PMManager

For Newport Laser Measurement Devices

User Manual

Table of Contents

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About this Manual

This manual describes how to operate the Newport **PMManager** application with any of the following Newport measuring devices:

PC Interfaces (without a GUI)

- 841-PE-USB / 844-PE-USB – compact sensor to USB interface
- 845-PE-RS -- compact sensor to serial RS232 interface

Power/Energy Meters

- 1938-R, 2938-R
- 1919-R
- 843-R-USB

How the Document is Organized

This manual describes installation and operation in the following order:

- Install the **PMManager** Software
- Connect the measuring device
- Using the **PMManager** application
- Sensor and device information in Appendices A through B
- Safety and Compliance in Appendix C

Definition of Terms

The Newport meters and PC interfaces are referred to in this manual as device or instrument. When a connection is opened between the device and the **PMManager** software running on your PC, the controls and the measurement information are displayed in what is referred to as a channel. Using the **PMManager** application, you can view each channel's laser power and energy information. You can work with multiple channels depending on the type of device you have and the number of free USB ports you have on your PC.

Chapter 1 - **PMManager** and Devices

This section includes the following topics:

- **PMManager** Features

- Package Contents

- System Requirements

- Install **PMManager**

PMManager Features

PMManager converts a PC into a laser power/energy multi-channel analysis workstation.

The **PMManager** software features include:

- Extensive graphic display of data:
    - Line Plot, Histogram, Pulse Chart, Simulated Analog Needle, Position, and Stability Graph
    - Multiple data sets on separate graphs on the same screen
- Advanced measurement processing
    - Power/energy density, scale factor, normalize against a reference
    - Multi-channel comparisons
    - User defined mathematical equations: channels A/B, etc.
- Connect additional devices during active measurements
- Data logging for future review
    - Displayed graphically or saved in text format
    - Exported to an Excel spreadsheet
- Printing of graphs and data
- Interfaces and supports data logging with Newport's devices

Package Contents

Each measuring device purchased from Newport ships with various items, depending on the device. When you receive a device package, inspect the packaging before unpacking. Evidence of damage should be noted and reported immediately. Unpack and check the contents against the relevant list below.

1938-R, 2938-R

The 19389-R & 2938-R package contains the following items:

- 1938-R / 2938-R meter
- USB cable
- Power cable

1919-R

The 1919-R package contains the following items:

- 1919-R meter
- USB cable
- 12v power supply

843-R-USB

The 843-R-USB package contains the following items:

- 843-R-USB meter
- USB cable
- 12v power supply

841-PE-USB / 844-PE-USB

The 841-PE-USB / 844-PE-USB package contains the following items:

- 841-PE-USB / 844-PE-USB device
- USB cable
- Analog output connector 2.5 mm mono jack

845-PE-RS

The 845-PERS package contains the following items:

- 845-PE-RS device
- Serial cable for RS232 communication
- 12v 2A AC/DC power supply with 2.5x5.5mm Screw Lock Connector and Center Positive Polarity
- For the Analog Output SMA Connector: you can order an accessory cable SMA to BNC **(not supplied)**

System Requirements

To run the **PMManager** application, you need a computer with the following minimum requirements:

CPU	Intel® Core i7-2600 CPU @3.40 GHz 3.40 GHz
RAM	4GB
Operating System	Windows 7 / 8 / 10 /11 (32-bit or 64-bit)
Display	1024 X 768 resolution (17" recommended)

Install **PMManager**

Install PMManager software

Download the PMManager from the product page in the web site (https://www.newport.com/g/optical-power-meters) and following the Installation Wizard steps.

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Chapter 2 - Connect Devices

After completing the software installation, follow the instructions in the relevant section below to connect the device to your PC.

When you start **PMManager**, it recognizes the connected device(s) and responds according to the options specified in the Preferences dialog. You can manually select which device(s) connect to **PMManager**.

Connect a 1938-R or a 2938-R

After completing the software installation, connect the 1938-R or 2938-R meters.

❖ If this is the first time you are connecting the meter to your PC via USB, ensure Windows is running in Administrator mode.

1. Connect the power cable between the electrical outlet and the 110-220V input located of the back panel of the meter.
2. Insert the 15 pin D type connector of the sensor cable into the socket marked "Sensor" on the Channel A section of the back panel of the meter. If using the 2938-R dual channel meter, you can use either or both of these sockets at the back of the meter.

3. Connect the USB cable between the USB port located on the back panel of the meter, and your PC.

4. Alternatively, if using Ethernet* connectivity and not USB, connect a network cable to the Ethernet socket located on the back panel of the meter, and check the Ethernet settings on the meter.

   Refer to the 1938-R 2938-R USER MANUAL for instructions on setting up the meter's network IP.

   *Ethernet connectivity is available from meter firmware version 4.02 up.

   o In PMManager, click Select Device(s) and verify Use Ethernet Devices is selected.

o   Click Configure Ethernet Devices. The Ethernet Device Setup dialog opens.

If you have a computer with more than one Network adaptor in use, select the relevant Network adaptor from the 'Chose Network' pull down.
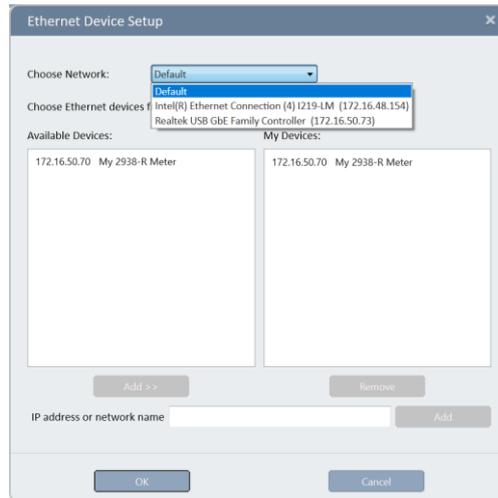
o   Select the device listed in the left panel and click ADD >>. The selected devices are entered in the My Devices panel. Click OK.
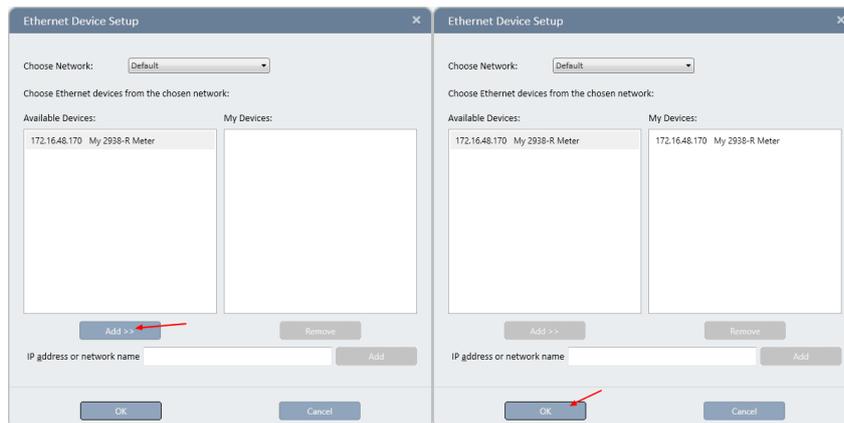
In some instances after restarting or re-connecting the meter, a previously selected meter in My Device is not discovered. The issue occurs because the meter has been set to dynamic IP address, and the IP address of the meter has changed. To rediscover the meter, remove it from the My Device panel and repeat the above steps

5. The Select Device window can then search for the selected device.
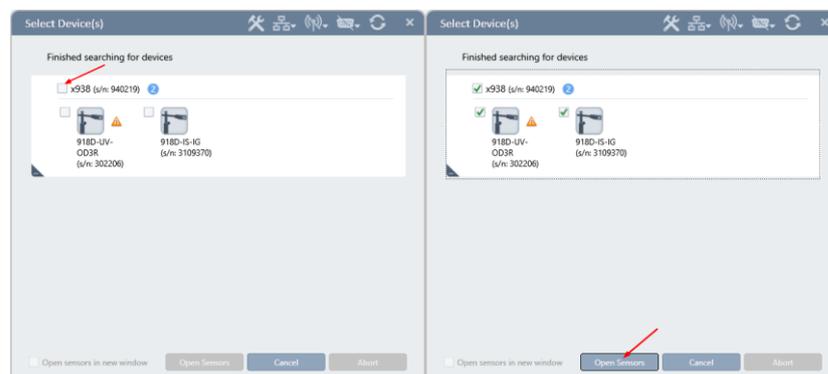
Connect a 1919-R

After completing the software installation, connect the **1919-R** meter.

❖ If this is the first time you are connecting the **1919-R** to your PC, ensure Windows is running in Administrator mode.

1. Connect the sensor to the sensor input located on the meter.

- Connect the USB cable between the USB port located on the meter, and your PC.

- Connect the 12v power cable between the electrical outlet and the 12VDC input located on the meter.

Connect an 843-R-USB

After completing the software installation, connect the **843-R-USB** meter.

1. Connect the sensor to the sensor input located on the meter.

- Connect the USB cable between the USB port located on the device, and your PC.
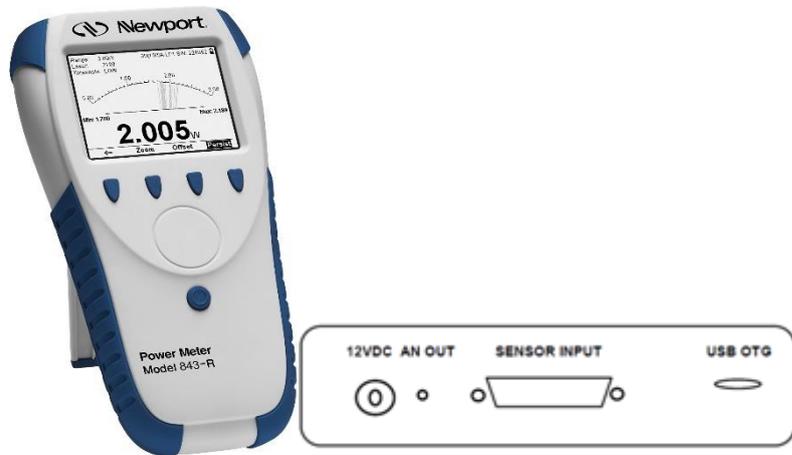
- Connect the 12v power cable between the electrical outlet and the 12VDC input located on the device.

  ❖ In order for a 843-R meter to communicate with **PMManager** it must have its USB capability activated. To do so, contact your Newport distributor to acquire a unique USB Activation Code.

Connect an 841-PE-USB / 844-PE-USB

After completing the software installation, connect the **841-PE-USB / 844-PE-USB** device

❖ If this is the first time you are connecting the **841-PE-USB / 844-PE-USB** to your PC, ensure Windows is running in Administrator mode.

1. Connect the sensor to the sensor head input.

• Connect the USB cable between the device and your PC.

  • The LINK LED flickers momentarily, indicating USB enumeration of the device.

841-PE-USB

844-PE-USB

Connect an 845-PE-RS

After completing the software installation, connect the **845-PE-RS** device

1. Connect the sensor to the sensor head input.

2. Connect the 12V DC power supply. The Status LED then lights Green (If there is a fault, it will be Red).

3. Connect the serial RS232 cable between the device and a serial port on your PC. If your PC doesn't have a serial port, use a USB to Serial adapter (not included).

Analog Output SMA connector   Sensor head input

12V DC Power   RS232 serial communication   Status LED

3. Open **PMManager** - double-click the **PMManager** shortcut icon, located on the desktop.

    *   Click Select Devices if the Select Devices window is not already open

    *   **Enable the Use of RS232 Devices, and then Configure RS232 Devices, as shown below**

    *   **Select and configure the correct serial COM port number being used to a baud rate of 115200 or 'Auto'.**
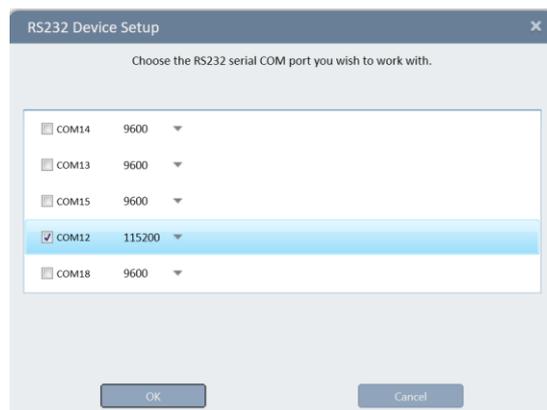
PMManager can now search for the device in the select devices window, and when the connected device is found you can then select it. It will then be open in a channel and be ready for use.

Chapter 3 - Getting Started

PMManager application is used with the following devices:

- 1938-R / 2938-R
- 1919-R
- 843-R-USB
- 841-PE-USB / 844-PE-USB
- 845-PE-RS

Multiple Sensors

PMManager application supports the use of multiple sensors.

Channels

Each connection between a **sensor**, **device**, and **PMManager** is referred to as a **channel**.
You can view **channels** as either separate graphs or combined graphs.

Multiple Channels

In **PMManager** you can simultaneously work with multiple channels from one or more devices.
The devices can be connected to many different kinds of sensors, including thermal, photodiode, pyroelectric, or a combination of different sensor types.

Example:

- Use a combination of single-channel devices (e.g., 1938-R, 843-R-USB, 841-PE-USB / 844-PE-USB, 845-PE-RS) working with one channel per device.

- Use a multi-channel device (e.g., 2938-R) working with multiple channels.

- Use a combination of single-channel and multi-channel devices (a & b above).

In addition to being able to connect **PMManager** to numerous channels simultaneously, you can also specify which of the connected channels you wish to view and use multiple Newport devices to create additional channel connections. For more information, see Multiple Channels.

This section describes the following:

- Start and end a **PMManager** session
- **PMManager** Window
- Resize **PMManager** Window Areas

Start and End a **PMManager** Session

Start a PMManager session

Double-click the **PMManager** shortcut icon , located on the desktop.
PMManager opens and searches for connected devices.

- If only one device is discovered **PMManager** opens by default in "merged screen"mode using the full **PMManager** screen"

- If multiple devices are discovered, or if there is more than one sensor on a single device, refer to Multiple Channels

  ❖ During a **PMManager** communication session, the keypad/touchscreen of the 1/2919-R, 1919-R and 843-R-USB devices are disabled until the device is released from the **PMManager** communication session.
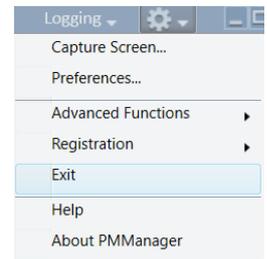
End a PMManager session

- Select Exit from the Options menu

- Click X (located in the title bar)

  ❖ Refer to Preferences and Features to learn about options available when ending a **PMManager** session.

Select a Sensor

PMManager enables you to work with multiple channels from one device or various devices simultaneously. The devices may be connected to many types of sensors including thermopile, photodiode, pyroelectric or a combination of different sensor types. In addition to being able to connect the application to numerous channels at once, you can specify which of the connected channels you wish to view.

For more information about multiple sensors, refer to Multiple Channels.

