy to the previously measured energy. The bin width can be set as percentage of the center energy value, the Y-scale can be set in percent or samples. Further the number of bins can be adjusted between 5 and 21. Energy levels that are outside of the measurement range are shown in black bins on the left and right side of the histogram.

3.9 System Configuration

The system configuration menu contains the following items:

Item	Value	Description
LCD Brightness	0 – 100%	Sets Backlight of the LCD
Sound	ON/OFF	
Local Operation/ Remote Operation	------- Go To Local	Shows Remote State
Line Filter	50Hz / 60Hz	Sets line filter to the mains conditions to suppress unwanted aliasing effects in the read outs

All other items are for information only and show for example serial number and software versions.

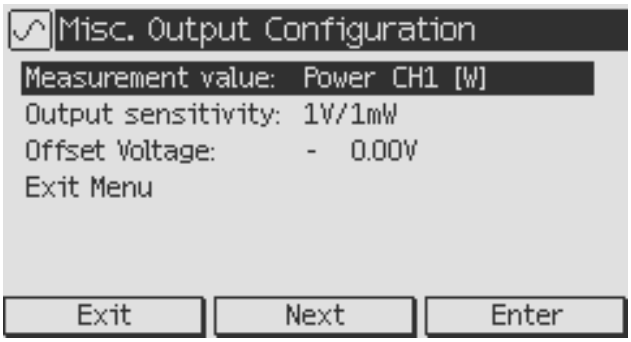
3.10 Analog Output

The analog outputs CH1 OUT and CH2 OUT provide the amplified photodiode current or the amplified thermal sensor voltage with the selected bandwidth. With thermal sensors, the analog output shows the direct amplified and accelerated voltage response from the sensor. With pyroelectric sensors, the signal from the analog output is the pulse response from the sensor prior to the peak detection circuit.

The signals from the analog outputs are not wavelength corrected. The voltage is range dependent within the interval from -10V to +10V.

3.11 Miscellaneous Analog Output

The MISC OUT is a programmable analog output that provides a voltage from -10V to +10V depending on the selected function. The voltage from this output can be configured in the ‘Misc Output Configuration’ in the main ‘Menu’ in terms of each possible power or energy read out (Measurement Value), gain (Output Sensitivity) and offset (Offset Voltage).



Display MISC OUT Configuration

4 Remote Operation

ThePM320E optical power meter has a USB 2.0 interface that allows to send commands from a host computer to the instrument. The connection between PC and PM320E is accomplished by a USB cable with a male type 'A' connector at the PC side and a type 'B' connector on the instrument side.

There are two categories of command types:

- Set commands that bring the PM320E to the desired configuration
- Query commands that get data from the PM320E. These commands are always terminated by a question mark (?).

4.1 Connecting a Computer

Note

To successfully complete the installation of the PM320E USB driver you must have administrator privileges on the PC which you are performing the installation.

Prior to connecting the PM320E to the PC, please insert the CD that is shipped with the instrument and install the PM320E drivers. When the following message appears after the installation, you also need to install NI-VISA form the distribution CD or from the National Instruments web site:

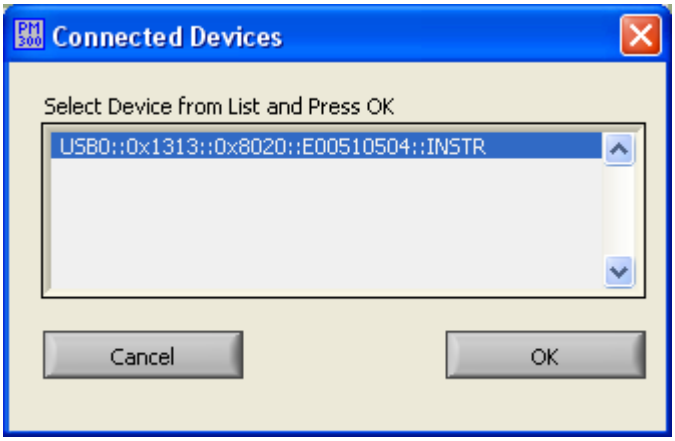
After the software is installed successfully, connect the PM320E to a USB port of your PC. The PC will find sequentially a PM320E and a DFU device. Please follow the instructions of the dialog screens and allow the installation.

4.2 PM320E Utility Software

The PM320E comes with a utility software that easily enables operating the PM320E and visualizing and logging measurement data. The software is written in LabVIEW 8.5 and can either be installed from the CD as executable where LabVIEW isn't required on the PC; or can be run with LabVIEW 8.5 or higher. In any case it is necessary to install the drivers as described in chapter Connecting a Computer.

The source code of the application is included on the CD and can be used to build own applications or to modify the utility program to customer requirements.

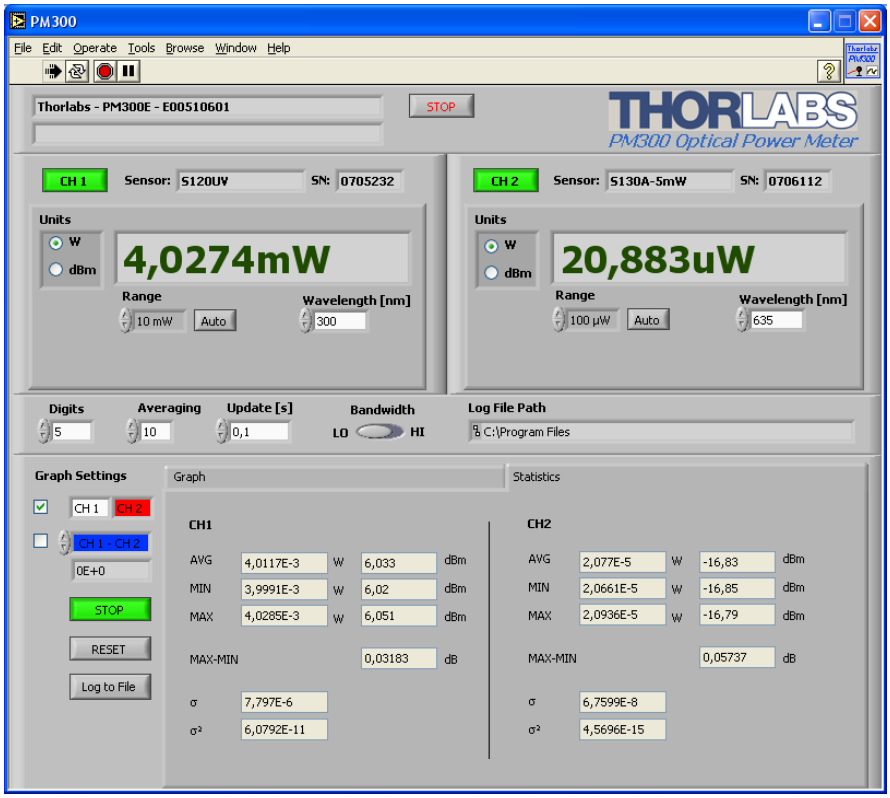
After launching the PM320E utility program it will automatically scan the USB interface for connected PM320E series devices. Select the desired PM320E device and press o.k.



The identification string contains the following items:

Thorlabs Vendor ID = 0x1313
Product ID: 0x8022 = PM320E
Serial number

The utility software will recognize and update connected sensors while the program is running. The display data can be logged to a file after pressing the <START> and <Log To File> buttons.



5 Command Reference

5.1 Common IEEE488.2 Commands

The device supports several IEEE488.2 common commands and queries. Additional descriptive information may be found in the IEEE488.2-1992-§10 standard.

Command List

Command	Description
***IDN?**	Identification query. (IEEE488.2-1992-§10.14)
***TST?**	Selftest query. (IEEE488.2-1992-§10.38)
***OPC**	Operation complete command. (IEEE488.2-1992-§10.18)
***OPC?**	Operation complete query. (IEEE488.2-1992-§10.19)
***WAI**	Wait command. (IEEE488.2-1992-§10.39)
***RST**	Reset command. (IEEE488.2-1992-§10.32)
***SRE**	Service Request Enable command. (IEEE488.2-1992-§10.34)
***SRE?**	Service Request Enable query. (IEEE488.2-1992-§10.35)
***STB?**	Read Status Byte query. (IEEE488.2-1992-§10.36)
***ESE**	Standard Event Status Enable command. (IEEE488.2-1992-§10.10)
***ESE?**	Standard Event Status Enable query. (IEEE488.2-1992-§10.11)
***ESR?**	Standard Event Status Register query. (IEEE488.2-1992-§10.12)
***CLS**	Clear Status command. (IEEE488.2-1992-§10.3)

Descriptions

Identification Query

Command format: ***IDN?**

Response format: **<ARBITRARY ASCII RESPONSE DATA>**

Description: Identification query (see also IEEE488.2-1992-§10.14).
The response is organized into four fields separated by commas.
(Manufacturer, Model, Serial number, Firmware level)

Selftest Query

Command format: ***TST?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Selftest query (see also IEEE488.2-1992-§10.38 and chapter ‘Selftest Results’ in this document).
A return value of ‘0’ means success.

Operation Complete Command

Command format: ***OPC**

Description: Sets the ‘OPC’ bit in the ‘Standard Event Status Register’ (see also IEEE488.2-1992-§10.18).

Operation Complete Query

Command format: ***OPC?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: The Operation Complete Query places a ‘1’ into the device’s output queue (see also IEEE488.2-1992-§10.19).

Wait Command

Command format: ***WAI**

Description: This command is required for IEEE488 compatibility and has no effect. (see also IEEE488.2-1992-§10.39).

Reset Command

Command format: ***RST**

Description: This command resets the device. (see also IEEE488.2-1992-§10.32).

Service Request Enable Command

Command format: ***SRE <DECIMAL NUMERIC PROGRAM DATA>**

Description: Sets the device's Service Request Enable Register (see also IEEE488.2-1992-§10.34 and chapter 'Status Reporting' in this document).