Select a device

1. Click Select Device(s) in the window title bar.

   - **PMManager** begins to search for attached devices

   - In addition to devices that connect via USB, there are devices that require a wireless, serial port or an ethernet connection. When using such devices, open the menu adjacent to the relevant icon.
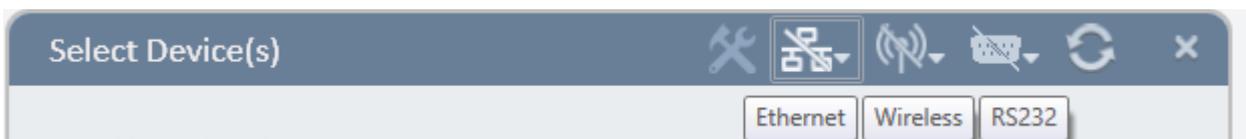
   - When the search in Select Devices is completed, a window opens, enabling you to select the device(s) that are currently found.
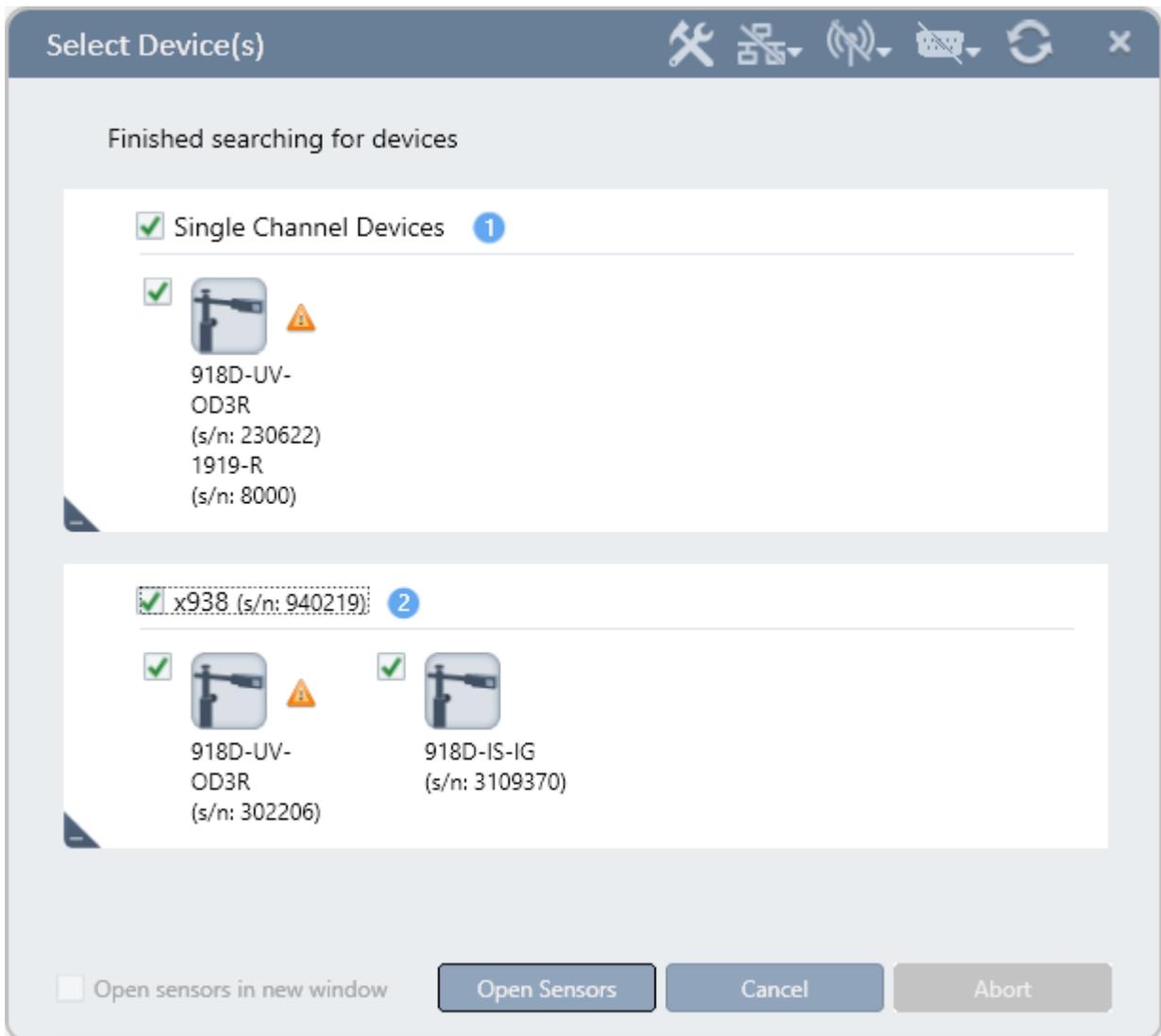
- Each connected device is displayed as an icon with its name, type, and serial number

2. Select the adjacent checkbox for each device you want to view.

- Click the Open Sensors icon indicated at the bottom of the window.

-

PMManager Window

PMManager enables you to work with multiple channels from one device or various devices simultaneously.

The **PMManager** window contains the following areas for all sensors:

- Channel Area
- Numeric Display Area
- Graph Configuration Area
- Statistics Area
- Logging Area
- Title Bar Controls

The specific items displayed in these areas depend on which channel is active – Math or sensor (Thermopile, Photodiode, Pyroelectric, or PD energy).

❖ See **PMManager Window Features** for details and examples.

Channel Area

The channel area contains a channel for each connected sensor and any math channel that was started by the user. Each channel is given its own colored line to identify it, both in channel area and the display area. When a channel is selected for the Y-axis values, its label appears in the upper corner of the display area.
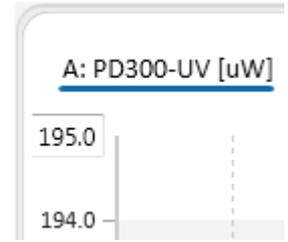
The settings for each sensor channel are input from the connected sensor. Each time you change a setting value, the setting is remembered for the next time the sensor is connected.

The Functions options can be set for each connected sensor.

Changes in settings, functions, and math are applied immediately and the results are shown in the display area. Making changes usually requires adjusting values in the graph configuration area.

For information on configuring measurement settings for the various types of sensors, refer to **PMManager** Window Features.

Channel Controls

When a sensor is connected, only the current reading and properties of the device and sensor are shown in the channel area. Its settings, math, and function dialogs are closed.

Icons are available to disconnect the device and to connect other devices.

Channel display with all controls closed:
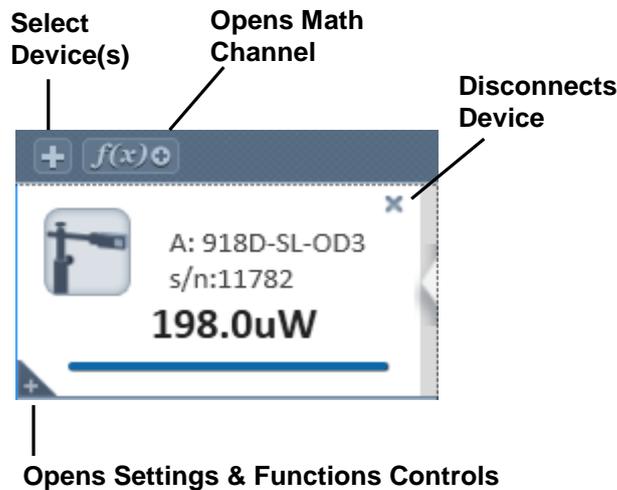
Device channel with Statistics, Math, and Functions opened:

Opens Select Device dialog

Opens a Math Channel

B: 918D-SL-OD3
s/n:11782

50.00uW

Arrows open
selection lists
settings

Closes only
Functions

Closes
Settings
and
Functions

Measuring:	Power▼
Wavelength:	1100▼
Range:	30.0mW▼
Filter:	OUT▼

Functions ❯

B: 918D-SL-OD3 Functions

Average	None ▼
Offset	
Scale factor	1.000
dBm	
Normalize	
Density	
Pass/Fail limits	

M: B/B
1.000 E+00

B▼ /▼ B▼   ƒ

Closes Math Channel

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Display Area

The display area shows the measurement readings in graph form, which you can modify with the options in the graph configuration area.

For information on configuring the display, refer to **PMManager** Window Features

❖ To clear (reset) the display area that has focus, click in the graphics control area for that device.

Numeric Display Area

The numeric display area shows the numeric value of the selected channel (sensor or math) and the statistics.

The colored vertical line separating the measurement value and the statistics identifies the sensor in the display area.
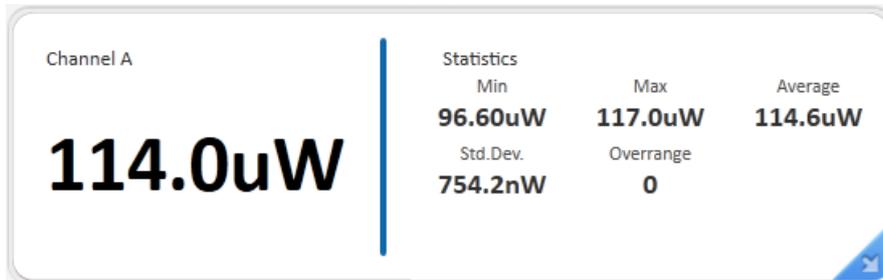
Graph Configuration Area

The graph configuration area is used to configure graph display settings.
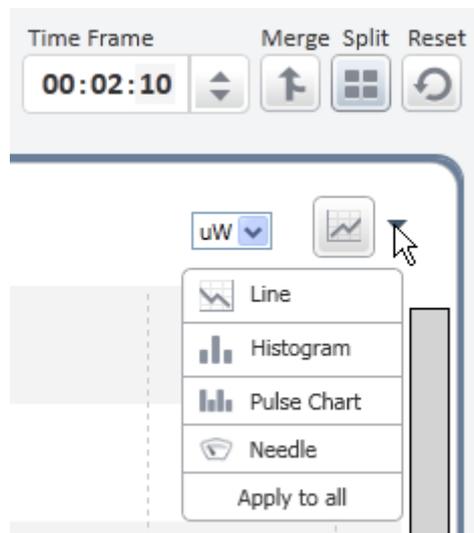
Control	Description
Time Frame	Value selected determines time period for the X-axis. Time is divided into three sections HH:MM:SS. To change a section value, click in the section (numbers shown with dark background), and click the up/down arrow to the desired

Control	Description
Power and Energy Graphs Line Histogram Pulse Chart Needle Apply to all	Click the down arrow to open the list of graphs. • The Line graph plots the values by connecting a line between points. The Y-axis is the value and the X-axis the time. • The Histogram presents a statistical analysis of all the measurements. • The Pulse Chart graph displays readings as bars with lengths proportional to the measurement. • The Needle graph displays value(s) as an analog meter. Option to include previous displays as a gray persistence. • Apply to all': Applies the current graph mode of the selected channel to the other channels, where applicable.
Track Graphs Position Stability Apply to all	These graph types are for sensors in the Track w/ Power measurement mode. • The Position graph shows the location of the laser beam as an offset from the center of the graph. • The Stability graph shows how stable the beam retains its position by counting the number of times the center of the beam remains within defined x-y cells on the graph. Apply to all': Applies the current graph mode of the selected channel to the other channels, where applicable.
Merge Split	• Merge to display multiple channels on the same graph. • Split to display multiple channels in separate graphs. If the graph mode on any channel is Position, Stability, or Needle, then Merge is not available.
Y-axis	A y-axis range is set from the Range control in the Device Channel. For the graph modes Line and Pulse, different range values can be manually entered on the graph display itself, by clicking and entering a new value on top range value at the top of the Y-axis.Measurements that are outside the immediate display area can be moved into view by the y-slide control. See Line Graph.
X-axis	The x-axis measurement is determined by the Graph Mode. The measurement can be time (Line), power/energy (Histogram and Needle), pulses (Pulse Chart).

❖ For more information on configuring graph display settings, refer to **PMManager** Window Features.

Statistics Area

The statistics area displays statistics for the current parameters. Changes made to the Math and Function settings are updated in the statistics.
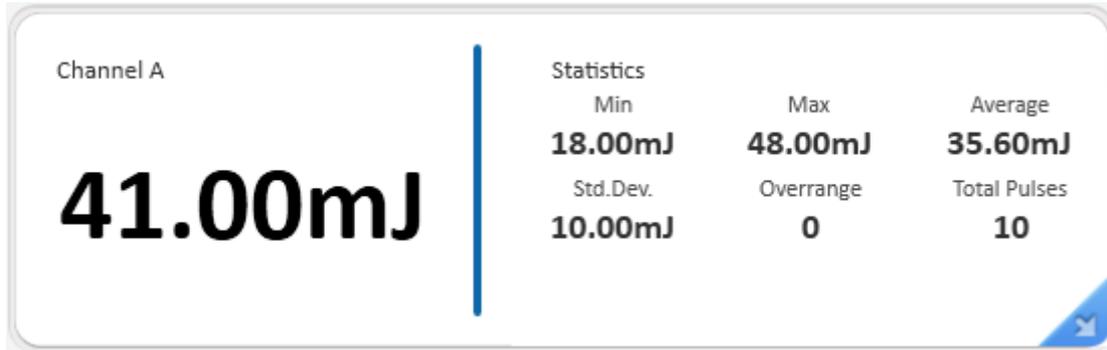
Statistic	Description
Min	Displays the minimum measurement taken.
Max	Displays the maximum measurement taken.
Average	Displays the average measurement taken.
Std. Dev.	Displays the standard deviation.
Overrange	Displays the number of readings measured that were over the maximum value for the chosen range. When a reading is over the maximum value for the chosen range, OVER is displayed in the numeric display area.
Total Pulses (Thermopile sensors in Energy Mode and pyroelectric and PD energy sensors in power or energy modes)	Displays the total number of measurements taken.
Frequency (Pyroelectric and PD energy sensors only)	Displays the frequency at which the laser is firing.

Logging Area

The logging controls are located below the channel area.
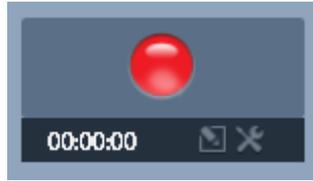
The logging area is used to configure log file settings and to start and stop the log.
For information on working with log files, refer to Log Files.

Title Bar Controls
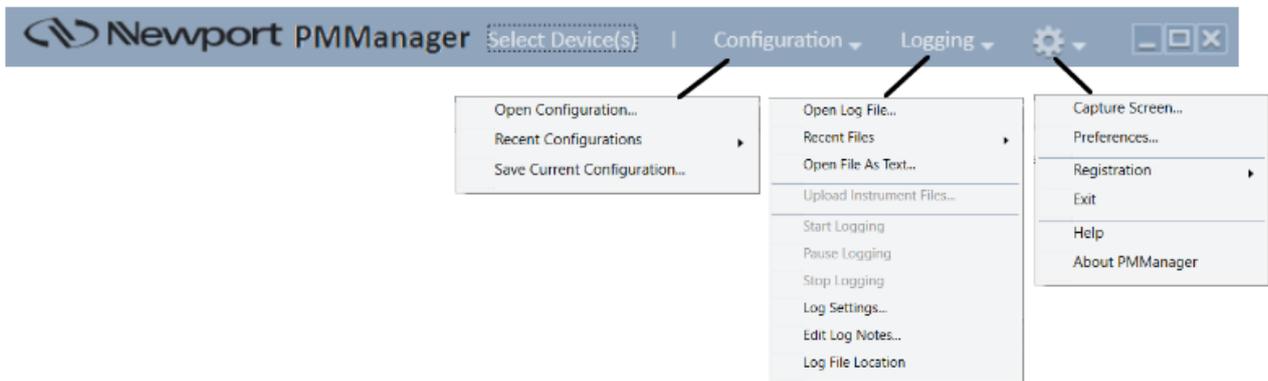
Control	Description
Select Device(s)	Command to select and connect devices (see Select a Sensor)
Configuration	List to select which configuration file to use (see StartUp)
Logging	List to select Logging options (see Log Files)
	Options Menu – features and preferences (see Preferences and Features). Some of the Advanced Functions are dependent on the device and/or sensor.
	Standard Windows control box options. See also Multiple Sessions.

Resize **PMManager** Window Areas

PMManager is meant to run in full screen mode. Although, you can resize the entire window by using the controls in the upper right corner, doing so may hide options in the graph configuration area.

There are individual controls to hide/show or expand/contract certain areas.

- Display area

  This area can be expanded to fill the entire screen by clicking the ![icon] icon of the display area.

  To contract to the default size, click the ![icon] icon in the expanded view.

- These actions hide and show the left control panel.

- Numerical Measurement and Statistics
  This area can be expanded to fill the entire display area or expanded to fill the entire screen.

  - To fill the display area, click the hide/reveal triangle ![triangle] located in the lower corner of the numerical area. While in this expanded mode, …you can hide the statistics area so that only the measurement area is shown. To do this, click 'X' at at the end of the horizontal line below the measurement value ![X] . To leave the view, click the hide/reveal triangle. ![triangle]

  - To return to the default size, click the hide/reveal triangle ![triangle] in corner of the numerical area.
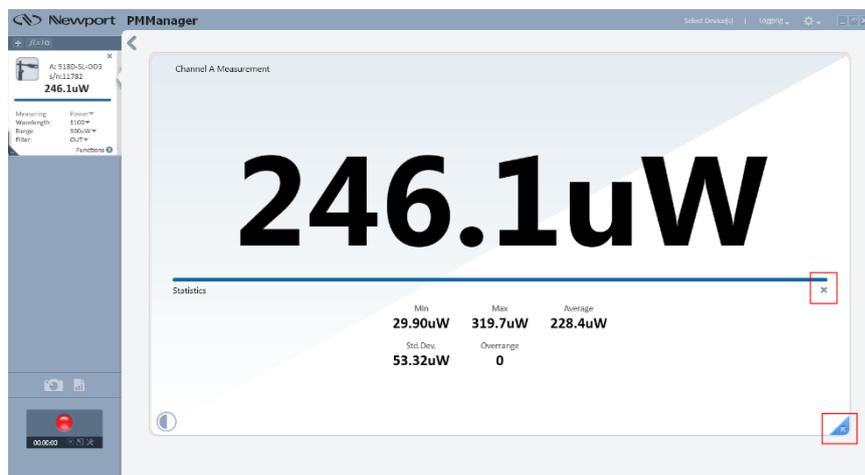
- To fill the entire screen area with the expanded view of the numerical area, click the ![icon] icon, in the display area. Click the appropriate button(s) to return to default size.
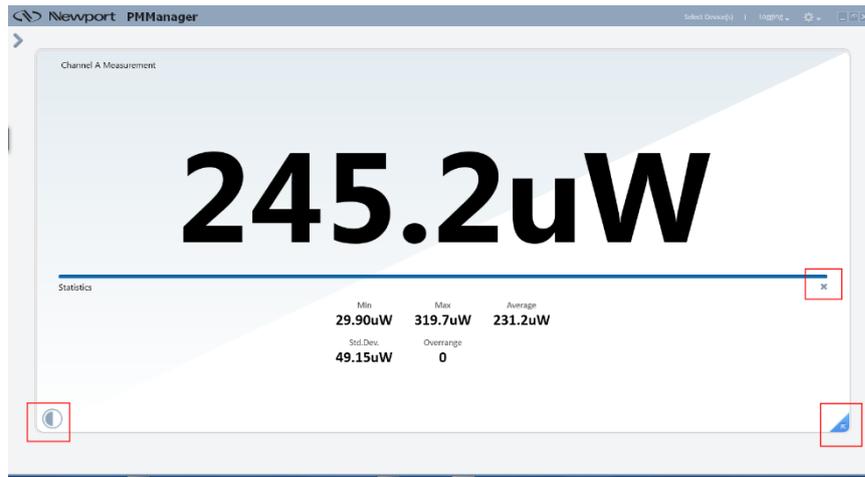
- To invert the color of the measurement area at any viewing option, click the Invert Color icon, ![icon] located in the lower left corner.
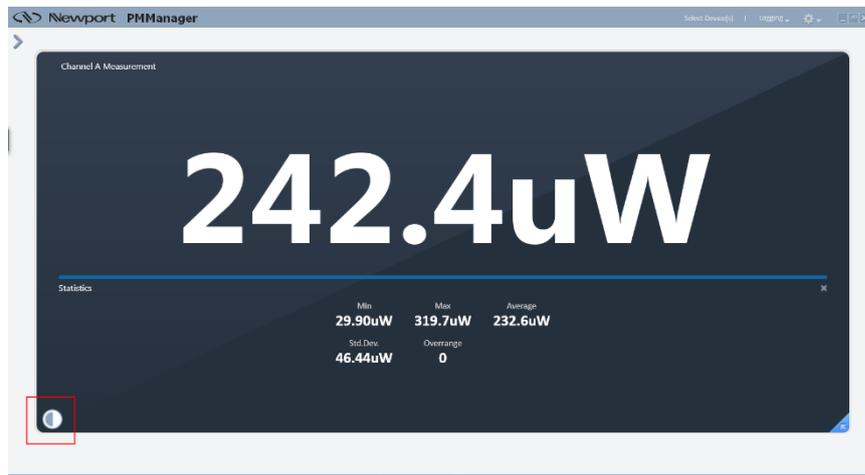
Chapter 4 - **PMManager** Window Features

PMManager offers a range of options to view, analyze, and plot sensor outputs.

You can analyze sensors individually, perform mathematical operations on their output, and then have outputs and/or results displayed individually or merged on a single graph with other sensors.

Each sensor output is assigned to its own channel (settings and functions) where the available settings are read from the sensor.

This section describes the following:

Channel

Measurement modes

Analog Output

Functions

Graphic Setup

Math channels have their primary usage when more than one channel is present. Refer to Multiple Channels.

Channel

A channel is opened for each sensor that is connected to **PMManager**. There are two sets of configuration fields for each channel: Settings and Functions. Each channel is assigned a letter character to identify the channel for graphic configurations and displays. The title or banner of the channel displays the sensor and the current value. Holding the mouse indicator over the banner displays full details of the sensor including sensor and devices serial numbers.
(Refer to Channel Controls)
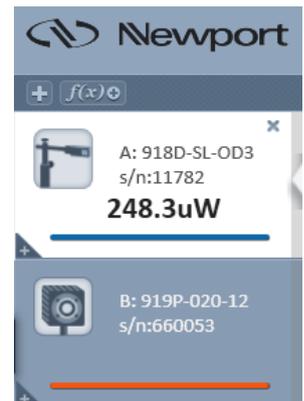
The channel measurement frame displays the current value measured by the sensor, adjusted by enabled (if any) Function parameters.

Measurement modes

The measurement modes and parameters, displayed in the Settings area of the **PMManager** Window, are sensor dependent - meaning, the modes and parameters differ according to the type of sensor deployed. For example, a photodiode sensor has different measurement modes and related parameters when compared to those of a pyroelectric sensor.
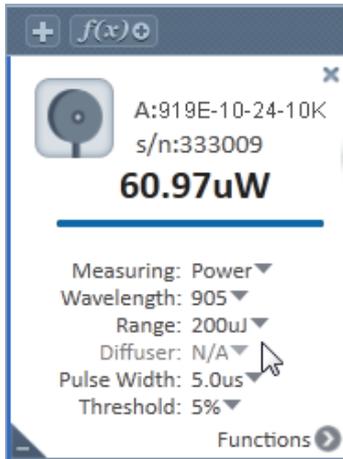
Pyroelectricsensor
Measuring mode and parameters

Photodiode sensor
Measuring mode and parameters

- Each time a mode or any other sensor parameter is modified, it is automatically saved for the next time the sensor is used

The table below displays the measurement modes available for different sensor types.

Device	Photodiode	Thermopile / PEPS[*]	Pyroelectric
1938-R / 2938-R	• Power • Exposure • Fast Power • Low Freq Power	• Power / Track* • Energy • Pulsed Power	• Power • Energy • Exposure
1919-R	• Power • Exposure • Low Freq Power	• Power /Track* • Energy • Pulsed Power	• Power • Energy • Exposure
841-PE-USB / 844-PE-USB	• Power • Low Freq Power	• Power / Track* • Energy • Pulsed Power	• Power • Energy • Exposure
845-PE-RS	• Power • Low Freq Power	• Power / Track* • Energy • Pulsed Power	• Power • Energy • Exposure
843-R-USB	• Power	• Power / Track* • Energy	• Power • Energy

* PEPS sensors include the Track measuring mode and is the trademark name of sensors that measure power, position and size.

For further information, refer to the following:

- <u>Measuring with Thermopile Sensors</u>
- <u>Measuring with Photodiode Sensors</u>
- <u>Measuring with Pyroelectric and PD Energy Sensors</u>

TTL Output

This feature is available only with the 1938-R / 2938-R

Each 1938-R / 2938-R channel is equipped with a digital output to signal to the outside world the measurement's status. This is beneficial in situations such as interlocking to shut down an out-of-range laser.

Select a TTL Output mode

Navigate to TTL Output (Options > Advanced Functions > TTL Output), and choose from one of the four TTL Output modes:

- <u>Disable (Low)</u>
- <u>On (High)</u>
- <u>Signal On Error</u>
- <u>Pass/Fail Limits</u>
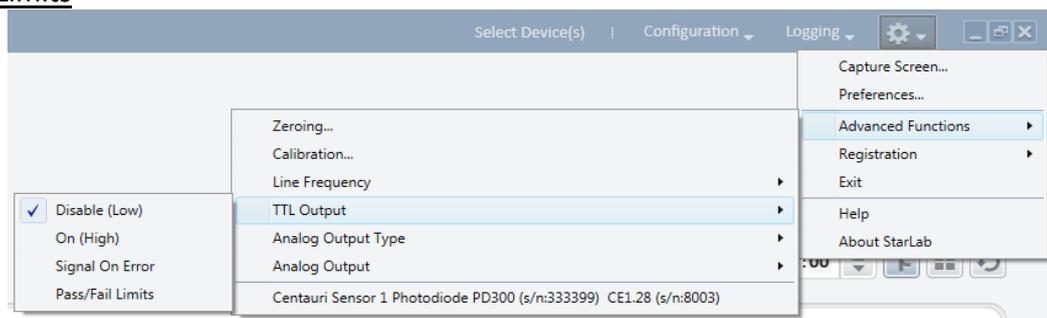
Disable (Low)

TTL Output mode is set to output a 0. This is the default state of TTL Output. It will not be left floating.

On (High)

This mode is intended for manually setting the TTL signal to 1 for controlling equipment connected to the device.

Signal On Error

In this state the TTL Output is set to High (1), when the measurement process reports one of the followings errors:

- A/D Saturation
- Sensor Saturated
- More than 10% over-range when in the Top Range
- More than 10% over-range when in any other range and the sensor is not in auto-ranging
- Any of error states when performing Single Shot Energy

❖ Frequency over-range, negative measurements, and dBm too low, are not defined as error states.

❖ When the error state is no longer true, then the TTL Out is cleared to Low (0)

Pass/Fail Limits

This is used in conjunction with the Limits Screen. If the measurement is above the Upper Limit or below the Lower Limit, then the TTL Out is set High. If the measurement is within the limits, then the TTL Out is set Low.

Analog Output

Analog output is useful for driving chart recorders and feeding measurements to analog input equipment.

PMMnager enables you to remotely configure the analog output settings in the x938-R, 844-PE-RS, 841-PE-USB and the 844-PE-USB only.

For meters with analogue output, such as the 1919-R, the analog output can be set locally on the meter.

Configure the analog output voltage range

3. Navigate to Analog Output (Options > Advanced Functions > Analog Output).

*   Select the relevant voltage setting.
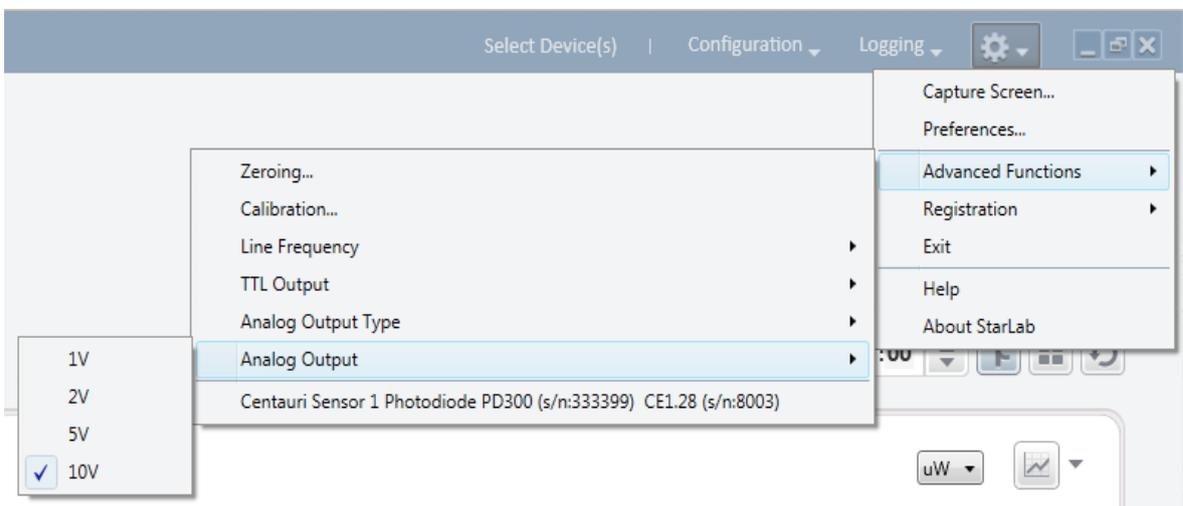
The analog output is driven through an impedance of 100 ohm. For best accuracy, it is recommended to limit the external load to 100K (or larger). A smaller load (down to 1K) is possible but may result in loss of accuracy.

*   For thermal and photodiode sensors in Power mode, the analog output is updated 15 times per second with the latest power measurement
*   For thermal sensors in single shot energy mode, the analog output is held until the next pulse is measured
*   For pyroelectric sensors, the analog output is updated at up to 10 times per second with the latest pulse energy

Select the analog output type – RAW or Digital

For the 841-PE-USB / 844-PE-USB, 1938-R / 2938-R and the 845-PE-RS, you can select the type of analog output - RAW or digital.

The 'Digital' analog output is the analog voltage representation of the measured (processed) laser power.

The 'Raw' analog output is a continuous non-digitized amplified signal, sourced directly from the sensor with little conditioning, and routed to the analog output voltage

If you want to use a photodiode sensor for temporal pulse shape measurements of the laser for instance, you would use the raw analog output. The signal from the sensor only passes through analog amplification.