Service Request Enable Query

Command format: ***SRE?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Service Request Enable Register (see also IEEE488.2-1992-§10.35 and chapter 'Status Reporting' in this document).

Read Status Byte Query

Command format: ***STB?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Status Byte (see also IEEE488.2-1992-§10.36 and chapter 'Status Reporting' in this document).

Standard Event Status Enable Command

Command format: ***ESE <DECIMAL NUMERIC PROGRAM DATA>**

Description: Sets the device's Standard Event Status Enable Register (see also IEEE488.2-1992-§10.10 and chapter 'Status Reporting' in this document).

Standard Event Status Enable Query

Command format: ***ESE?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Standard Event Status Enable Register (see also IEEE488.2-1992-§10.11 and chapter 'Status Reporting' in this document).

Standard Event Status Register Query

Command format: ***ESR?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Standard Event Status Register (see also IEEE488.2-1992-§10.12 and chapter 'Status Reporting' in this document).

Clear Status Command

Command format: ***CLS**

Prerequisite: None

Description: Clears the following device's status registers (see also IEEE488.2-1992-§10.3):

- Standard Event Status Register
- Device Error Event Register
- Device Operation Event Register
- Device Error Queue

5.2 Measurement Commands

Command List

Command	Description
:AVER[1,2]?	Query the channel 1/2 averaging rate
:AVER[1,2]	Set the channel 1/2 averaging rate
:POW[1,2]:VAL?	Query the channel 1/2 measured power [W]
:CURR[1,2]:VAL?	Query the channel 1/2 measured current [A]
:VOLT[1,2]:VAL?	Query the channel 1/2 measured voltage [V]
:UPY[1,2]:VAL?	Query the channel 1/2 measured pyroelectric adapter voltage [V]
:ZERO[1,2]:VAL?	Query the channel 1/2 Zero Offset Value
:ZERO[1,2]:ADJ	Performs a Zero Offset Value adjustment for channel 1/2
:ENERGY[1,2]:VAL?	Query the channel 1/2 measured pulse energy [J]
:PAVG[1,2]:VAL?	Query the channel 1/2 measured average power [W]
:FREP[1,2]:VAL?	Query the channel 1/2 measured pulse rep. frequency [Hz]
:EDENSITY[1,2]:VAL?	Query the channel 1/2 measured energy density [J/cm²]
:PDENSITY[1,2]:VAL?	Query the channel 1/2 measured power density [W/cm²]
:MEAS:INIT[1,2]	Initiate a measurement on channel 1/2
:MEAS:ABORT[1,2]	Abort a measurement initiated on channel 1/2
:MEAS:CHECK[1,2]?	Check if measurement initiated on channel 1/2 has finished
:FETCH:CURR[1,2]:VAL?	Fetch the channel 1/2 measured photodiode current value [A]
:FETCH:VOLT[1,2]:VAL?	Fetch the channel 1/2 measured photodiode thermopile voltage value [V]
:FETCH:UPY[1,2]:VAL?	Fetch the channel 1/2 measured pyroelectric adapter voltage value [V]
:FETCH:POW[1,2]:VAL?	Fetch the channel 1/2 measured optical power [W]
:FETCH:ENERGY[1,2]:VAL?	Fetch the channel 1/2 measured pulse energy value [J]
:FETCH:FREP[1,2]:VAL?	Fetch the channel 1/2 measured pulse repetition frequency value [Hz]
:FETCH:EDENSITY[1,2]:VAL?	Fetch the channel 1/2 measured pulse energy density value [J/cm²]
:FETCH:PAVG[1,2]:VAL?	Fetch the channel 1/2 measured average power value [W]
:FETCH:PDENSITY[1,2]:VAL?	Fetch the channel 1/2 measured power density value [W/cm²]

Descriptions

Query the Averaging Rate

Command format: **:AVER[1,2]?**

Response format: currently used Averaging Rate **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the currently used averaging rate for channel 1/2.

Set the Averaging Rate

Command format: **:AVER[1,2] <DECIMAL NUMERIC PROGRAM DATA>**

Description: Sets the averaging rate for channel 1/2.
Note: The averaging rate does not influence the front panel display. The instrument measures at 500Hz rate. Use this value to achieve an appropriate line filtering. To achieve a good 60Hz filtering use a multiple of 25. To achieve a good 50Hz filtering use a multiple of 10.

Power Query

Command format:	**:POW[1,2]:VAL?**
Response format:	Optical power **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured optical power value in Watt [W]. Note: If an overflow occurs the value '+Inf' or '-Inf' is returned.

Current Query

Command format:	**:CURR[1,2]:VAL?**
Response format:	Photodiode current **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured photodiode current in Ampere [A]. Note: If an overflow occurs the value '+Inf' or '-Inf' is returned.

Voltage Query (channel 2 PM320E only)

Command format:	**:VOLT[1,2]:VAL?**
Response format:	Thermopile voltage **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured thermopile voltage in Volt [V]. Note: If an overflow occurs the value '+Inf' or '-Inf' is returned.

Pyroelectric Adapter Voltage Query

Command syntax:	**:UPY[1,2]:VAL?**
Response syntax:	Pyroelectric adaptor voltage **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pyroelectric adapter voltage in Volt [V]. Note: If an overflow occurs the value '+Inf' or '-Inf' is returned.

Query the Zero Offset Value

Command format:	**:ZERO[1,2]:VAL?**
Response format:	Zero offset value **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the currently used channel 1/2 zero offset value in Ampere/Volt.

Perform a Zero Offset Value Adjustment

Command format:	**:ZERO[1,2]:ADJ**
Description:	Performs a zero offset value adjustment for channel 1/2. Note: The zero offset value adjustment will take some seconds to complete.

Energy Query

Command format:	**:ENERGY[1,2]:VAL?**
Response format:	Pulse Energy **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pulse energy in Joules [W]. Note: If an overflow occurs the value '+Inf' or '-Inf' is returned.

Average Power Query

Command format:	**:PAVG[1,2]:VAL?**
Response format:	Averaged Power **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured averaged power Watts [W]. (i.e. P_{AVG} = (last) pulse energy × repetition frequency Note: If an overflow occurs the value '+Inf' or '-Inf' is returned.

Repetition Frequency Query

Command format:	**:FREP[1,2]:VAL?**
Response format:	Pulse Repetition Frequency **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pulse repetition frequency in Hertz [Hz]. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Energy Density Query

Command format:	**:EDENSITY[1,2]:VAL?**
Response format:	Pulse Energy Density **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pulse energy density [J/cm²]. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Power Density Query

Command format:	**:PDENSITY[1,2]:VAL?**
Response format:	Power Density **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured power density [W/cm²]. (i.e. $D_{POW} = D_{ENERGY} \times$ repetition frequency Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Initiate a measurement

Command syntax:	**:MEAS:INIT[1,2]**
Description:	Initiates a new measurement at the selected channel. The status of a measurement can be checked with the :MEAS:CHECK[1,2]? command (see below).

Abort a running measurement

Command syntax:	**:MEAS:ABORT[1,2]**
Description:	Cancels a running measurement at the selected channel.

Measurement Status Check Query

Command syntax:	**:MEAS:CHECK[1,2]?**
Response syntax:	**<CHARACTER RESPONSE DATA> [0,1]**
Description:	Queries the status of a measurement. In case the measurement is still in process the return value will be 1. When the measurement is finished the return value is 0.

Current Value Query

Command syntax:	**:FETCH:CURR[1,2]:VAL?**
Response syntax:	Photodiode current **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured photodiode current value in Ampere [A] of the measurement started by **:MEAS:INIT[1,2]**. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Voltage Value Query

Command syntax:	**:FETCH:VOLT[1,2]:VAL?**
Response syntax:	Thermopile voltage **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured thermopile voltage value in Volt [V] of the measurement started by **:MEAS:INIT[1,2]**. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Pyroelectric Adapter Voltage Value Query

Command syntax:	**:FETCH:UPY[1,2]:VAL?**
Response syntax:	Pyroelectric adaptor voltage **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pyroelectric adapter voltage value in Volt [V] of the measurement started by **:MEAS:INIT[1,2]**. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Power Value Query

Command syntax:	**:FETCH:POW[1,2]:VAL?**
Response syntax:	Optical power **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured optical power value in Watt [W] of the measurement started by **:MEAS:INIT[1,2]**. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Energy Value Query

Command syntax:	**:FETCH:ENERGY[1,2]:VAL?**
Response syntax:	Pulse Energy **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pulse energy value in Joules [W] of the measurement started by **:MEAS:INIT[1,2]**. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Repetition Frequency Value Query

Command syntax:	**:FETCH:FREP[1,2]:VAL?**
Response syntax:	Pulse Repitition Frequency **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pulse repitition frequency value in Hertz [Hz] of the measurement started by **:MEAS:INIT[1,2]**. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Energy Density Value Query

Command syntax:	**:FETCH:EDENSITY[1,2]:VAL?**
Response syntax:	Energy Density **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured pulse energy density value in Joules per square cm [J/cm^2] of the measurement started by **:MEAS:INIT[1,2]**. Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Average Power Value Query

Command syntax:	**:FETCH:PAVG[1,2]:VAL?**
Response syntax:	Averaged Power **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured averaged power value in Watts [W] of the measurement started by **:MEAS:INIT[1,2]**. (i.e. P_{AVG} = (last) pulse energy × repetition frequency Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

Power Density Value Query

Command syntax:	**:FETCH:PDENSITY[1,2]:VAL?**
Response syntax:	Power Density **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 measured average pulse power density value in Watts per square cm [W/cm²] of the measurement started by **:MEAS:INIT[1,2]**. (i.e. D_{POW} = D_{ENERGY} × repetition frequency) Note: If an overflow occurs the value ‘+Inf’ or ‘-Inf’ is returned.

5.3 Device Setup Commands

Command List

Command	Description
:PRANGE[1,2]	Set the channel 1/2 power range.
:PRANGE[1,2]?	Query the channel 1/2 power range.
:PRANGE[1,2]:MIN?	Query the channel 1/2 minimum settable power range.
:PRANGE[1,2]:MAX?	Query the channel 1/2 maximum settable power range.
:IRANGE[1,2]	Set the channel 1/2 current range.
:IRANGE[1,2]?	Query the channel 1/2 current range.
:IRANGE[1,2]:MIN?	Query the channel 1/2 minimum settable current range.
:IRANGE[1,2]:MAX?	Query the channel 1/2 maximum settable current range.
:URANGE[1,2]	Set the channel 1/2 voltage range.
:URANGE[1,2]?	Query the channel 1/2 voltage range.
:URANGE[1,2]:MIN?	Query the channel 1/2 minimum settable voltage range.
:URANGE[1,2]:MAX?	Query the channel 1/2 maximum settable voltage range.
:ERANGE[1,2]	Set the channel 1/2 energy range.
:ERANGE[1,2]?	Query the channel 1/2 energy range.
:ERANGE[1,2]:MIN?	Query the channel 1/2 minimum settable energy range.
:ERANGE[1,2]:MAX?	Query the channel 1/2 maximum settable energy range.
:VRANGE[1,2]	Set the channel 1/2 pyroelectric voltage range.
:VRANGE[1,2]?	Query the channel 1/2 pyroelectric voltage range.
:VRANGE[1,2]:MIN?	Query the channel 1/2 minimum settable pyroelectric voltage range.
:VRANGE[1,2]:MAX?	Query the channel 1/2 maximum settable pyroelectric voltage range.
:WAVEL[1,2]:VAL	Set the wavelength for channel 1/2
:WAVEL[1,2]:VAL?	Query the currently used wavelength for channel 1/2
:WAVEL[1,2]:RNG?	Query the channel 1/2 wavelength range
:ATTEN[1,2]:VAL	Set the channel 1/2 power attenuation
:ATTEN[1,2]:VAL?	Query the channel 1/2 power attenuation
:ATTEN[1,2]:RNG?	Query the channel 1/2 power attenuation range
:PDBANDW[1,2]	Set the channel 1/2 photodiode input/photodiode sensor bandwidth.
:PDBANDW[1,2]?	Query the channel 1/2 photodiode input/photodiode sensor bandwidth.
:PDPOL[1,2]	Set the channel 1/2 photodiode input polarity
:PDPOL[1,2]?	Query the channel 1/2 photodiode input polarity
:PDRESP[1,2]:VAL	Set the photodiode responsivity for channel 1/2
:PDRESP[1,2]:VAL?	Query the currently used photodiode responsivity for channel 1/2
:PDRESP[1,2]:RNG?	Query the channel 1/2 photodiode responsivity range
:PDBIAS[1,2]	Set the channel 1/2 photodiode input BIAS state
:PDBIAS[1,2]?	Query the channel 1/2 photodiode input BIAS state
:PDBIAS[1,2]:VAL	Set the channel 1/2 photodiode input BIAS voltage
:PDBIAS[1,2]:VAL?	Query the channel 1/2 photodiode input BIAS voltage
:PDBIAS[1,2]:RNG?	Query the channel 1/2 photodiode input BIAS voltage range
:THACCEL[1,2]	Set the channel 1/2 thermopile accelerator state.
:THACCEL[1,2]?	Query the channel 1/2 thermopile accelerator state.

Command	Description
:THTIMECONST[1,2]:VAL	Set the channel 1/2 thermopile adapter accelerator time constant value [s]
:THTIMECONST[1,2]:VAL?	Query the channel 1/2 thermopile adapter accelerator time constant value [s]
:THTIMECONST[1,2]:RNG?	Query the channel 1/2 thermopile adapter accelerator time constant value range [s]
:THRESP[1,2]:VAL	Set the thermopile responsivity for channel 1/2
:THRESP[1,2]:VAL?	Query the currently used thermopile responsivity for channel 1/2
:THRESP[1,2]:RNG?	Query the channel 1/2 thermopile responsivity range
:PYRESP[1,2]:VAL	Set the pyro sensor responsivity for channel 1/2
:PYRESP[1,2]:VAL?	Query the pyro sensor responsivity for channel 1/2
:PYRESP[1,2]:RNG?	Query the channel 1/2 pyro sensor responsivity range
:TRIGLVL[1,2]:VAL	Set the pyro sensor trigger level for channel 1/2
:TRIGLVL[1,2]:VAL?	Query the pyro sensor trigger level for channel 1/2
:TRIGLVL[1,2]:RNG?	Query the channel 1/2 pyro sensor trigger level range
:TRIGMODE[1,2]	Set the channel 1/2 trigger mode
:TRIGMODE[1,2]?	Query the channel 1/2 trigger mode
:BEAMDIA[1,2]:VAL	Set the pyro sensor beam diameter 1/2
:BEAMDIA[1,2]:VAL?	Query the pyro sensor beam diameter for channel 1/2
:BEAMDIA[1,2]:RNG?	Query the channel 1/2 pyro sensor beam diameter range
:ADAPTYPE[1,2]	Set the sensor type to use if an adapter is connected
:ADAPTYPE[1,2]?	Query the sensor type to use if an adapter is connected

Descriptions

Set Channel 1/2 Power Range

Command format: **:PRANGE[1,2] <CHARACTER PROGRAM DATA>**
[AUTO,R1NW,R10NW,R100NW,R1UW,R10UW,R100UW,R1MW,R10MW,
R100MW,R1W,R10W,R100W,R1KW]

Description: Sets the power range for channel 1/2.

Query Channel 1/2 Power Range

Command format: **:PRANGE[1,2]?**

Response format: **<CHARACTER RESPONSE DATA>**
[AUTO,R1NW,R10NW,R100NW,R1UW,R10UW,R100UW,R1MW,R10MW,
R100MW,R1W,R10W,R100W,R1KW]

Description: Queries the channel 1/2 power range.

Query Channel 1/2 Minimum Power Range

Command format: **:PRANGE[1,2]:MIN?**

Response format: **<CHARACTER RESPONSE DATA>**
[AUTO,R1NW,R10NW,R100NW,R1UW,R10UW,R100UW,R1MW,R10MW,
R100MW,R1W,R10W,R100W,R1KW]

Description: Queries the channel 1/2 minimum settable power range.

Query Channel 1/2 Maximum Power Range

Command format: **:PRANGE[1,2]:MAX?**

Response format: **<CHARACTER RESPONSE DATA>**
[AUTO,R1NW,R10NW,R100NW,R1UW,R10UW,R100UW,R1MW,R10MW,
R100MW,R1W,R10W,R100W,R1KW]

Description: Queries the channel 1/2 maximum settable power range.

Set Channel 1/2 Current Range

Command format: **:IRANGE[1,2] <CHARACTER PROGRAM DATA>**
[AUTO,R100NA,R1UA,R10UA,R100UA,R1MA,R10MA]

Description: Sets the current range for channel 1/2.

Query Channel 1/2 Current Range

Command format: **:IRANGE[1,2]?**

Response format: **<CHARACTER RESPONSE DATA>**
[AUTO,R100NA,R1UA,R10UA,R100UA,R1MA,R10MA]

Description: Queries the channel 1/2 current range.

Query Channel 1/2 Minimum Current Range

Command format: **:IRANGE[1,2]:MIN?**

Response format: **<CHARACTER RESPONSE DATA>**
[AUTO,R100NA,R1UA,R10UA,R100UA,R1MA,R10MA]

Description: Queries the channel 1/2 minimum settable current range.

Query Channel 1/2 Maximum Current Range

Command format: **:IRANGE[1,2]:MAX?**

Response format: **<CHARACTER RESPONSE DATA>**
[AUTO,R100NA,R1UA,R10UA,R100UA,R1MA,R10MA]

Description: Queries the channel 1/2 maximum settable current range.

Set Channel 1/2 Thermopile Voltage Range

Command format: **:URANGE[1,2] <CHARACTER PROGRAM DATA> [AUTO,R1MV,R10MV,R100MV,R1V]**
Response format

Description: Sets the thermopile voltage range for channel 1/2.

Query Channel 1/2 Thermopile Voltage Range

Command format: **:URANGE[1,2]?**

Response format: **<CHARACTER RESPONSE DATA> [AUTO,R1MV,R10MV,R100MV,R1V]**

Description: Queries the channel 1/2 thermopile voltage range.

Query Channel 1/2 Minimum Thermopile Voltage Range

Command format: **:URANGE[1,2]:MIN?**

Response format: **<CHARACTER RESPONSE DATA> [AUTO,R1MV,R10MV,R100MV,R1V]**

Description: Queries the channel 1/2 minimum settable thermopile voltage range.

Query Channel 1/2 Maximum Thermopile Voltage Range

Command format: **:URANGE[1,2]:MAX?**

Response format: **<CHARACTER RESPONSE DATA> [AUTO,R1MV,R10MV,R100MV,R1V]**

Description: Queries the channel 1/2 maximum settable thermopile voltage range.

Set Channel 1/2 Energy Range

Command format: **:ERANGE[1,2] <CHARACTER PROGRAM DATA>**
Response format: **[R10UJ,R100UJ,R1MJ,R10MJ,R100MJ,R1J,R10J,R100J,R1KJ]**
Description: Sets the energy range for channel 1/2.

Query Channel 1/2 Energy Range

Command format: **:ERANGE[1,2]? <CHARACTER RESPONSE DATA>**
Response format: **[R10UJ,R100UJ,R1MJ,R10MJ,R100MJ,R1J,R10J,R100J,R1KJ]**
Description: Queries the channel 1/2 energy range.