Select the analog output type

4. Navigate to Analog Output Type (Options > Advanced Functions > Analog Output Type).

5. Select either Digital or RAW
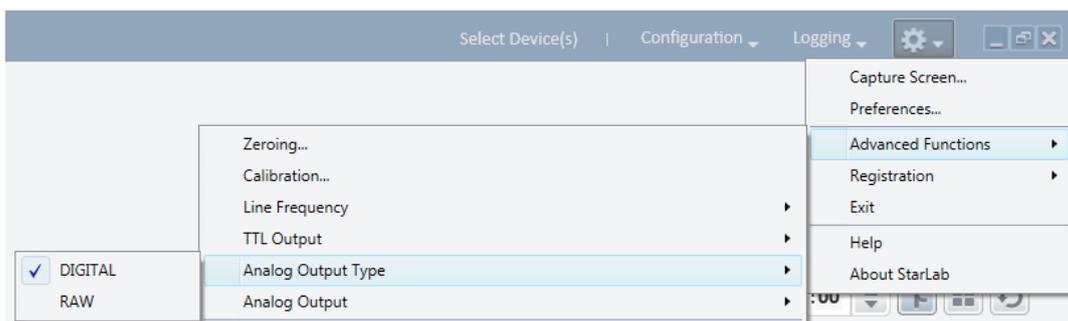
Functions

Each sensor channel comes with a Functions section. The parameters are the same for each sensor, but their values are related to the sensor and the current readings of the settings.

Functions apply to power and energy readings. For a sensor in Track w/Power measurement mode, the functions will apply to the power reading, not to the position and size readings.

Average

The Average function offers several choices as to the time interval over which sensor readouts are averaged.

When you set the channel to average mode, **PMManager** displays the average of the readings spanning from the last time average mode was activated, to the present. Once the time period of the average is reached, the average becomes a running average, spanning the average period backwards in time. For example, if the average period is 30 seconds, at 15 seconds, the average is over 15 seconds; at 30 seconds, the average is over 30 seconds; at 5 minutes, it is over the period from 4 minutes and 30 seconds to 5 minutes (30 seconds back from the present).
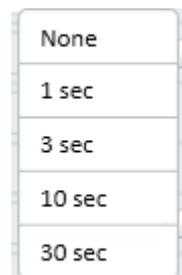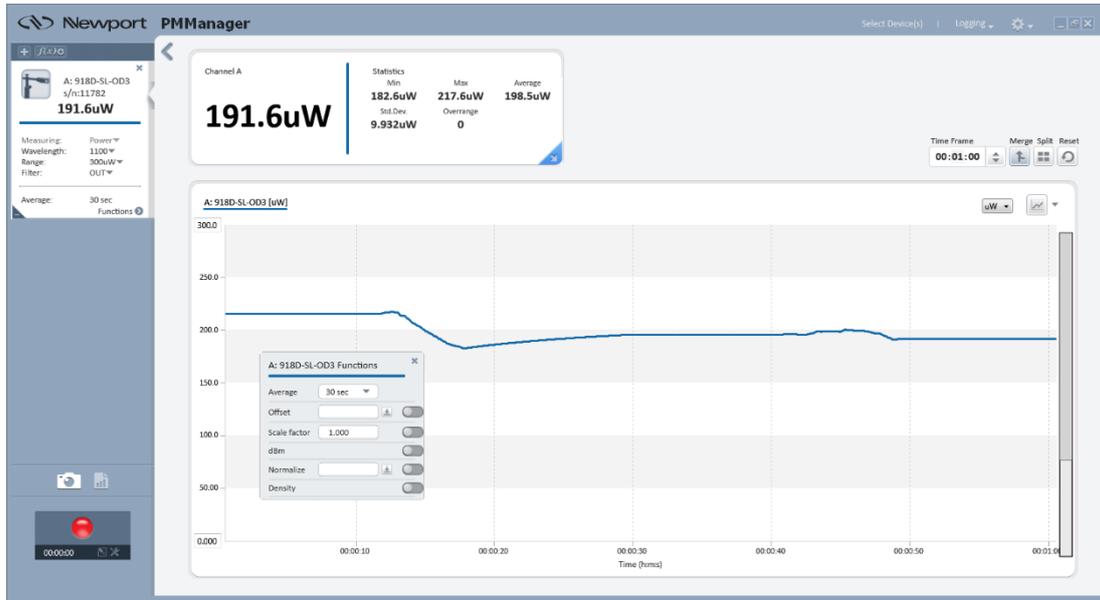
Offset

The Offset function lets you select a "current" value as an offset value.

1. Open the Function dialog.
   If this is the first use of Offset, the value is blank (grey).

2. To use the current measurement value, click ⬇
   That value becomes the Offset value and the adjacent slide switch is engaged.

Every time you click ⬇ the current value becomes the offset value and shows in the adjacent field. The offset value remains until another value is selected.

The difference between the "current" value and the Offset is displayed in the measurement frame.

If you click the button while the offset is in effect, the new offset value is the "current" value, not the displaced difference.

3. Slide the toggle to off , to remove the Offset value, but maintain the current value.

Scale Factor

The Scale Factor function multiplies the "current" value with the positive or negative value you enter in the adjacent field once you select the check box.

1. Open the Function dialog.
   If this is the first use of Offset, the value is 1.000 (grey).

- Slide the toggle to ON, to enable the value field.

- Enter the scale factor.

- Slide the toggle to OFF to set and use the factor.

- Slide the toggle to OFF to remove the scale value, but maintain the current value.
  This option is especially useful in measurement configurations that have a beam splitter in front of the sensor. By multiplying by the correct scale factor (usually about 20), the user will see the actual laser power/energy measurement and not just what hits the sensor.

dBm and dB offset

The dBm function enables you to display current values as dBm values and with a dB offset.

1. Open the Function dialog.

- Verify that the Normalize function is off.

- Slide the toggle to ON.
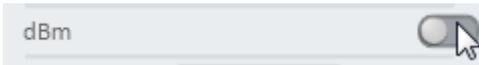
The dBm options are enabled.
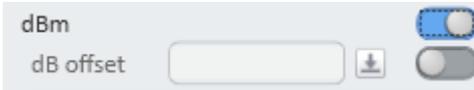
The measurements values are displayed as dBm.

- To include dBm offset, click the adjacent ⊥
  This offset parameter functions like the Offset one. Every time you click the adjacent ⊥ button, the current value becomes the offset value. The difference between the "current" dBm value and the dB Offset value is displayed in the Channel Measurement frame.

- Slide the toggles to OFF to remove dBm (and offset, keeping current value).
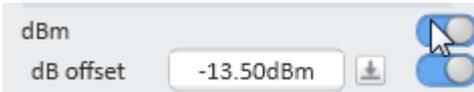
Normalize

The Normalize function uses the selected "current" value and divides all subsequent values by the selected value and displays the result in Channel Measurement frame.

1. Open the Function dialog.

- Verify that dBm function is off.

- To begin normalization, click the adjacent ⊥ button.

- The current value becomes the normalizing value and is displayed in the text field.
  You can also enter the normalization value manually.

- To remove normalization, keeping current value, slide the toggle.

Density

The Density function displays the sensor output as a per cm² value. The option lets you choose a Round Spot or a Rectangular Spot diameter from the adjacent list box.

1. Open the Functions dialog.

2. Verify that the dBm option is off.

3. Select a spot:

   - For a round spot, check the Round Spot option, and enter the diameter.

   - For a rectangular spot, check the Rectangular Spot option, and enter the width
     (W and height H).respective fields.
     With either of the selections, the Graph plot power density, and the displayed measurement Statistics is updated to reflect the selection.
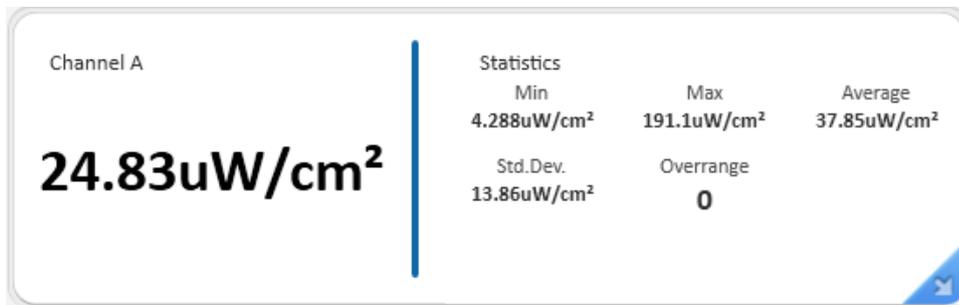
Pass/Fail Limits

Define maximum and minimum limits for the reading. If a reading 'out of the limits' is received, it will be marked. This feature is ideal for final QA testing

1. Open the Functions dialog.
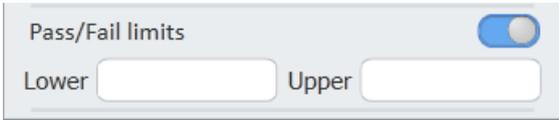
2. Enter values in the appropriate fields.
   Two red dotted lines are placed on the graph. The lines are indicators to show pass/fail limits. They do not alter the values of the graph. When using "split" mode, limits are set individually.
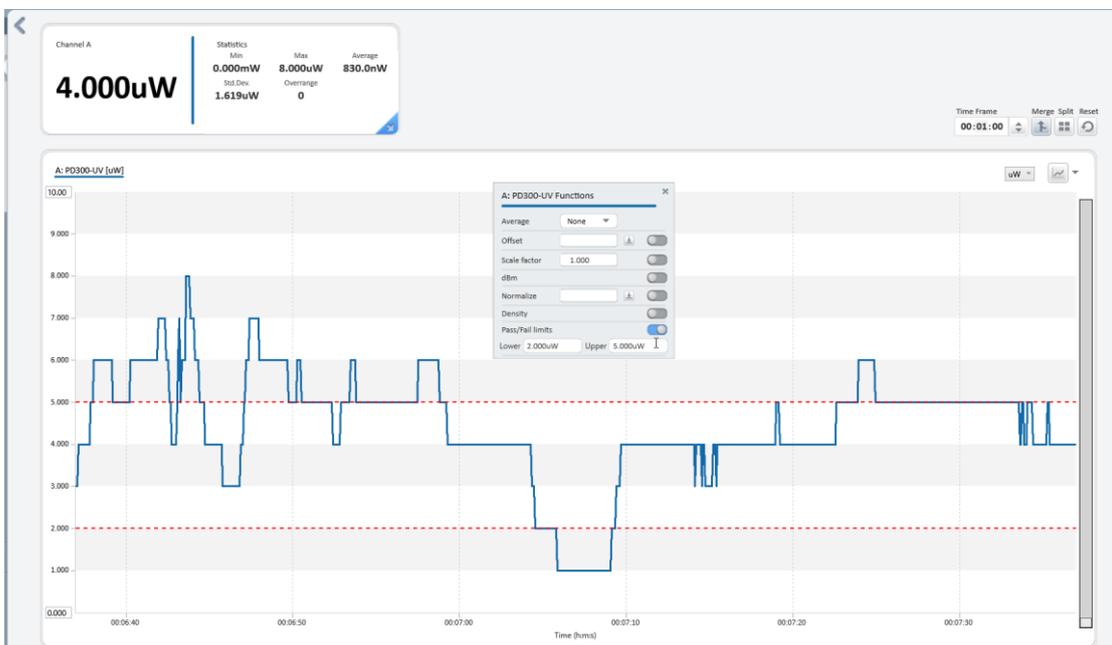
Graphic Setup

This section describes the Graphic Setup using one channel as an example.

Graph selection starts by clicking the adjacent list arrow to a list to select the graph type. The icon picture updates to show your selection.
Multi-channel displaying would follow the same use of the controls, only then you can show the channels on separate graphs or merged into one.
When merged, the channel you click defines the axis definitions.

Line Graph

Configure a line graph

1. In the Graph option list, select Line.

2. In the Time Period section, select the time period to represent the width of the X-axis.
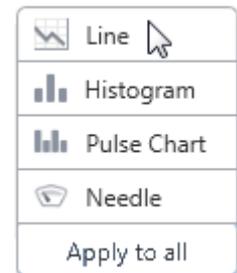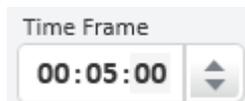
   Since the X-axis always has 10 major divisions, then in this case, each one is 1-second.
   After 10 seconds has elapsed, the X-axis will begin sliding to right and after each second another division is added to the right and one division is removed on the left.

3. Observe the value in the Channel A Measurement frame as well as the Min and Max displayed in the Statistics frame. This information will guide you in selecting Y-axis limits.

4. Open the list box to select the units for the Y-axis.

5. Select a unit based on the information gathered from the previous steps.
   With the slide controls in this position, the values are 0 to 1,000 of the unit that you selected.

   ❖ When options from Functions are used, the unit selection will change accordingly.

   Refer to Y-axis with Functions for details.

6. Adjust the slide controls to give you the definition that you wish to see in the display.
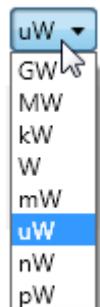
Y-axis with Functions

Function	Y-axis Unit
dBm	dBm
Normalize	No units displayed
Density	W/cm² or J/ cm²
Offset and Scale Factor	Selecting one of these functions does not change the units of the Y-axis scale but may require adjusting the limits.

7. The line graph also has a pause button to enable temporarily 'freezing' the presently displayed graph.

Histogram Graph

Configure a histogram

1. In the Graphic option list, select Histogram.

2. Observe the value in the Channel A Measurement frame as well as the Min and Max shown in the Statistics frame. This information will guide you in selecting X-axis limits.

3. Open the list box to select the units for the X-axis.

4. Experiment with the controls in Histogram Settings so the data is displayed in appropriately.

   ❖ When options from Functions are used, the unit selection will change accordingly.
   Refer to Y-axis with Functions for details.