Query Channel 1/2 Minimum Energy Range

Command format: **:ERANGE[1,2]:MIN? <CHARACTER RESPONSE DATA>**
Response format: **[R10UJ,R100UJ,R1MJ,R10MJ,R100MJ,R1J,R10J,R100J,R1KJ]**
Description: Queries the channel 1/2 minimum settable energy range.

Query Channel 1/2 Maximum Energy Range

Command format: **:ERANGE[1,2]:MAX? <CHARACTER RESPONSE DATA>**
Response format: **[R10UJ,R100UJ,R1MJ,R10MJ,R100MJ,R1J,R10J,R100J,R1KJ]**
Description: Queries the channel 1/2 maximum settable energy range.

Set Channel 1/2 Pyroelectric Voltage Range

Command format: **:VRANGE[1,2] <CHARACTER PROGRAM DATA>**
Response format: **[R100MV,R1V,R10V,R100V]**
Description: Sets the pyroelectric voltage range for channel 1/2.

Query Channel 1/2 Pyroelectric Voltage Range

Command format: **:VRANGE[1,2]? <CHARACTER RESPONSE DATA>**
Response format: **[R100MV,R1V,R10V,R100V]**
Description: Queries the channel 1/2 pyroelectric voltage range.

Query Channel 1/2 Minimum Pyroelectric Voltage Range

Command format: **:VRANGE[1,2]:MIN? <CHARACTER RESPONSE DATA>**
Response format: **[R100MV,R1V,R10V,R100V]**
Description: Queries the channel 1/2 minimum settable pyroelectric voltage range.

Query Channel 1/2 Maximum Pyroelectric Voltage Range

Command format: **:VRANGE[1,2]:MAX? <CHARACTER RESPONSE DATA>**
Response format: **[R100MV,R1V,R10V,R100V]**
Description: Queries the channel 1/2 maximum settable pyroelectric voltage range.

Set Channel 1/2 Wavelength

Command format: **:WAVEL[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description: Sets the channel 1/2 wavelength [nm] to use for calculating the sensor sensitivity.

Query Channel 1/2 Wavelength

Command format: **:WAVEL[1,2]:VAL?**
Response format: currently used wavelength **<NR3 NUMERIC RESPONSE DATA>**
Description: Queries the channel 1/2 currently used wavelength [nm].

Query Channel 1/2 Wavelength Range

Command format:	**:WAVEL[1,2]:RNG?**
Response format:	minimum settable wavelength [nm] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable wavelength [nm] **<NR3 NUMERIC RESPONSE DATA>,** currently used wavelength [nm] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 wavelength range.

Set Channel 1/2 Power Attenuation

Command format:	**:ATTEN[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the channel 1/2 power attenuation [dB].

Query Channel 1/2 Power Attenuation

Command format:	**:ATTEN[1,2]:VAL?**
Response format:	currently used power attenuation **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 currently used power attenuation [dB].

Query Channel 1/2 Power Attenuation Range

Command format:	**:ATTEN[1,2]:RNG?**
Response format:	minimum settable power attenuation [dB] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable power attenuation [dB] **<NR3 NUMERIC RESPONSE DATA>,** default power attenuation [dB] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 power attenuation range.

Set Channel 1/2 Photodiode Input/Sensor Bandwidth

Command format:	**:PDBANDW[1,2] <CHARACTER PROGRAM DATA> [LOW,HIGH]**
Description:	Sets the photo diode input/sensor bandwidth setting.

Query Channel 1/2 Photodiode Input/Sensor Bandwidth

Command format:	**:PDBANDW[1,2]?**
Response format:	**<CHARACTER RESPONSE DATA> [LOW,HIGH]**
Description:	Queries the photo diode input/sensor bandwidth setting.

Set Channel 1/2 Photodiode Input Polarity

Command format:	**:PDPOL[1,2] <CHARACTER PROGRAM DATA> [AG,CG]**
Description:	Sets the photodiode input polarity to anode ground/cathode ground..

Query Channel 1/2 Photodiode Input Polarity

Command format:	**:PDPOL[1,2]?**
Response format:	**<CHARACTER RESPONSE DATA> [AG,CG]**
Description:	Queries the photodiode input polarity.

Set Channel 1/2 Photodiode Responsivity

Command format:	**:PDRESP[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the channel 1/2 photodiode responsivity [A/W].

Query Channel 1/2 Photodiode Responsivity

Command format:	**:PDRESP[1,2]:VAL?**
Response format:	currently used photodiode responsivity **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 currently used photodiode responsivity [A/W].

Query Channel 1/2 Photodiode Responsivity Range

Command format:	**:PDRESP[1,2]:RNG?**
Response format:	minimum settable photodiode resp. [A/W] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable photodiode resp. [A/W] **<NR3 NUMERIC RESPONSE DATA>,** currently used photodiode responsivity [A/W] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 photodiode responsivity range.

Set Channel 1/2 Photodiode Input BIAS State

Command format:	**:PDBIAS[1,2] <CHARACTER PROGRAM DATA> [ON,OFF]**
Description:	Switches the photodiode input BIAS voltage on/off..

Query Channel 1/2 Photodiode Input BIAS State

Command format:	**:PDBIAS[1,2]?**
Response format:	**<CHARACTER RESPONSE DATA> [ON,OFF]**
Description:	Queries the photodiode input BIAS state.

Set Channel 1/2 Photodiode Input BIAS Voltage

Command format:	**:PDBIAS[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the channel 1/2 photodiode input BIAS voltage [V].

Query Channel 1/2 Photodiode Input BIAS Voltage

Command format:	**:PDBIAS[1,2]:VAL?**
Response format:	currently used BIAS voltage **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 currently used photodiode input BIAS voltage [V].

Query Channel 1/2 Photodiode Input BIAS Voltage Range

Command format:	**:PDBIAS[1,2]:RNG?**
Response format:	minimum settable BIAS voltage [V] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable BIAS voltage [V] **<NR3 NUMERIC RESPONSE DATA>,** default BIAS voltage [V] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 photodiode input BIAS voltage range.

Set Channel 1/2 Thermopile Sensor Accelerator State

Command format:	**:THACCEL[1,2] <CHARACTER PROGRAM DATA> [OFF,ON]**
Description:	Sets the thermopile sensor accelerator state.

Query Channel 1/2 Thermopile Sensor Accelerator State

Command format:	**:THACCEL[1,2]?**
Response format:	**<CHARACTER RESPONSE DATA> [OFF,ON]**
Description:	Queries the channel 1/2 thermopile sensor accelerator state.

Set Channel 1/2 Thermal Time Constant

Command format:	**:THTIMECONST[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the channel 1/2 thermal time constant [s]. (used only with thermopile adaptors)

Query Channel 1/2 Thermal Time Constant

Command format:	**:THTIMECONST[1,2]:VAL?**
Response format:	currently used thermal time constant **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 currently used thermal time constant [s].

Query Channel 1/2 Thermal Time Constant Range

Command format:	**:THTIMECONST[1,2]:RNG?**
Response format:	minimum settable thermal time constant [s] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable thermal time constant [s] **<NR3 NUMERIC RESPONSE DATA>,** currently used thermal time constant [s] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 thermal time constant range.

Set Channel 1/2 Thermopile Responsivity

Command format:	**:THRESP[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the channel 1/2 thermopile responsivity [V/W].

Query Channel 1/2 Thermopile Responsivity

Command format:	**:THRESP[1,2]:VAL?**
Response format:	currently used thermopile responsivity **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 currently used thermopile responsivity [V/W].

Query Channel 1/2 Thermopile Responsivity Range

Command format:	**:THRESP[1,2]:RNG?**
Response format:	minimum settable thermopile resp. [V/W] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable thermopile resp. [V/W] **<NR3 NUMERIC RESPONSE DATA>,** currently used thermopile responsivity [V/W] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 thermopile responsivity range.

Set Channel 1/2 Pyro Sensor Responsivity

Command format:	**:PYRESP[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the channel 1/2 pyro sensor responsivity [V/J].

Query Channel 1/2 Pyro Sensor Responsivity

Command format:	**:PYRESP[1,2]:VAL?**
Response format:	currently used thermopile responsivity **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 currently used pyro sensor responsivity [V/J].

Query Channel 1/2 Pyro Sensor Responsivity Range

Command format:	**:PYRESP[1,2]:RNG?**
Response format:	minimum settable pyro sensor resp. [V/J] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable pyro sensor resp. [V/J] **<NR3 NUMERIC RESPONSE DATA>,** currently used pyro sensor responsivity [V/J] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 pyro sensor responsivity range.

Set Channel 1/2 Trigger Mode

Command format:	**:TRIGMODE[1,2] <CHARACTER PROGRAM DATA>** **[AUTOPOWER, EXTERNPOWER, AUTOENERGY, EXTERNENERGY]**
Description:	Sets the trigger mode for channel 1/2.

Query Channel 1/2 Trigger Mode

Command format:	**:TRIGMODE[1,2]?**
Response format:	**<CHARACTER PROGRAM DATA>** **[AUTOPOWER, EXTERNPOWER, AUTOENERGY, EXTERNENERGY]**
Description:	Queries the channel 1/2 trigger mode

Set Channel 1/2 Pyro Sensor Beam Diameter

Command format:	**:BEAMDIA[1,2]:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the channel 1/2 pyro sensor responsivity [V/J].

Query Channel 1/2 Pyro Beam Diameter

Command format:	**:BEAMDIA[1,2]:VAL?**
Response format:	currently used pyro sensor beam diameter **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the channel 1/2 currently used pyro sensor responsivity [V/J].

Query Channel 1/2 Pyro Beam Diameter Range

Command format:	**:BEAMDIA[1,2]:RNG?**
Response format:	minimum settable pyro sensor beam diam. [m] **<NR3 NUMERIC RESPONSE DATA>,** maximum settable pyro sensor beam diam. [m] **<NR3 NUMERIC RESPONSE DATA>,** currently used pyro sensor beam diameter [m] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries channel 1/2 pyro beam diameter range.

Set Channel 1/2 Sensor Adaptor Type

Command format:	**:ADAPTYPE[1,2] <CHARACTER PROGRAM DATA> [PD,TH,PY]**
Description:	Sets the sensor type to use if an adaptor is connected on channel 1/2.

Query Channel 1/2 Sensor Adaptor Type

Command format:	**:ADAPTYPE[1,2]?**
Response format:	**<CHARACTER PROGRAM DATA> [PD,TH,PY]**
Description:	Queries the sensor type to use if an adaptor is connected on channel 1/2.

5.4 Sensor Commands

Command List

Command	Description
:SENS[1,2]:TYPE?	Query the channel 1/2 optical sensor's type.
:SENS[1,2]:NAME?	Query the channel 1/2 optical sensor's name.
:SENS[1,2]:SERNR?	Query the channel 1/2 optical sensor's serial number.
:SENS[1,2]:RANGE?	Query the channel 1/2 optical sensor's range data.

Descriptions

Query Channel 1/2 Optical Sensor Type/ID

Command format: **:SENS[1,2]:TYPE?**

Response format: Sensor-Type/ID **<HEXADECIMAL NUMERIC RESPONSE DATA>**

Description: Queries the sensor type and ID.

Value (hex)	Sensor
00001	No sensor connected. Photo diode input (front) is used.
30101	Photo Diode Adaptor
30102	Photo Diode Sensor
30103	Photo Diode Sensor with switchable filter
30112	Photo Diode Sensor with temperature monitor
30201	Thermopile Adaptor
30202	Thermopile Sensor
30212	Thermopile Sensor with temperature monitor
30301	Pyroelectric Adaptor
30302	Pyroelectric Sensor
30312	Pyroelectric Sensor with temperature monitor
0FFFF	Unknown sensor connected

Query Channel 1/2 Optical Sensor Name

Command format: **:SENS[1,2]:NAME?**

Response format: **<ARBITRARY ASCII RESPONSE DATA>**

Description: Queries the name of the connected optical sensor.

Query Channel 1/2 Optical Sensor Serial Number

Command format: **:SENS[1,2]:SERNR?**

Response format: **<ARBITRARY ASCII RESPONSE DATA>**

Description: Queries the serial number of the connected optical sensor.

Query Channel 1/2 Optical Sensor Range

Command format: **:SENS[1,2]:RANGE?**

Response format: Minimum wavelength [m] **<NR3 NUMERIC RESPONSE DATA>** ,
Maximum wavelength [m] **<NR3 NUMERIC RESPONSE DATA>** ,
Minimum power [W] **<NR3 NUMERIC RESPONSE DATA>** ,
Maximum power [W] **<NR3 NUMERIC RESPONSE DATA>**

Description: Queries the optical sensor head wavelength and power ranges.

5.5 MISC-Output Commands

Command List

Command	Description
:MISCOUT:MODE	Set the MISC-Output operating mode
:MISCOUT:MODE?	Query the MISC-Output operating mode
:MISCOUT:SENS:WATT	Set the MISC-Output sensitivity for Watt modes
:MISCOUT:SENS:WATT?	Query the MISC-Output sensitivity for Watt modes
:MISCOUT:SENS:DBM	Set the MISC-Output sensitivity for dBm modes
:MISCOUT:SENS:DBM?	Query the MISC-Output sensitivity for dBm modes
:MISCOUT:SENS:DB	Set the MISC-Output sensitivity for dB modes
:MISCOUT:SENS:DB?	Query the MISC-Output sensitivity for dB modes
:MISCOUT:SENS:J	Set the MISC-Output sensitivity for J modes
:MISCOUT:SENS:J?	Query the MISC-Output sensitivity for J modes
:MISCOUT:OFFS:VAL	Set the MISC-Output offset voltage
:MISCOUT:OFFS:VAL?	Query the MISC-Output offset voltage
:MISCOUT:OFFS:RNG?	Query the MISC-Output offset voltage range

Descriptions

Set MISC-Output Operating Mode

Command format: **:MISCOUT:MODE <CHARACTER PROGRAM DATA>**
[POW1W,POW1DBM,SUB12,RATIO12,POW2W,POW2DBM,SUB21,RATIO21,
ENERGY1J,ENERGY2J,OFFSET]

Description: Sets the MISC-Output operating mode according to the following list:

POW1W	Power channel 1 [W]
POW1DBM	Power channel 1 [dBm]
SUB12	Power difference channel 1 – channel 2 [W]
RATIO12	Power ratio channel 1 / channel 2 [dB]
POW2W	Power channel 2 [W]
POW2DBM	Power channel 2 [dBm]
SUB21	Power difference channel 2 – channel 1 [W]
RATIO21	Power ratio channel 2 / channel 1 [dB]
ENERGY1J	Energy channel 1 [J]
ENERGY2J	Energy channel 2 [J]
OFFSET	Offset voltage [V]

Query MISC-Output Operating Mode

Command format: **:MISCOUT:MODE?**

Response format: **<CHARACTER RESPONSE DATA>**
[POW1W,POW1DBM,SUB12,RATIO12,POW2W,POW2DBM,SUB21,RATIO21,
ENERGY1J,ENERGY2J,OFFSET]

Description: Queries the MISC-Output operating mode.

Set MISC-Output sensitivity (Watt modes)

Command format: **:MISCOUT:SENS:WATT <CHARACTER PROGRAM DATA>**
[R1NW,R3NW,R10NW,R30NW,R100NW,R1UW,R3UW,R10UW,R30UW,R100UW,
R1MW,R3MW,R10MW,R30MW,R100MW,R1W,R3W,R10W,R30W,R100W]

Description: Sets the MISC-Output sensitivity for Watt modes according to the following table:.

R1NW	1V / 1nW
R3NW	1V / 3nW
R10NW	1V / 10nW
R30NW	1V / 30nW
R100NW	1V / 100nW
R300NW	1V / 300nW
R1UW	1V / 1µW
R3UW	1V / 3µW
R10UW	1V / 10µW
R30UW	1V / 30µW
R100UW	1V / 100µW
R300UW	1V / 300µW
R1MW	1V / 1mW
R3MW	1V / 3mW
R10MW	1V / 10mW
R30MW	1V / 30mW
R100MW	1V / 100mW
R300MW	1V / 300mW
R1W	1V / 1W
R3W	1V / 3W
R10W	1V / 10W
R30W	1V / 30W
R100W	1V / 100W

Query MISC-Output sensitivity (Watt modes)

Command format: **:MISCOUT:SENS:WATT?**

Response format: **<CHARACTER RESPONSE DATA>**
[R1NW,R3NW,R10NW,R30NW,R100NW,R1UW,R3UW,R10UW,R30UW,R100UW,
R1MW,R3MW,R10MW,R30MW,R100MW,R1W,R3W,R10W,R30W,R100W]

Description: Queries the MISC-Output sensitivity for Watt modes.

Set MISC-Output sensitivity (dBm modes)

Command format: **:MISCOUT:SENS:DBM <CHARACTER PROGRAM DATA>**
[R0_1DBM,R0_3DBM,R1DBM,R3DBM,R10DBM]

Description: Sets the MISC-Output sensitivity for dBm modes according to the following table:

R0_1DBM	1V / 0.1dBm
R0_3DBM	1V / 0.3dBm
R1DBM	1V / 1dBm
R3DBM	1V / 3dBm
R10DBM	1V / 10dBm

Query MISC-Output sensitivity (dBm modes)

Command format: **:MISCOUT:SENS:DBM?**

Response format: **<CHARACTER RESPONSE DATA>**
[R0_1DBM,R0_3DBM,R1DBM,R3DBM,R10DBM]

Description: Queries the MISC-Output sensitivity for dBm modes.

Set MISC-Output sensitivity (dB modes)

Command format: **:MISCOUT:SENS:DB <CHARACTER PROGRAM DATA>**
[R0_1DB,R0_3DB,R1DB,R3DB,R10DB]

Description: Sets the MISC-Output sensitivity for dB modes according to the following table:

R0_1DB	1V / 0.1dB
R0_3DB	1V / 0.3dB
R1DB	1V / 1dB
R3DB	1V / 3dB
R10DB	1V / 10dB

Query MISC-Output sensitivity (dB modes)

Command format: **:MISCOUT:SENS:DB?**

Response format: **<CHARACTER RESPONSE DATA>**
[R0_1DB,R0_3DB,R1DB,R3DB,R10DB]

Description: Queries the MISC-Output sensitivity for dB modes.

Set MISC-Output sensitivity (J modes)

Command format: **:MISCOUT:SENS:J <CHARACTER PROGRAM DATA>**
[R10UJ,R30UJ,R100UJ,R300UJ,R1MJ,R3MJ,R10MJ,R30MJ,
R100MJ,R300MJ,R1J,R3J,R10J,R30J,R100J,R300J,R1KJ]

Description: Sets the MISC-Output sensitivity for dB modes according to the following table:

R10UJ	1V / 10µJ
R30UJ	1V / 30µJ
R100UJ	1V / 100µJ
R300UJ	1V / 300µJ
R1MJ	1V / 1mJ
R3MJ	1V / 3mJ
R10MJ	1V / 10mJ
R30MJ	1V / 30mJ
R100MJ	1V / 100mJ
R300MJ	1V / 300mJ
R1J	1V / 1J
R3J	1V / 3J
R10J	1V / 10J
R30J	1V / 30J
R100J	1V / 100J
R300J	1V / 300J
R1KJ	1V / 1kJ

Query MISC-Output sensitivity (J modes)

Command format:	**:MISCOUT:SENS:J?**
Response format:	**<CHARACTER RESPONSE DATA>** **[R10UJ,R30UJ,R100UJ,R300UJ,R1MJ,R3MJ,R10MJ,R30MJ,** **R100MJ,R300MJ,R1J,R3J,R10J,R30J,R100J,R300J,R1KJ]**
Description:	Queries the MISC-Output sensitivity for J modes.