   ❖ Measurements that are out of the selected X-Axis limits can be displayed by the slide below

   ❖
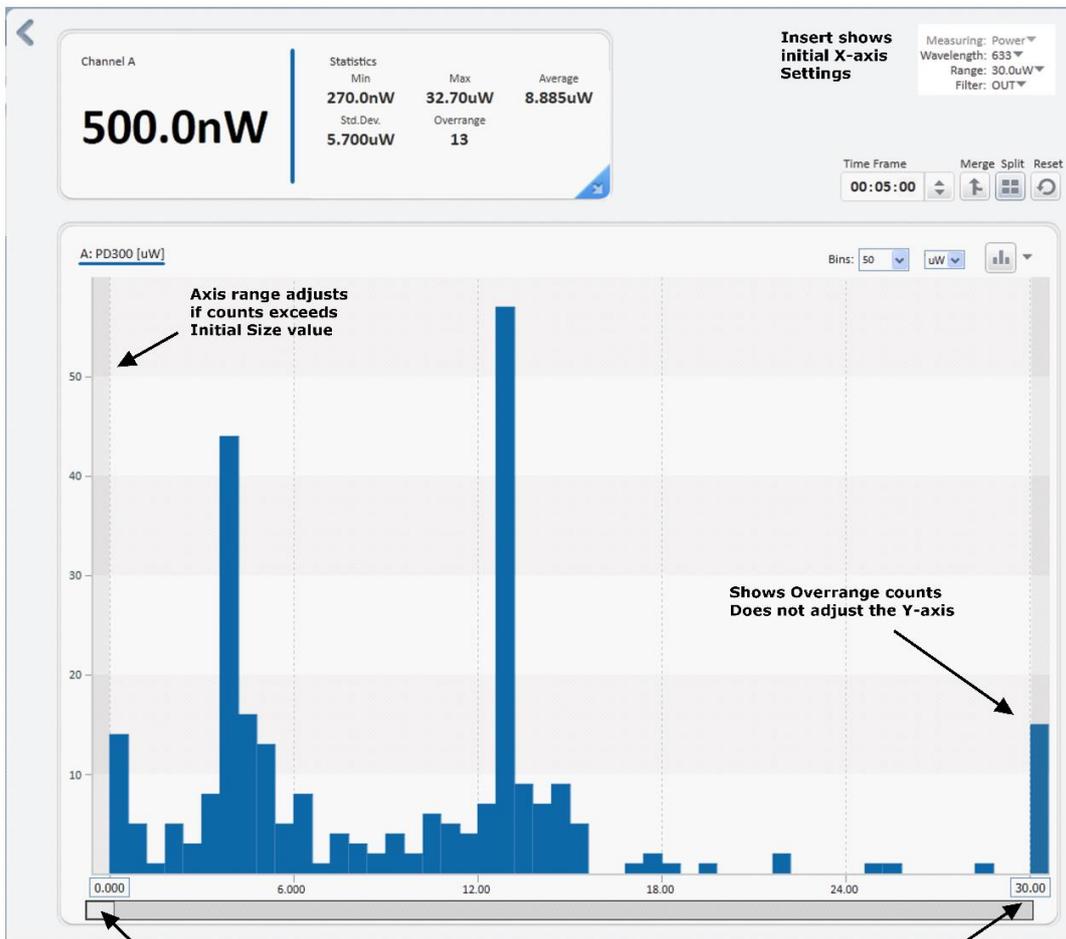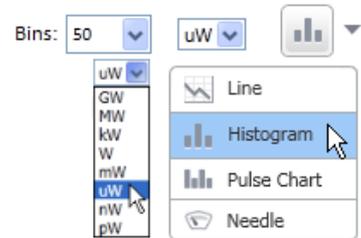
Pulse Chart

Configure a pulse chart

1. In the Graphic option list, select Pulse Chart.

2. Observe the value in the Channel A Measurement frame as well as the Min and Max shown in the Statistics frame.
This information guides you in selecting Y-axis limits.
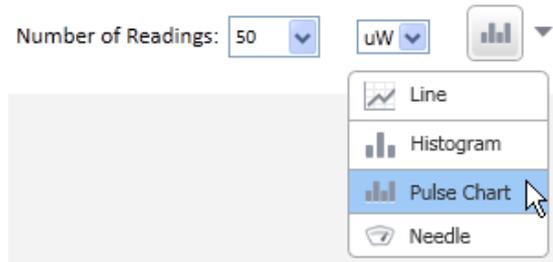
3. Open the list box to select the units for the X-axis.
In this example, the Y-axis was modified to display 5.000W at the top because the measurement values were less. Initially, the value 30.000 was changed and after clicking in the bottom field (0.0), the chart show was displayed.

Needle Graph

A needle graph simulates an analog display, similar to the style of an analog voltmeter.

Configure a needle graph

1. In the Graphic option list, select Needle.

2. Observe the value in the Channel A Measurement frame as well as the Min and Max shown in the Statistics frame.
This information guides you in selecting Y-axis limits.

3. Follow the steps for a <u>Line Graph</u> as the requirements for these two graphs are similar.

Needle Modes

The Needle graph has two modes:

• Persistence
In this mode, previous measurements remain and are displayed in gray.
Also, the Min and Max values are displayed.
Click Clear to clear the display of previous measurements, including Min and Max.

Clear the Persistence option to convert to Non-Persistence display.

• Non-Persistence
In this mode, only the current measurement is displayed.
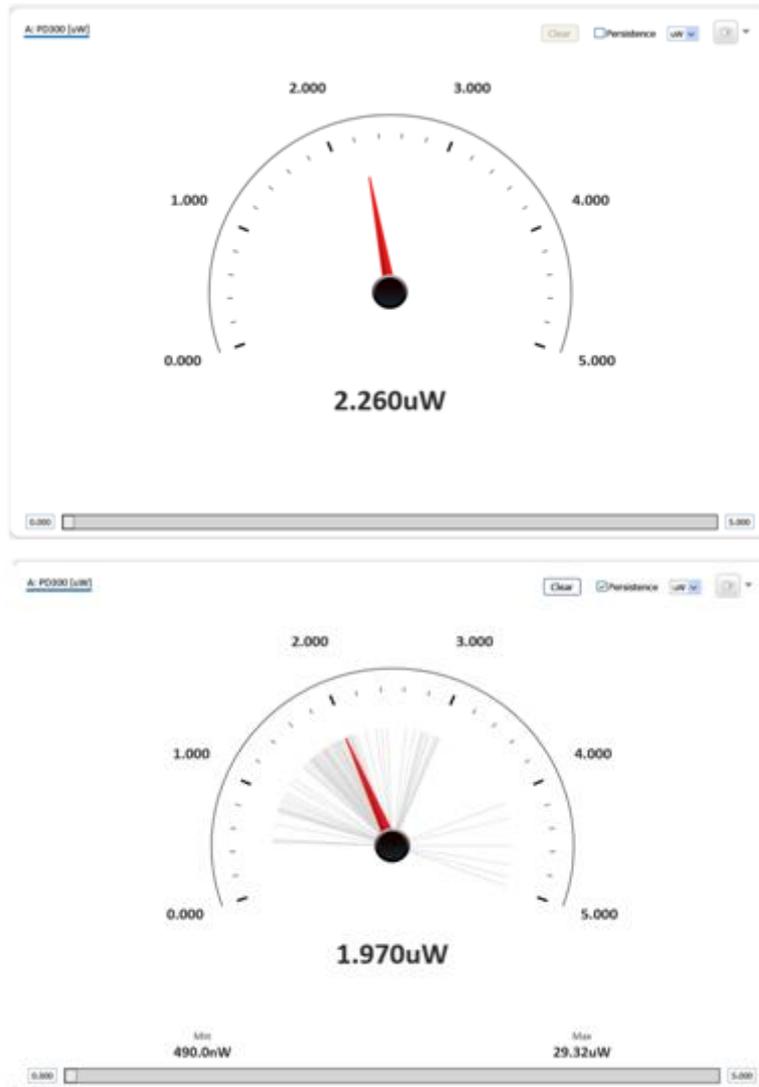
Position

When a sensor is in Track w/Power measurement mode, the graphic display can either be Position or Stability. In the Position graph, **PMManager** displays the position of the laser beam on a coordinate graph as well as numerically. It also displays size as a circle drawn to scale on the graph and numerically. If size cannot be measured, then position data only will be shown.

The numeric display and statistics are of the power measurement. Functions that are set will affect the power and statistics measurement. They have no effect on the position and size measurements.

Centering — A slide switch in the display area can be set for absolute or for relative position measurements when the switch is moved to the left side.

You can select the current position of the laser as center, and all the later positions of the laser will be calculated according to the origin. The offset of the current position will be displayed on the graph.
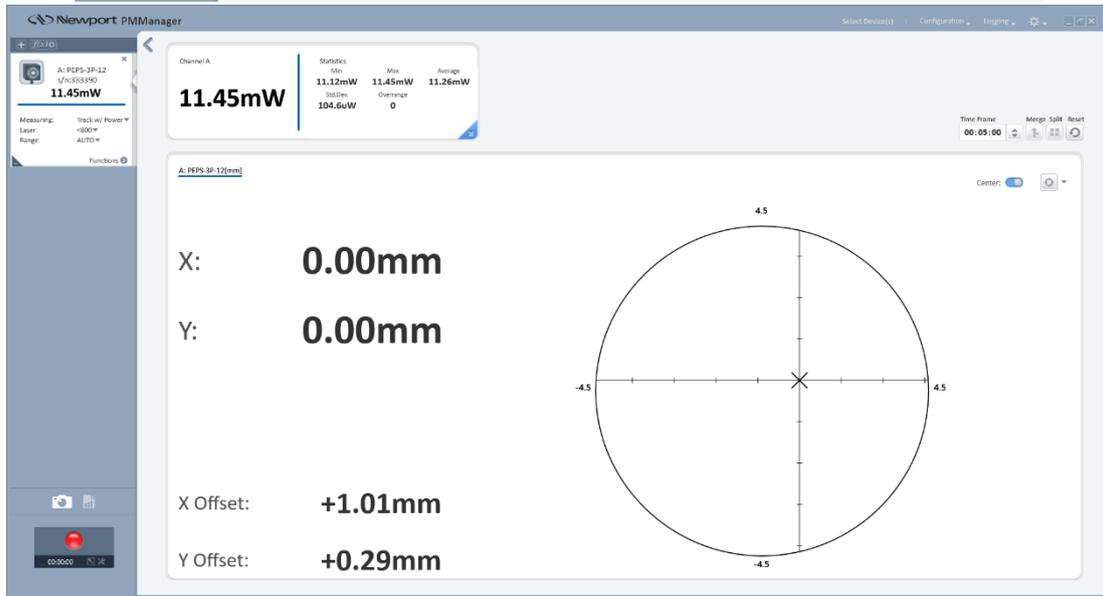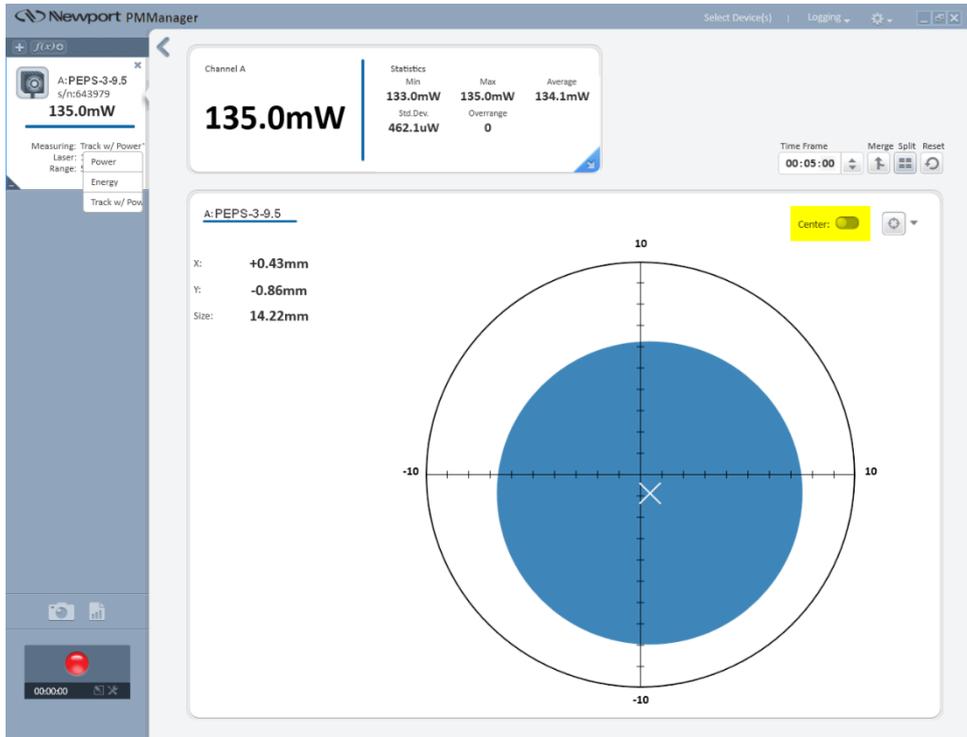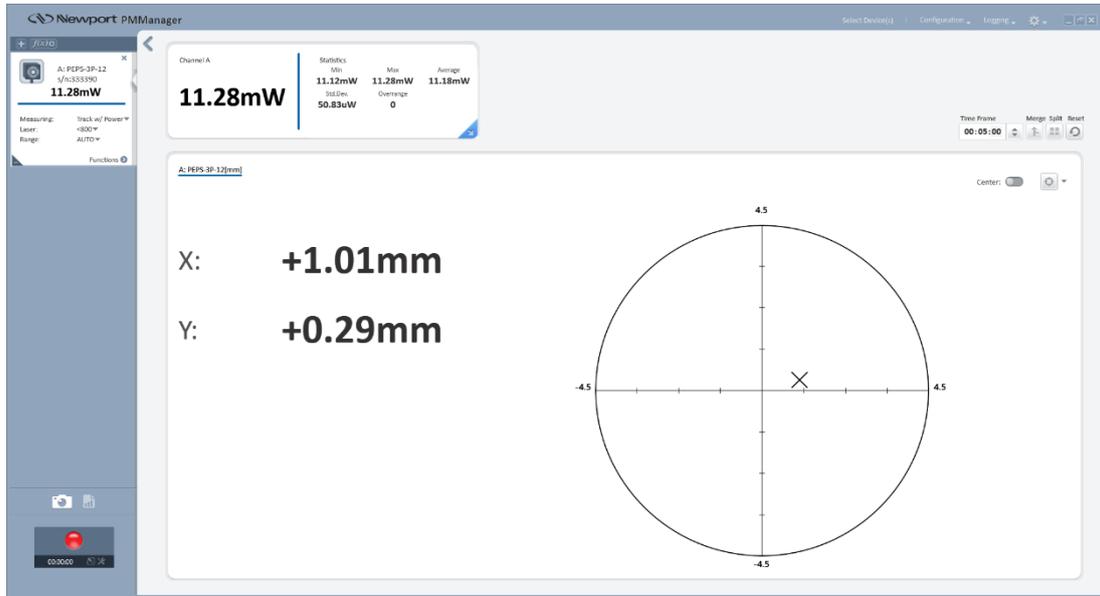
Stability

When a sensor is in Track w/Power measurement mode, the graphic display can either be Stability or Position. The Stability graph tracks the pointing stability of the laser beam over time.
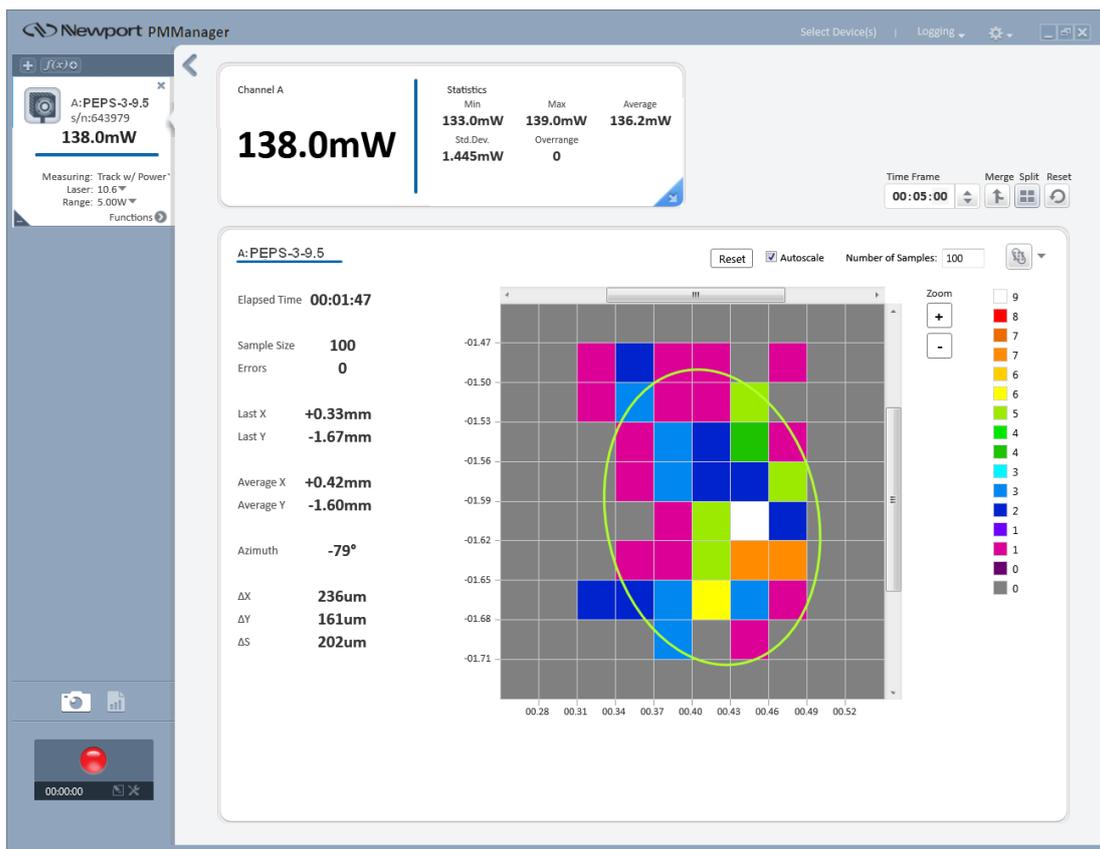
Configure a stability graph

1. Select Stability

2. Set the number of samples to collect.
   Enter a number from 1 to a million. This is the number of beam center locations that will be counted. When the sample count reaches this value, old readings are removed from the sample set as new readings are added to keep the sample count constant.
   You can follow the count in the Data area.
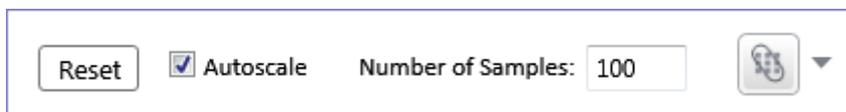
Graphic area

The default size for the area is the position tracking area available on the PEPS sensor being used, with zero in the center. The measuring dimensions can be altered by using one of the Zooming options.
Each axis is divided into 10 units creating 100 cells in which the counting is made for the beam center position. In the Stability example, each cell is 0.05mm by 0.05mm.
Each cell is given a color that represents the number of readings for that cell, see Legend. As the stability measurement proceeds, the cells change colors.