Set MISC-Output Offset Voltage

Command format:	**:MISCOUT:OFFS:VAL <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the MISC-Output offset voltage [V].

Query MISC-Output Offset Voltage

Command format:	**:MISCOUT:OFFS:VAL?**
Response format:	offset voltage **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the currently used MISC-Output offset voltage [V].

Query MISC-Output Offset Voltage Range

Command format:	**:MISCOUT:OFFS:RNG?**
Response format:	minimum offset voltage [V] **<NR3 NUMERIC RESPONSE DATA>,** maximum offset voltage [V] **<NR3 NUMERIC RESPONSE DATA>,** default offset voltage [V] **<NR3 NUMERIC RESPONSE DATA>**
Description:	Queries the MISC-Output offset voltage range.

5.6 Device Status Commands

Command List

Command	Description
:STAT:ERR:CND?	Query the Device Error Condition register.
:STAT:ERR:EVT?	Query the Device Error Event register.
:STAT:ERR:ENA?	Query the Device Error Event Enable register.
:STAT:ERR:ENA	Set the Device Error Event Enable register.
:STAT:OPER:CND?	Query the Device Operation Condition register.
:STAT:OPER:EVT?	Query the Device Operation Event register.
:STAT:OPER:ENA?	Query the Device Operation Event Enable register.
:STAT:OPER:ENA	Set the Device Operation Event Enable register.

Descriptions

Query Device Error Condition Register

Command format: **:STAT:ERR:CND?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Error Condition Register (see also chapter 'Status Reporting' in this document).

Query Device Error Event Register

Command format: **:STAT:ERR:EVT?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Error Event Register (see also chapter 'Status Reporting' in this document).

Set Device Error Event Enable Register

Command format: **:STAT:ERR:ENA <DECIMAL NUMERIC PROGRAM DATA>**

Description: Sets the device's Error Event Enable Register (see also chapter 'Status Reporting' in this document).

Query Device Error Event Enable Register

Command format: **:STAT:ERR:ENA?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Error Event Enable Register (see also chapter 'Status Reporting' in this document).

Query Device Operation Condition Register

Command format: **:STAT:OPER:CND?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Operation Condition Register (see also chapter 'Status Reporting' in this document).

Query Device Operation Event Register

Command format: **:STAT:OPER:EVT?**

Response format: **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's Operation Event Register (see also chapter 'Status Reporting' in this document).

Set Device Operation Event Enable Register

Command format:	**:STAT:OPER:ENA <DECIMAL NUMERIC PROGRAM DATA>**
Description:	Sets the device's Operation Event Enable Register (see also chapter 'Status Reporting' in this document).

Query Device Operation Event Enable Register

Command format:	**:STAT:OPER:ENA?**
Response format:	**<NR1 NUMERIC RESPONSE DATA>**
Description:	Queries the device's Operation Event Enable Register (see also chapter 'Status Reporting' in this document).

5.7 General System Commands

Command List

Command	Description
:SYST:ERR?	Query the device's error queue.
:SYST:OPTIONS?	Query the hardware and software options.
:SYST:CALDATE?	Query the calibration date.
:SYST:NCALDATE?	Query the next calibration date.
:SYST:BIRGHT	Set the display brightness.
:SYST:INFO?	Query descriptive device information.
:SYST:LINEFILTER	Set the line filter setting
:SYST:LINEFILTER?	Query the line filter setting

Descriptions

Error Query

Command format: **:SYST:ERR?**

Response format: Error number **<NR1 NUMERIC RESPONSE DATA>** ,
Error text **<ARBITRARY ASCII RESPONSE DATA>**

Description: Queries the device's error queue (see also: chapter 'Error Reporting' in this document).

Query Options

Command format: **:SYST:OPTION?**

Response format: Hardware Options **<HEXADECIMAL NUMERIC RESPONSE DATA>**,
Software Options **<HEXADECIMAL NUMERIC RESPONSE DATA>**,
Mainboard ID **<NR1 NUMERIC RESPONSE DATA>**

Description: Queries the device's hardware option bitmap, software option bitmap and the mainboard ID. For further information see chapters 'Hardware Options', 'Software Options' and 'Supported Mainboard IDs' in this document.

Query Calibration Date

Command format: **:SYST:CALDATE?**

Response format: **<ARBITRARY ASCII RESPONSE DATA>**

Description: Queries the device's calibration date. The response data is either '`not assigned`' if the date is not assigned or in the format '`MM-DD-YYYY hh:mm:ss`', where `MM` is the month, `DD` is the day of the month, `YYYY` is the year, `hh` is the hour, `mm` is the minute, `ss` is the second.

Query Next Calibration Date

Command format: **:SYST:NCALDATE?**

Response format: **<ARBITRARY ASCII RESPONSE DATA>**

Description: Queries the date of the next calibration of the device. The response data is either '`not assigned`' if the date is not assigned or in the format '`MM-DD-YYYY hh:mm:ss`', where `MM` is the month, `DD` is the day of the month, `YYYY` is the year, `hh` is the hour, `mm` is the minute, `ss` is the second.

Set Display Brightness

Command format: **:SYST:BRIGHT <DECIMAL NUMERIC PROGRAM DATA>**

Description: Sets the display brightness in the range of 0 (backlight off) and 100.

Query Descriptive Device Information

Command format:	**:SYST:INFO?**
Response format:	**<ARBITRARY ASCII RESPONSE DATA>**
Description:	Queries descriptive device information.

Set Linefilter

Command format:	**:SYST:LINEFILTER <CHARACTER PROGRAM DATA> [50HZ,60HZ]**
Description:	Sets the device line filter setting. Note: For optimum device operation set the line filter to your local mains frequency.

Query Linefilter

Command format:	**: SYST:LINEFILTER?**
Response format:	**<CHARACTER RESPONSE DATA>[50HZ,60HZ]**
Description:	Queries the device line filter setting

5.8 Status Reporting

Status Byte Register

The Status Byte Register gives a summary of all underlying status structures. The structure is defined in IEEE488.2-1992-§11.2.

Bit #	Mnemonic	Description
7		reserved
6	**RQS/MSS**	Request Service / Master Summary Status
5	**ESB**	Standard Event Status Bit
4	**MAV**	Message Available. There is response data available for readout
3	**DES**	Device Error Status Structure Summary Bit
2	**EAV**	Error Available. There is at least one error in the error queue.
1	**DOS**	Device Operation Status Structure Summary Bit
0		Reserved

Device Error Status Structure

The Device Error Status Structure reflects asynchronous device errors. Bits in the according event register are rising and falling edge triggered.

Bit #	Mnemonic	Description
15..9		reserved
8	**SM2**	Sensor missing channel 2
7..1		reserved
0	**SM1**	Sensor missing channel 1

Device Operation Status Structure

The Device Operation Status Structure reflects device states. Bits in the according event register are rising edge and falling edge triggered.

Bit #	Mnemonic	Description
15..9		reserved
8	**ZR2**	Zero procedure running channel 2
7..1		reserved
0	**ZR1**	Zero procedure running channel 1

5.9 Error Reporting

The device stores errors in a queue containing up to 30 entries. The error queue may be read out by the ':SYST:ERR?' command. The following table lists all error numbers and the according descriptive messages.

Error	Description
0	No error
1	General system failure
2	Floating point error - domain
3	Value out of range
4	Mainboard not supported
5	Feature not supported
6	Measurement in progress
7	Measurement interrupted
10	No keyboard bootloader found
11	Unknown keyboard bootloader found
13	Timeout occurred while setting bootloader address
14	Keyboard controller update failed at chip erase
15	Timeout occurred while reading keyboard controller signature
16	Keyboard controller update failed with timeout at writing image
17	Keyboard controller update failed with timeout at reading back image
18	Keyboard controller update verification failed
20	Keyboard communications timeout
33	Timeout occurred while accessing keyboard controller EEPROM
40	Timeout occurred while accessing onboard EEPROM
41	Checksum error reading EEPROM
42	Attempt to read from unknown EEPROM
50	Response message buffer overflow
60	Error queue overflow
61	Command message buffer overflow
62	Unknown command
63	Invalid number of command parameters
64	Erroneous decimal command parameter
65	Erroneous nondecimal command parameter
66	Erroneous char/string command parameter
67	Invalid character program data value
70	Adjustment data invalid
71	Adjustment data set invalid by user
72	Device setup data corrupt

Error	Description
80	Internal calculation error
81	Zero procedure running
82	Zero procedure failed
83	No PD polarity switching during BIAS on
100	Authentication required for operation
101	Authentication failed
110	Operation is not allowed in SERVICE-MODE
111	Operation is allowed in SERVICE-MODE only
121	No or not supported sensor
122	Operation not allowed for this sensor

6 Measurement Considerations

6.1 Choosing the Right Sensor

The selection of the right sensor depends on many factors, such as the type of the light source to be measured and the application. No sensor can cover all applications; the following table shows the main pros and contras of the different power sensor types. Of course this can be only a rough guide because within each sensor group there are special models best suitable for specific applications.

Power Sensors:

	Photodiode			Thermal		
Light Source	**Si**	**Ge**	**InGaAs**	**BB**	**HTC**	**Volume**
Diode UV - NIR	+++	+	-	++	-	-
Diode NIR	-	+	+++	++	-	-
High Power Fiber Lasers	-	-	++	++	++	-
ASE sources	-	-	++	++	-	-
fs Laser	-	+	++	++	+	-
Gas Laser	++	-	-	++	+	-
Excimer	-	-	-	-	+++	+
YAG	-	-	-	-	+	+++
LED	+	-	-	+++	+	-

6.2 Reducing Noise for High Accuracy Measurements

Main disturbing influence on each measurement is noise from grounding, the cable capacitance, temperature effects, stray and ambient light, and detector noise.

- The housing of power sensors are connected to the digital ground of the meter and should be linked to earth ground (e.g. via a post); energy sensors should be mounted isolated, because the housing is connected to the PM320E analog ground.
- The sensor cable must handle very small current or voltage signals. Moving the cable will induce disturbances caused by the cable capacitance. For measuring low power or energy levels the cable should be fixed in position.
- With photodiode sensors the bandwidth should be set to “Low” setting; with thermal sensors the acceleration circuit should be shut off.
- Silicon InGaAs sensors show the lowest noise level.
- For long term measurements in free space applications it is necessary to provide constant ambient light conditions, or shielding the beam.
- The temperature should be stable over the time of the measurement.

6.3 Power Measurement of Pulsed Signals

The PM320E will read the average value of a pulsed signal when the following conditions apply:

- Thermal sensor: The pulse length, repetition rate and peak power are not critical as long as the peak power is lower than the damage threshold of the sensor. A thermal sensor reacts very slow and will integrate the power incident on the active area of the sensor.

- Photodiode sensor: It can follow short pulses in the ns range. It is important that the pulse peak power is within the maximum power range of the sensor. It is also important that the power range is set that accordingly the peak power is within this range, otherwise the reading will clip at the range end and lead to a wrong average value. Further it is important to use a power range in manual mode that can measure the peak value, therefore the Min-Max function is very helpful. Depending on the pulse length and repetition rate the bandwidth setting will influence the power reading. It is recommended to use the low bandwidth setting for a stable display; when the pulse should be monitored via the analog output, the bandwidth should be set to 'HI'.

6.4 Line Width of Light Sources

The line width of light sources can be neglected only when using a broadband thermal or pyroelectric sensor. Photodiode sensors show a strong dependency of the operating wavelength so if the line width of light sources is greater than 10nm (e.g. LED) there may be an influence on the displayed power. To achieve the best result for broadband light sources with a photodiode sensor it is necessary that the response curve is nearly linear over the line width. When entering the center wavelength of the light source as operation wavelength the PM320E will nearly show the right optical power for a symmetrical spectral response shape.

6.5 Temperature Effects on Thermal Sensors

Thermal sensors react on any temperature differences that occur between thermal disc and heat sink. The measurement results can be influenced by airflow disturbances or by heating up the heat sink as a result of a long exposure of the thermal disc by the laser beam.

To avoid disturbances it is recommended to shield the sensor as good as possible from airflow and to zero it properly in the operating condition. That means for short term measurements zero the cold sensor, for long term measurements zero the sensor when it is in a state of thermal stability (e.g. after 10 minutes light exposure).

6.6 Ambient and Stray Light

Ambient or stray light can strongly affect the measurement accuracy in free-space applications. A permanent background light level can be subtracted by conducting a zero adjustment. More complicated is varying ambient light like daylight or turning on/off room light. In such cases the only solution is a proper light shielding of the sensor.

6.7 Back Reflection

Photodiodes, ND filters and even black coatings of thermal sensors show a certain kind of back reflection of the incoming light. So back reflections to a HeNe or diode laser may interfere the power stability of the laser, therefore it is recommended to slightly tilt the power meter sensor in the laser beam.

In order to totally avoid back reflections it is recommended to use an integrating sphere based S14xC series sensor where the incoming light gets nearly completely absorbed in the sensor.

6.8 Beam Diameter vs. Active Sensor Area

Most sensors are not completely uniform in their response over the active area; except for sensors that are using an integrating sphere as filter and diffuser.

To overcome uniformity issues the incident beam should have a diameter larger than 10% of the sensor area.

A second topic to consider are the maximum allowed power and energy densities of the sensor. The maximum ratings are given in the sensor spec sheet. The PM320E can display the actual power or energy density for a known beam diameter. For high power or high energy beams a good efficiency can be reached to chose a detector with an active area that is about 20% - 30% larger than the beam diameter.

6.9 Fiber Based Measurements

Laser light emits from an optical fiber in a conical shape, with an angle twice the acceptance angle of the fiber. The acceptance angle is calculated by the numerical aperture of the fiber and is defined as the inverse sine of the numerical aperture.

Fore typical single mode fibers the total angle of the emitted light is between 15° and 25°, for an angled connector (APC) the cone shifts by approximately 4° from the fiber axis.

This expansion of the beam has to be considered to avoid overfilling the detector and getting wrong results. On the other hand for measurements with high power fiber lasers a certain gap between fiber tip and detector surface has to be kept to decrease the power density.

Thorlabs offers fiber adapters for the most common connectors that are verified with the S12xC series optical sensors and with most thermal sensors.

For large divergence angles or fiber measurements that are critical to back reflections it is recommended to use an integrating sphere based sensor from the S14xC series.

Another good choice for fiber based measurements are the S15xC series ‘Fiber-Heads’. They plug directly to the meter and go without a disturbing cable between sensor and console.

7 Maintenance and Service

Protect the PM320E from adverse weather conditions. The PM320E is not water resistant.

Attention

To avoid damage to the instrument, do not expose it to spray, liquids or solvents!

If necessary the unit and the display can be cleaned with a cloth dampened with water.

The unit does not need a regular maintenance by the user. It does not contain any modules and/or components that could be repaired by the user himself. If a malfunction occurs, please contact Thorlabs for return instructions.

Do not remove covers!

To guarantee the specifications over a long period it is recommended to have the unit calibrated by Thorlabs once a year.

7.1 Line Voltage Setting

The PM320E optical power meter operates at fixed line voltages of

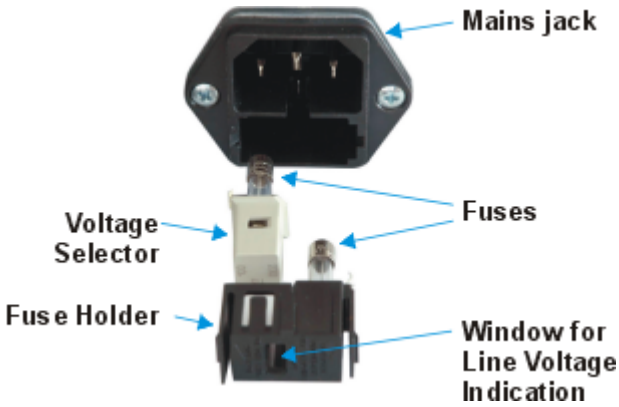
100 V +10% -10% (90 V … 115 V) or

115 V +10% -10% (104 V … 132 V) or

230 V +10% -10% (207 V … 264 V).

The line voltage setting can be changed on the rear without opening the unit.

1. Turn off the PM320E and disconnect the mains cable.
2. The fuse holder (see figure below) is located below the 3-pole mains power jack. Release the fuse holder by pressing its plastic retainers with the aid of a small screwdriver. The retainers are located on the right and left side of the holder and must be pressed towards the center.
3. Unplug the line voltage switch/indicator (containing the left fuse) from the fuse holder, rotate it until the appropriate voltage marking (100V, 115V, or 230V) is on target for the window of the fuse holder, and plug it back into the fuse holder. Press in the fuse holder until it locks on both sides. The appropriate line voltage marking must be visible in the window of the fuse holder.



Attention

If you have changed to or from 230 V, also change the mains fuses to the correct value given in section Exchange Mains Fuses!

7.2 Exchange Mains Fuses

The two power input fuses are externally accessible. If they have opened due to line distortions, incorrect line voltage or other causes, they can be replaced from the rear without opening the unit.

Attention

To avoid risk of fire the appropriate fuses for the corresponding line voltage must be used.

1. Turn off the PM320E and disconnect the mains cable.
2. The fuse holder (see figure in section Line Voltage Setting) is located below the 3-pole power connector of the mains jack. Release the fuse holder by pressing its plastic retainers with the aid of a small screwdriver. The retainers are located on the right and left side of the holder and must be pressed towards the center.
3. Replace the defective or wrong fuses and press in the fuse holder until locked on both sides. Take care to maintain the correct rotation of the line voltage indicator / switch which contains the left fuse and is plugged into the fuse holder. The appropriate line voltage marking must be visible in the window of the fuse holder.

Fuse types

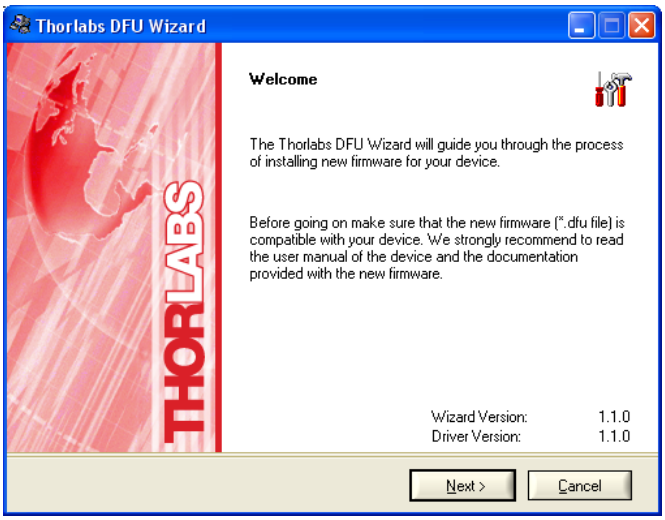
100 V	1000 mA, time-lag, 250V	T1A250V
115 V	1000 mA, time-lag, 250V	T1A250V
230 V	500 mA, time-lag, 250V	T0.5A250V

All fuses must meet IEC specification 60127-2/III, time characteristic: time-lag (T), 250V AC, size 5 x 20 mm.

7.3 Firmware Update

Firmware upgrades can be done by the user via the USB interface. Therefore install the DFU (device firmware upgrade) wizard from the distribution CD.

Connect the PM320E to an USB port of your PC and launch the DFU wizard from the start bar. Follow the wizard instructions.



Please refer to www.thorlabs.com for the latest PM320E firmware version that can be downloaded as a *.dfu file.