Autoscale

Selecting this option in Graph Setup scales the X- and Y-axes so that the display occupies the maximum area of the graph.
If you then de-select the option, these axis settings remain. One of the Zooming options must be used to change the display.

Legend

The legend is a series of vertical, colored squares where each square's number is the number of counts for that x-y cell in the graph. The value zero, which means no hits in that cell, is the background color of the display. The cell with the greatest number of counts is made white. The values of the squares in between are given values divided between zero and the highest values. As the stability measurement proceeds, you will see the values of the legend's squares change.

Data area

Laboratory System. An X, Y coordinate system defined in the space of the laser sensor. The zero point is the sensor center, X is horizontal and Y is vertical.
Beam Axis System. An X, Y coordinate system where the X direction is the direction of the maximum amplitude of movement of the laser beam, and the Y direction is perpendicular to the X direction. The zero point is the average position. This coordinate system moves relative to the Laboratory System as the laser beam moves.

Elapsed Time	Shows duration of the counting. Counting begins when the Graph option Stability is selected or when the Reset button is clicked.
Sample Size	Indicates how many samples have been measured. This value increases until the entered value for the number of samples is reached; after which old samples are discarded from the sample set to keep the value constant.

Errors	When value is greater than zero indicates number of times a count could not be made. The usual reason is that the beam center when outside the sensor's field of view.
Last X and Y	The position of the beam center for the last reading, in the Laboratory System.
Average X and Y	Shows the average X and Y positions for the readings in the sample set, in the Laboratory System.
Azimuth	The rotation angle of the X axis of the Beam Axis System relative to the X axis of the Laboratory System.
Δ, Y, and S	The position stability, calculated as 4 in the X, Y and S directions respectively in the Beam Axis System, where is the standard deviation. S represents a general radial direction.

Zooming

Zooming the displayed stability graph is available during measurements as well when viewing a recorded log file. Zooming is accomplished by keyboard, the left mouse button, and by the mouse wheel. As zooming is increased or decreased, the X- and Y-axes will adjust. Moreover, cell colors and legend values will change. You can use the scroll bars of the graph to center the new zoom field.

- *Keyboard*

  Clicking the Plus and Minus keys on the main keyboard section or on the Number keypad will zoom in and zoom out the display.

  The arrow keys can be used to scroll the display.
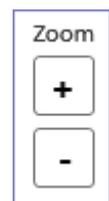
- *Left mouse button*

  This button can zoom the display by clicking the appropriate button on the Zoom control.

  The left mouse will drag the display by holding down the button and moving in the desired direction. The mouse indicator changes to a 4-point motion indicator icon.
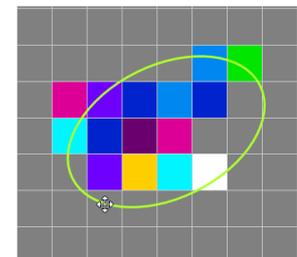
- *Mouse wheel*

  Rolling the mouse wheel away from you zooms in, and towards you zooms out. The display may be scrolled in any direction by pressing the mouse wheel (or middle mouse button) and dragging.

Apply to All

This option sets all displays to the same Graph mode as the display that is selected. Apply to All does not affect displays which cannot be changed to the selected graph.
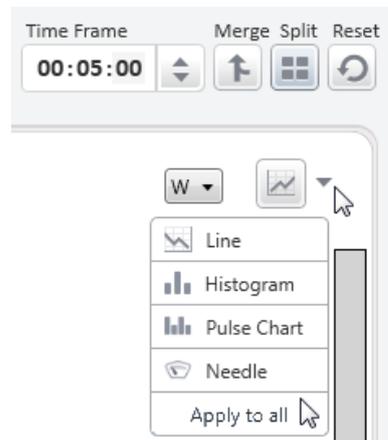
Chapter 5 - Measuring with Thermopile Sensors

This chapter describes how to take measurements with thermopile sensors.

About Thermopile Sensors

Newport thermopile sensors measure both power and single shot energy. When a radiant heat source, such as a laser, is directed at the absorber sensor aperture, a temperature gradient is created across the thermopile of the enclosed detector disc.
This generates a voltage proportional to the incident power.

The instrument amplifies this signal and indicates the power level received by the sensor. At the same time, the signal-processing software enables the instrument to respond faster than the thermal rise time of the detector disc, reducing the response time of instrument.
The energy of a single pulse is measured by digitally integrating the pulse power over time.

Configure Measurement Settings

If you are planning to repeat similar measurements, you can configure the settings for each individual sensor, and save them to the instrument. The saved settings become the default configuration for that channel, and are displayed every time the channel is opened.
The following sections describe how to select a measuring mode, how to configure thermopile sensors measurement settings, and how to save the settings as the default configuration for that channel.

❖ Measurement settings are mode dependent, meaning the settings differ depending on the measuring mode selected.

Select a Measuring Mode

In the Settings area, select a measuring mode from the Measuring list.
Choose from either Power, Energy, Track w/Power or Pulsed Power*.
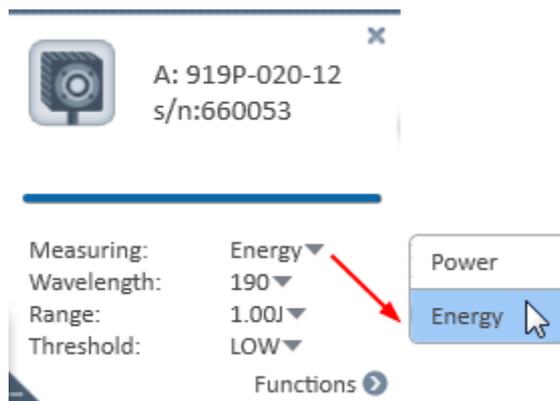
Configure Power Settings

Specify the laser wavelength

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* Pulsed Power mode is only available with 1919-R and 841-PE-USB / 844-PE-USB devices

Laser Wavelengths

Thermopile sensors have different absorption at different wavelengths. To compensate for these differences, each sensor has been calibrated by a laser at several wavelengths. By specifying the correct laser wavelength, the correction factor for that wavelength is automatically introduced.

Specify the laser wavelength

In the Laser list, specify a laser wavelength.
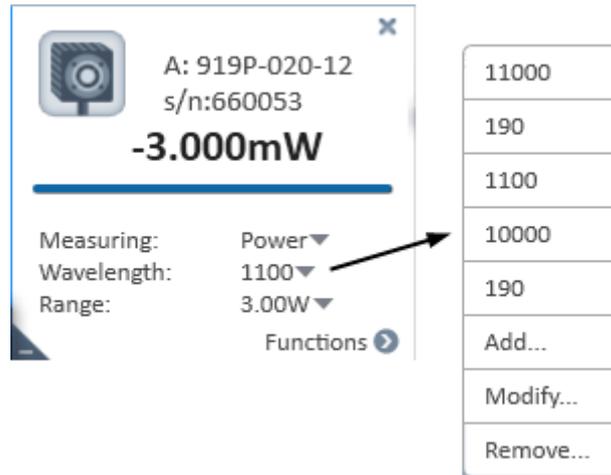
LP1 Sensors

For the LP1 family of sensors, the absorption of the detector coating varies somewhat according to wavelength. The correction curve for the absorber is stored in the sensor EEROM.
This correction curve ensures the power reading is correct at all laser wavelengths.

Power Ranges

Thermopile sensors cover a wide range of powers, from microwatt to 1000s of watts, depending on the type of sensor. To provide accuracy at each end of the range, the electronics of the device must be configured to work in a range that is most suited to your needs.

Specify the power range

In the Range list, specify a power range.

❖ When the range of the expected readings is unknown, or if highly varied readings are expected, select AUTO (see Auto Range)

The instrument configures itself according to the selected range.
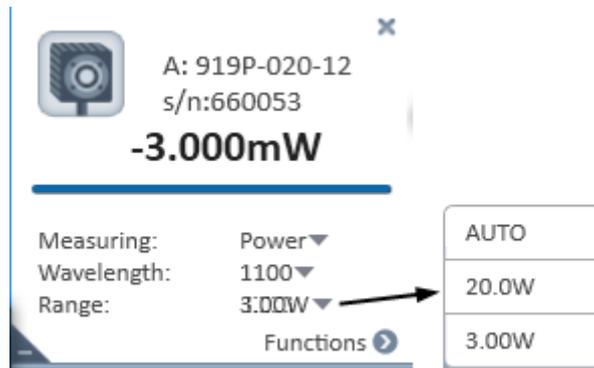
Auto Range

When the range is set to Auto, the instrument configures itself in the lowest range possible that is higher than the latest readings.

* If the readings exceed 100% of the present range, the instrument reconfigures itself for the next higher range

* If the readings fall below 9% of the present range, the instrument reconfigures itself for the next lower range after a short delay

The delay prevents an infinite range-changing loop when readings are close to the end of the scale.

Average the Measurements

The thermopile sensor is measured 15 times per second. **PMManager** automatically refines the readings and applies a moving average (see Average).

Configure Energy Settings

Specify the laser wavelength, power range, and energy thresholds.

Instrument is Ready

When the instrument is ready to measure a new pulse, the word READY flashes in the numeric display area. The next pulse automatically clears the screen, and the new value is then displayed.
If a further pulse is fired before the word READY is displayed, the reading may be inaccurate or may not be displayed.

Energy Thresholds

If the instrument is used in a noisy environment, or where high levels of background thermal radiation are present, the instrument may trigger spuriously on the noise or background radiation. It would then fail to measure the intended pulse. Since some degree of noise or background radiation is inevitable, the instrument is designed not to respond to pulses below a preset minimum level.

The minimum energy threshold is typically set to 0.3% of the full scale of the selected range.
However, the range can be modified when the level is too sensitive for particular environment.
The thresholds however, should not be raised higher than necessary, as this will cause degradation in the accuracy of energy measurements of pulses below about 4 times the threshold level.

Specify the energy thresholds

In the Threshold list, specify the energy thresholds as described as follows.

‣ **Low**   Select this threshold when measuring small energies and unit does not trigger

‣ **Medium** This is the default factory setting

‣ **High**   Select this threshold when there is noise and unit does not trigger
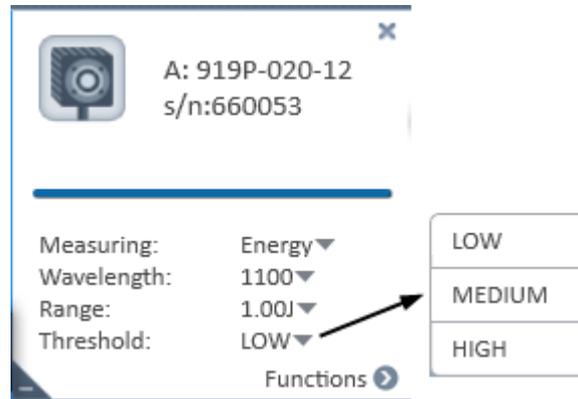
Configure Pulsed Power Settings

❖ The Pulsed Power setting is only available with 1919-R, 841-PE-USB / 844-PE-USB devices

Specify the <u>laser wavelength</u>, <u>power range</u>, <u>energy thresholds</u>. and <u>pulse width</u>.

Pulsed Power

Thermopile sensors models are capable of measuring pulsed power in order to display instantaneous power of a laser pulse. Power can be calculated from energy if the length of the pulse is known.

ⓘ **The accuracy of measurement is dependent on setting the pulse width correctly**

Pulse Width

A key element in measuring pulsed lasers is to define the pulse width (or pulse length) of the laser pulses.

Specify the pulse width

Specify the pulse width to the shortest time that is longer than the expected pulse width.