When proceeding the DFU wizard the first time a new DFU device will be recognized, please allow installing.

Do not switch off the PM320E or disconnect the USB cable during the firmware download.

7.4 Troubleshooting

➢ **Unit does not work at all (no display at the front)**

- Is the PM320E connected properly to the mains?
  - Check the mains cable and the line voltage setting.
- Is the PM320E turned on?
  - Turn on the mains switch of your PM320E.
- Check the fuses on the rear panel.
  - If blown, replace the fuse with the correct type.

➢ **Power reading is zero (-----)**

- A photodiode sensor is connected
  - Check if the channel display is in the right mode to display absolute power
  - Conduct the dark current adjustment procedure
- A thermal sensor is connected
  - Check if the channel display is in the right mode to display absolute power
  - Conduct the dark current adjustment procedure
- A photodiode is connected
  - Check the polarity setting. If not known, switch to the current display. The displayed current must be positive, otherwise change the polarity.

➢ **Power display does not update**

- Check for correct selection of the trigger source (Auto)

➢ **Pulse Energy cannot be measured or is measured wrong**

- Check for correct selection of the trigger source (Auto)
- Check for correct trigger level (must be between noise level and expected pulse height)
- Check if the used energy sensor is able to handle the repetition rate of the laser

If you cannot resolve the problem, please contact Thorlabs.

8 Appendix

8.1 Technical Data

Current Inputs	
Full Scale Measurement Ranges	100 nA … 10 mA (in decade steps)
Maximum Display Resolution	10 pA
Photodiode Polarity	cathode grounded (CG) or anode grounded (AG)
Display Units	A, W, dBm
Bias Voltage	0 … -10 V (CG), 0 .. +10 V (AG)
Max. Photodiode Capacitance	10 nF
Input Impedance	~0 Ω (virtual ground)

Current Range	Resolution	Gain	Accuracy	Bandwidth
10 mA	1 µA	1 x 10^2 V/A	+/- 0.2% f.s.	100 kHz / 25 Hz
1 mA	100 nA	1 x 10^3 V/A	+/- 0.2% f.s.	100 kHz / 25 Hz
100 µA	10 nA	1 x 10^4 V/A	+/- 0.2% f.s.	100 kHz / 25 Hz
10 µA	1 nA	1 x 10^5 V/A	+/- 0.2% f.s.	100 kHz / 25 Hz
1 µA	100 pA	1 x 10^6 V/A	+/- 0.2% f.s.	10 kHz / 25 Hz
100 nA	10 pA	1 x 10^7 V/A	+/- 0.5% f.s.	1 kHz / 25 Hz

Voltage Input Thermal Sensors	
Full Scale Measurement Ranges	1 mV … 1 V (in decade steps)
Maximum Display Resolution	0.1 µV
Display Units	V, W, dBm
Input Impedance	1 MΩ
Time constant correction	< 1 s to 30 s

Voltage Range	Resolution	Gain	Accuracy	Bandwidth
1 V	100 µV	1 x 10^0	+/- 0.5% f.s.	1.5 Hz
100 mV	10 µV	1 x 10^1	+/- 0.5% f.s.	15 Hz
10 mV	1 µV	1 x 10^2	+/- 0.5% f.s.	7 Hz
1 mV	0.1 µV	1 x 10^3	+/- 0.5% f.s.	0.7 Hz

Voltage Input Pyroelectric Sensors	
Full Scale Measurement Ranges	100 mV … 100 V (in decade steps)
Maximum Display Resolution	10 µV
Display Units	V, J, W, J/cm², W/cm²
Input Impedance	1 MΩ
Measurement Repetition Rate	0.1 Hz to 1500 Hz

Voltage Range	Resolution	Gain	Accuracy	Rep. Rate
100 V	10 mV	1 x 10^{-2}	+/- 0.5% f.s.	1.5 kHz
10 V	1 mV	1 x 10^{-1}	+/- 0.5% f.s.	1.5 kHz
1 V	100 µV	1 x 10^0	+/- 0.5% f.s.	1.5 kHz
100 mV	10 µV	1 x 10^1	+/- 0.5% f.s.	1.5 kHz

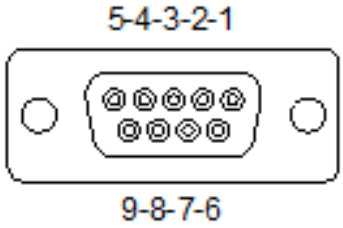
Analog Outputs	
Analog Output CH1 / CH2	0 to ± 10 V
Programmable MISC Analog Output	0 to ± 10 V
Minimum Load Resistance	10 kΩ
Trigger Input	
Signal Type	TTL
Max. Trigger Frequency	1.5 kHz
Connectors	
Power / Energy Sensor Input	DB9 (9 pin DSUB) female
Photodiode Input	BNC
Analog Output	BNC
Trigger Input	BNC
Programmable Analog Output	BNC
Chassis Ground	4 mm Banana Jack
Mains Input	IEC 60320
Interface	USB, B
Display	
Type	Graphical LCD 240 x 128 pixels
Update Rate	up to 20 Hz (mode depending)
Supported Sensors	
S1xxC Photodiode Sensors	
S3xxC Thermal Sensors	
ES1xxC / ES2xxC Pyroelectric Sensors	
Anode and Cathode Grounded Photodiodes	
Custom Thermal Sensors	
Custom Pyroelectric Sensors	

General Data	
Line Voltage (selectable)	100 V / 115 V / 230 V (±10 %)
Line Frequency	50 to 60 Hz
Power consumption (max.)	20 VA
Supply mains over voltage	Category II (Cat II)
Operating Temperature Range [1])	0 - 40 °C
Storage Temperature Range	-40 to 70 °C
Relative Humidity	Max. 80% up to 31 °C, decreasing to 50% at 40 °C
Pollution Degree (indoor use only)	2
Operation altitude	< 3000 m
Warm-up time for rated accuracy	10 min
Dimensions (W x H x D)	220 x 110 x 290 mm (w/o operating elements) 220 x 122 x 325 mm (with operating elements)
Weight	< 4 kg

[1]) non-condensing

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

8.2 Pin Assignment of the Sensor Connector



Pin	Assignment
1	+5V. Drive max. 50mA from this pin
2	EEPROM Digital I/O **Attention** This pin is uniquely used for the memory in the sensor head and must not be used. Connecting this pin may cause malfunction of the PM320E
3	photodiode ground (anode), thermal and pyro sensor ground, analog ground
4	photodiode cathode
5	pyro-electric sensor +
6	DGND
7	PRESENT: Connect this pin via a 1 kΩ to 10 kΩ resistor to Pin 3 (AGND)
8	thermal sensor +
9	n.c.

8.3 Certifications and Compliances

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs GmbH

Of: Hans-Boeckler-Str. 6, 85221 Dachau/München, Deutschland

in accordance with the following Directive(s):

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: ***PM320E***

Equipment: ***Dual Channel Optical Power Meter***

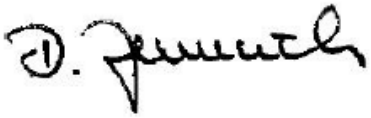
is in conformity with the applicable requirements of the following documents:

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed:  *On:* 05 April 2016

Name: Dorothee Jennrich

Position: General Manager

EDC - PM320E -2016-04-05

CE 16

This product was tested for and complies with the following standards:

- CAN/CSA-C22.2 No. 61010-1-04
- ANSI/UL 61010-1-2004

8.4 Warranty

Thorlabs GmbH warrants material and production of the PM320E for a period of 24 months starting with the date of shipment. During this warranty period Thorlabs GmbH will see to defaults by repair or by exchange if these are entitled to warranty.

For warranty repairs or service the unit must be sent back to Thorlabs GmbH. The customer will carry the shipping costs to Thorlabs GmbH, in case of warranty repairs Thorlabs GmbH will carry the shipping costs back to the customer.

If no warranty repair is applicable the customer also has to carry the costs for back shipment.

In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs GmbH warrants the hard- and/or software determined by Thorlabs GmbH for this unit to operate fault-free provided that they are handled according to our requirements. However, Thorlabs GmbH does not warrant a fault free and uninterrupted operation of the unit, of the software or firmware for special applications nor this instruction manual to be error free. Thorlabs GmbH is not liable for consequential damages.

Restriction of Warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. Thorlabs GmbH does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs GmbH reserves the right to change this instruction manual or the technical data of the described unit at any time.

8.5 Copyright and Exclusion of Reliability

Thorlabs GmbH has taken every possible care in preparing this document. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this document is regularly updated and adapted to reflect the current status of the hardware and/or software. We furthermore do not guarantee that this product will function without errors, even if the stated specifications are adhered to.

Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.

Insofar as permitted under statutory regulations, we assume no liability for direct damage, indirect damage or damages suffered by third parties resulting from the purchase of this product. In no event shall any liability exceed the purchase price of the product.

Please note that the content of this document is neither part of any previous or existing agreement, promise, representation or legal relationship, nor an alteration or amendment thereof. All obligations of *Thorlabs GmbH* result from the respective contract of sale, which also includes the complete and exclusively applicable warranty regulations. These contractual warranty regulations are neither extended nor limited by the information contained in this document. Should you require further information on this product, or encounter specific problems that are not discussed in sufficient detail in the document, please contact your local *Thorlabs GmbH* dealer or system installer.

8.6 Thorlabs 'End of Life' Policy

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs GmbH offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs GmbH electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see figure below)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs GmbH products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

Waste treatment on your own responsibility

If you do not return an “end of life” unit to Thorlabs GmbH, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

WEEE Number (Germany) : DE97581288

Ecological background

It is well known that waste treatment pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS Directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE Directive is to enforce the recycling of WEEE. A controlled recycling of end-of-life products will thereby avoid negative impacts on the environment.

Crossed out
"Wheelie Bin" symbol

8.7 Thorlabs Worldwide Contacts

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