1. In the Pulse Width list, select Modify.

2. In the Modify Pulse Width dialog box, specify the pulse width duration in the seconds field.

   • Specify a shorter pulse width setting for higher frequency lasers
   • Specify a longer pulse width setting for higher energy lasers
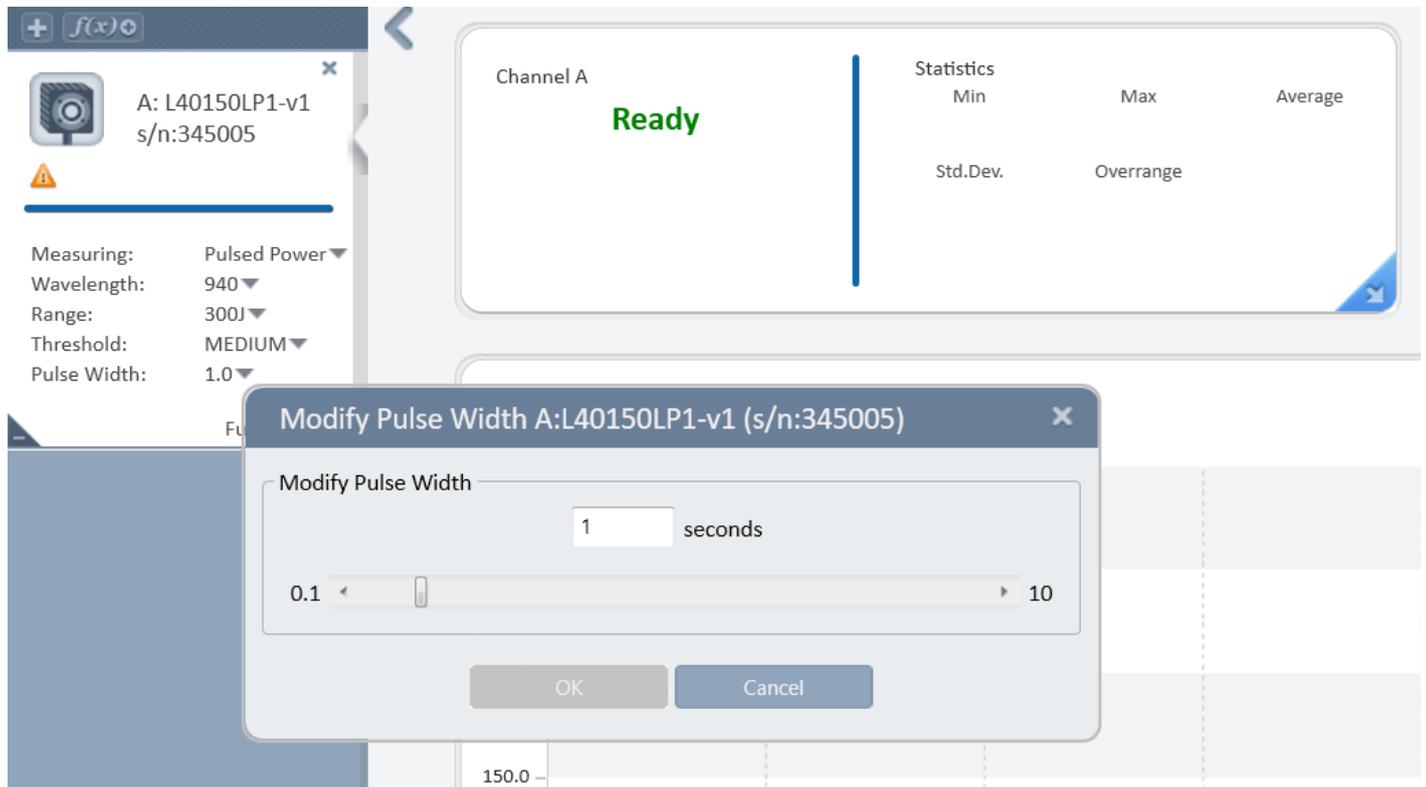
Optimize the Readings

PMManager can be optimized to achieve the most accurate and efficient results. This section describes the most commonly used optimizations: offset, zeroing the instrument, and setting line frequency.

Apply an Offset

When there is thermal background in the environment, thermopile sensors may show a non-zero power reading, even when there is no laser. For example, the display reads 0.1 Watts when the laser is blocked, and reads 20.5 Watts when laser power is applied.
In this case, the true power is 20.5 - 0.1 = 20.4 Watts.
To subtract the background, apply an offset while the laser is blocked. The display will now read zero, and the 0.1 Watt background will be subtracted from all subsequent readings.
The laser power reading will be 20.4 Watts.

❖ If you suspect the instrument has a permanent zero offset, disconnect the sensor while the sensor is in power measurement mode. If the instrument still displays a similar reading even when the sensor is not connected, zero the instrument.

Zero the Instrument

All adjustments performed on Newport devices, including zeroing internal circuits, are done via the software. This ensures simple and accurate realignment.
For optimum performance, it is recommended to frequently zero the instruments.

- 1919-R and 843-R-USB, devices:

Newport®

- Thermopile sensors:

  It is necessary to <u>zero the instrument with no sensor attached</u>, and then repeat with the sensor attached

- Photodiode sensors:

  It is only required to zero with the sensor attached

- 841-PE-USB / 844-PE-USB, instruments:

  - All sensors:

    It is only required to zero the instrument with the sensor attached.

Zero the device with no sensor attached

1. Start up the instrument with no sensor attached: unplug the USB cable, disconnect the sensor, and replace the USB cable.

2. Check the instrument is not in an electrically noisy environment and is undisturbed.

3. Open the Select Device(s) dialog, and click Diagnostics.
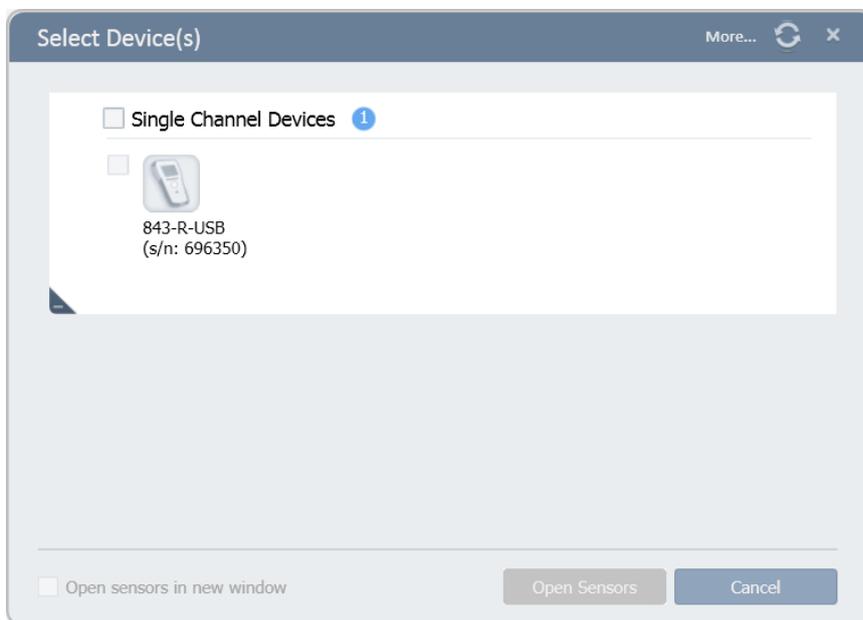
4. In the Diagnostics dialog, click Zeroing.
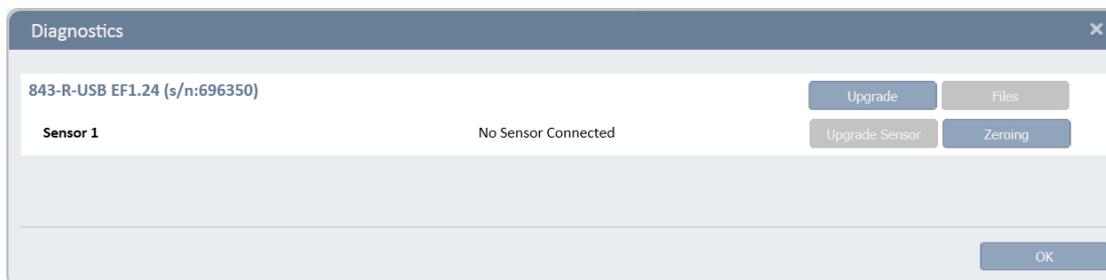
The Zeroing Instrument dialog opens.

5. In the Zeroing Instrument dialog, click Start to begin zeroing the instrument.
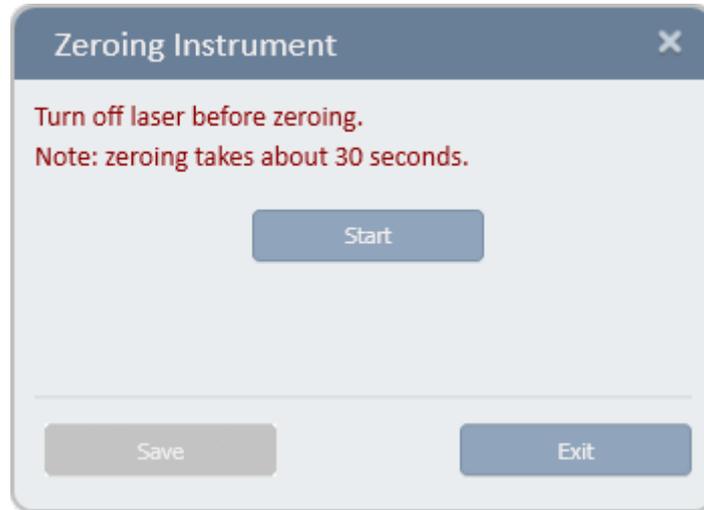
When the zeroing is complete, a dialog opens with a message describing if the zeroing was successfully completed or failed. Click OK to dismiss the message.

Zero the device with a sensor attached

1. Start up the instrument with a sensor attached.

2. From the Settings option Cogwheel, Open the Advanced Functions menu and select Zeroing. The Zeroing Instrument dialog opens.

3. In the Zeroing Instrument dialog, click Start to begin zeroing the instrument.

4. When the zeroing is complete, click Save to save the zeroing.

Specify Line Frequency

Use the line frequency feature to remove interference caused by AC electricity in the room.
The 843-R-USB, 1919-R, and 841-PE-USB / 844-PE-USB are factory set at 50Hz.

❖ **Reset the line frequency if your country uses 60Hz**

Set line frequency

1. In Options, select Line Frequency.

2. Select the line frequency according to your geographical location:

   - Europe = 50Hz
   - USA, Japan = 60Hz
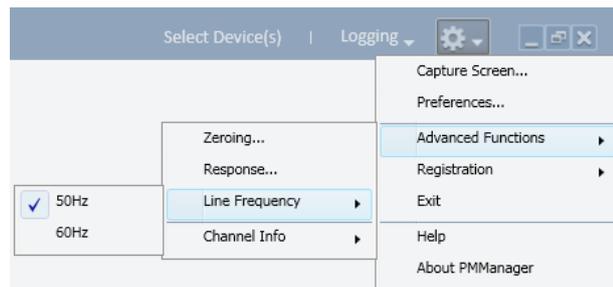
Calibration Factors

PMManager enables you to adjust power calibration factors, configure the response factor, and adjust energy calibration factors.

⚠️ **WARNING**	Adjusting the calibration factor makes a permanent change in the sensor. It is strongly recommended that before making any change to the factor, the original factory setting is recorded separately. This makes it easier, if required, to later restore the value to its original setting.

Adjust Power Calibration Factors

The absorption of the various Newport thermal absorbers can vary from disc to disc. Therefore, all Newport absorbers are individually calibrated against NIST traceable standards. Newport sensors are laser-calibrated at several wavelengths, against a NIST calibrated standard meter. For more information on Newport sensor calibration and traceability, refer to <u>Appendix B – Calibration, Traceability, and</u> individually <u>Recalibration</u>.

PMManager offers two types of calibration:

• **Overall Calibration** - Changes the calibration at all wavelengths simultaneously

• **Laser Specific Calibration** - Changes the calibration at one specific laser wavelength

Adjust the power calibration factors

1. Make sure Measuring is set for Power.

2. In Options, select Calibrate.
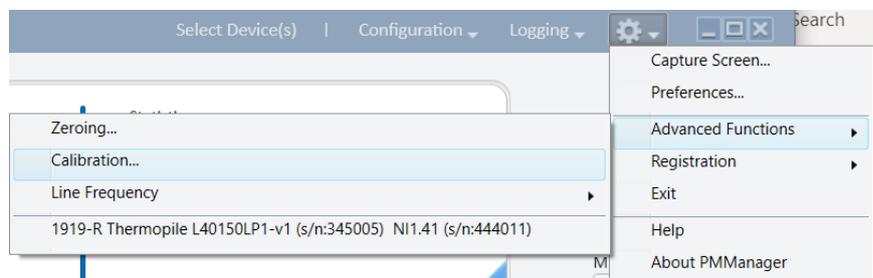
   The Adjust Calibration Factors dialog opens.

   The Original area displays the original Measurement, Overall Sensitivity, and Laser Factor fields.

   The Current wavelength is displayed beneath the Original area.
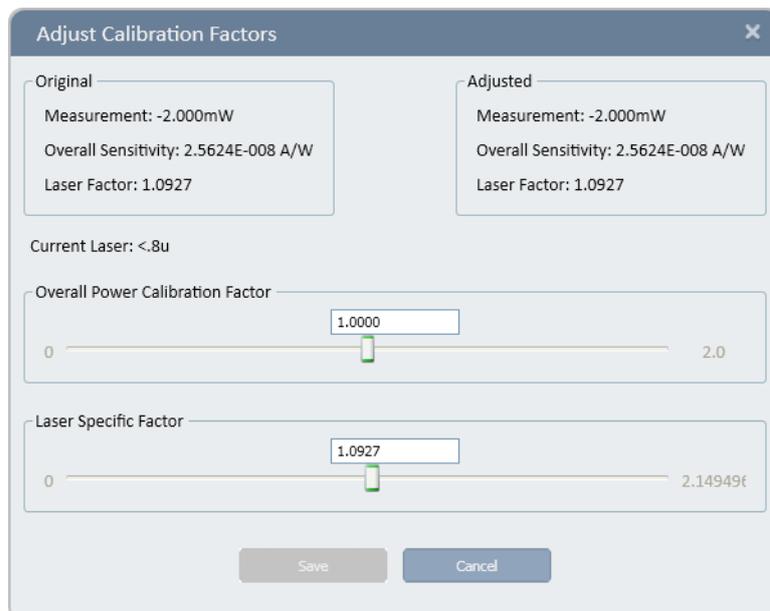
3. Use the Overall Power Calibration Factor scroll bar to attain an accurate reading in the Overall Sensitivity field in the Adjusted area,

OR

Enter the desired factor into the text box above the scroll bar.

> ❖ Adjusting the overall power calibration factor effects both the Measurement and the Overall Sensitivity values.

4. Use the Laser Specific Factor scroll bar to attain an accurate reading in the Overall Sensitivity and Laser Factor fields in the Adjusted area,
OR
Enter the desired factor into the text box above the scroll bar.

> ❖ Adjusting the Laser Specific Factor effects both the Measurement and the Laser Factor values.

5. Click Save to save the adjustment for the active channel.

Configure the Response Factor

The response factor feature finds the optimum response time to enable an accurate reading as quickly as possible, while minimizing the risk of overshoot, (the erroneous reporting of readings above 100% of the full scale). Response factor adjustment is only possible when the sensor is in power mode.
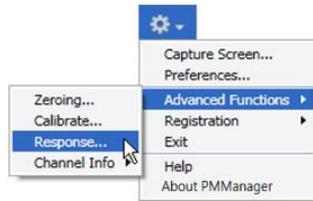
Set the response factor

1. In Options, select Response.

    The Adjust Response Time Factor dialog opens.
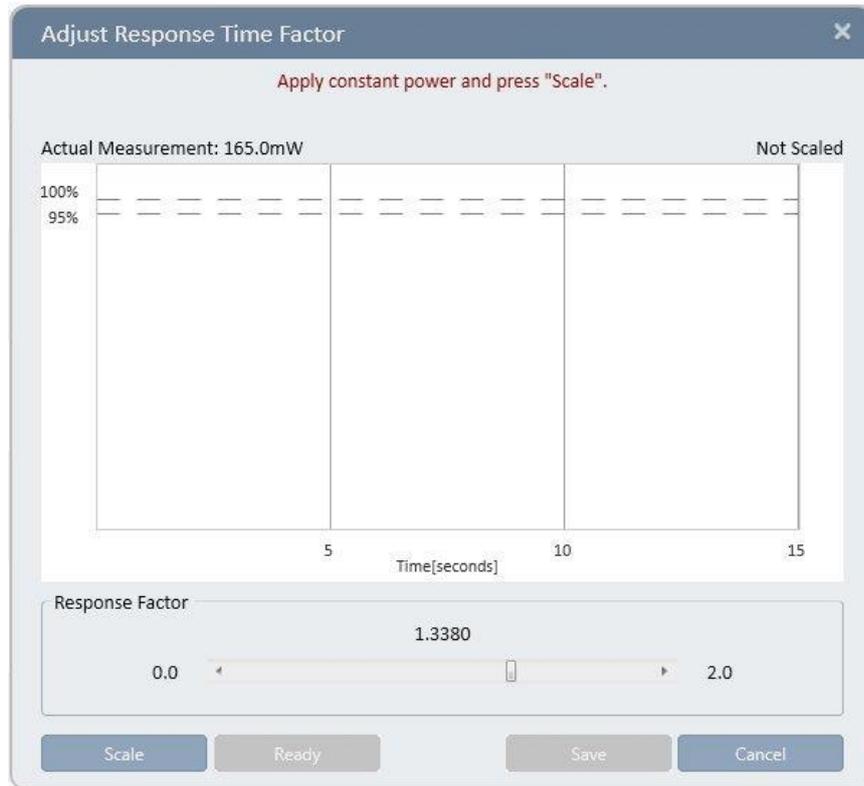
2. Apply constant power, and click Scale.
    When the scaling is complete, the scaled value is displayed on the right side of the dialog.
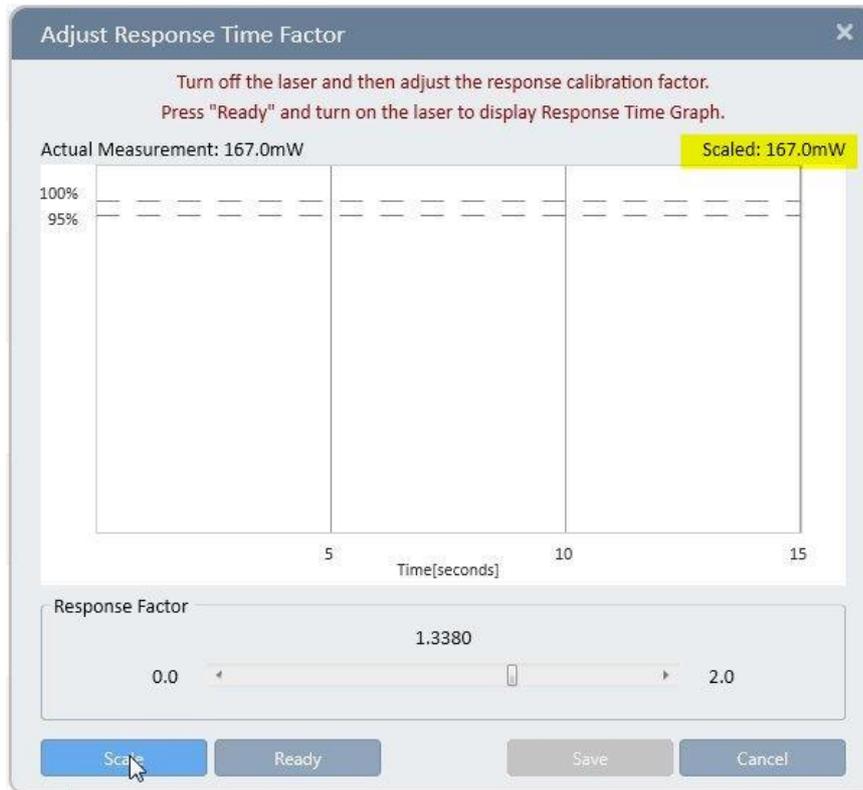
Use the scroll bar to adjust the response factor in the Response Factor area.

3. Apply constant power to the thermopile sensor until the graph stabilizes.

4. Click Scale.

5. Block the laser for several moments to allow the sensor to cool down.

6. Adjust the response factor:

- To reduce overshoot, at the risk of possibly slowing down the response of the sensor, lower the response factor

- To speed up the response of the sensor, at the risk of possible overshoot, raise the response factor

8. Click Ready.

8. Unblock the thermopile sensor.

9. Take a second reading.

10. Repeat steps 5 through 9 until the response is optimized.

Adjust Energy Calibration Factors

Both power and energy readings are equally affected by changes in the absorption and/or sensitivity of the thermal disc. Therefore, changing power calibration proportionately changes energy calibration. In addition, adjusting the response time of the sensor can also affect energy calibration. For this reason, provisions are made to adjust energy calibration without affecting power calibration.

Adjust the energy calibration factors

1. In Options, select Calibrate.
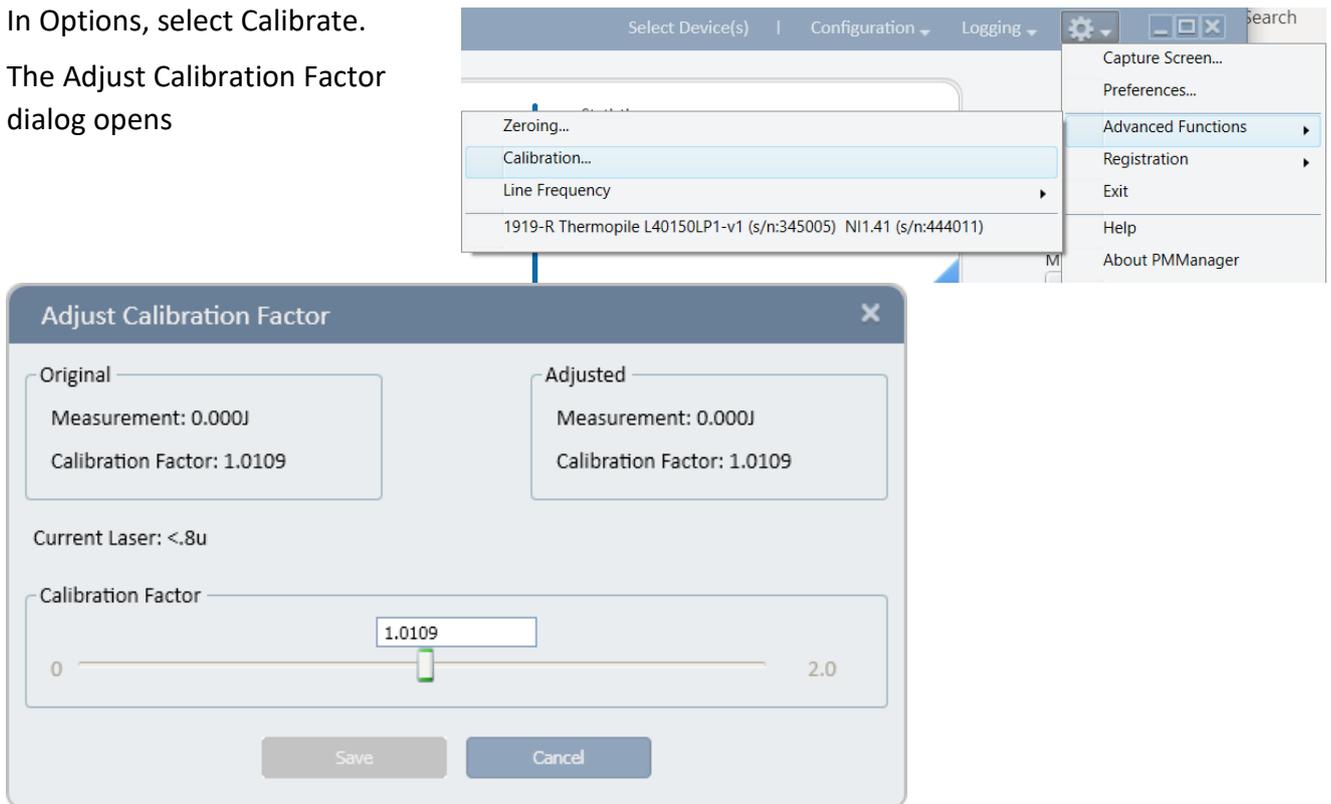
   The Adjust Calibration Factor
   dialog opens

The Original area displays the original Measurement and Calibration Factor. The Current wavelength is displayed beneath the Original area.

2. Use the scroll bar to adjust the Calibration Factor in order to attain an accurate Calibration Factor reading.

3. Click Save to save the adjustment for the active channel.

PEPS Sensors

PEPS sensors are a line of thermopile sensors that can measure beam position and beam size while measuring power. This is accomplished by adding quadrant detectors to the classical thermopile disc, as well as a patented beam size detector in the center
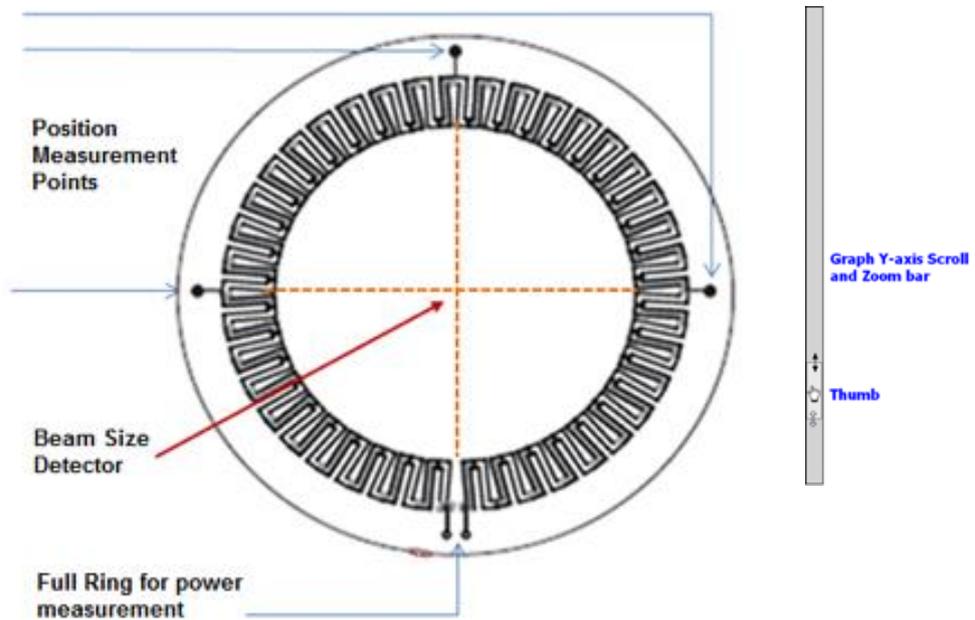
Configure Track w/Power Settings

Measure with track w/power

In the Measuring list, select Track w/Power.

> The graph types available in Track w/Power measurement mode are Position and Stability.

> For more details, refer to Position and Stability in Chapter 4 – Features of the **PMManager** Window.

- Functions apply to power measurements only, not to the position and size measurements See Functions

- Data Logging includes position and size readings in addition to power measurements See Log Files

- Math channel functionality only applies to power See Math Channels
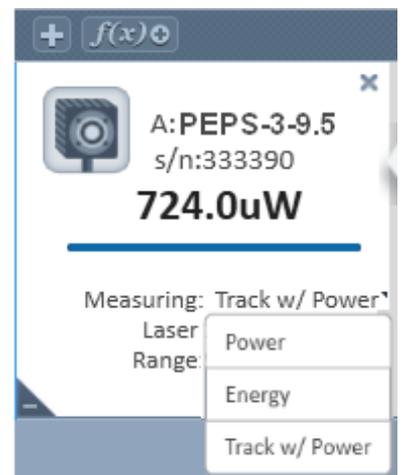
Additional Graphical Display Options

For additional graphic display options, see **PMManager** Window.

Chapter 6 - Measuring with Photodiode Sensors

This section describes how to take measurements with photodiode sensors.

About Photodiode Sensors

When a photon source, such as a laser, is directed at a photodiode sensor, a current is created proportional to the light intensity and dependent on the wavelength.

Newport photodiode sensors significantly reduce background noise because they have a unique dual detector sensor, containing two identical detectors which are connected back-to-back.
When a uniform signal, such as background room light, falls on the detector sensor, the signal from the two detectors cancels. Conversely, when a laser beam falls on the sensor, it illuminates the first detector only and is detected. This is how the sensor subtracts most of the background while still detecting the desired signal. In general, 98% of the background signal is eliminated.
This means that the detector can be used in ordinary laboratory lighting conditions.

The instrument amplifies this signal and indicates the power level received by the sensor.
Due to the superior circuitry of the Newport instruments, the noise level is very low, and Newport photodiode sensors have a large dynamic range, from pico Watts to Watts.

Since many low power lasers have powers ranging from 5 to 30mW, and most photodiode detectors saturate at about 2mW, Newport photodiode sensors have a built in filter to allow the sensor to measure up to 30mW or more without saturation. When the additional filter is applied, the maximum power can range from 300mW to 3W. Photodiode sensors saturate when the output current exceeds 1.3mA so the exact maximum power depends on the sensitivity of the detector at the wavelength used.

For a more detailed description of the principles of operation of Newport photodiode sensors, refer to the Newport Optronics catalog, available for download from http://www.Newportopt.com.

Configure Measurement Settings

If you are planning to repeat similar measurements, you can configure the settings for each individual sensor, and save them to the instrument. The saved settings become the default configuration for that channel, and are displayed each time the channel is opened.

The following sections describe how to configure measurement settings for photodiode sensors and how to save them as the default configuration for that channel.
Configuration settings include: configuring laser wavelengths, range, average readings, and inserting/removing the filter.

Configure Laser Wavelengths

Photodiode sensors have a different sensitivity at different wavelengths. Moreover, the filters used in the sensor have a different transmission at different wavelengths. When you choose the correct laser wavelength, the correction factor for that wavelength is automatically introduced.

You can select which laser wavelength to work with from an editable drop down list. You can configure a maximum of six wavelengths to appear in the drop down list, to simplify changing from one laser wavelength to another. Laser wavelengths can also be modified or removed.

Select a laser wavelength

In the Wavelength list, select a laser wavelength.
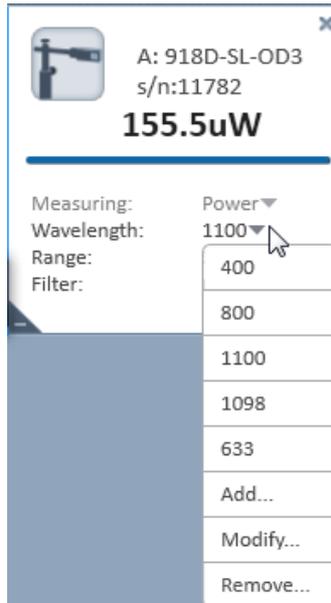
Add a laser wavelength

1. In the Wavelength list, select Add. The Add Wavelength dialog opens.

   ❖ The Add option is only available if less than 6 wavelengths are listed in the Wavelength list.

   Manually enter the wavelength,
   OR
   Use the scroll bar or arrows to configure the new wavelength.

2. Click OK to save the new wavelength and close the dialog box.
   The new wavelength appears in the Wavelength drop down list.

Modify a laser wavelength

1. In the Wavelength list, select Modify. The Modify Wavelength dialog opens.

2. Manually enter the required wavelength,
   OR
   Use the scroll bar or arrows to modify the wavelength.

3. Click OK to save the modified wavelength and close the dialog.
   The modified wavelength appears in the Wavelength list.

Remove a laser wavelength

1. In the Wavelength list, select Remove. The Remove Wavelength dialog opens, displaying the wavelengths in the Laser Wavelength list.

   ❖ The Remove option is only available if more than 1 wavelength is listed in the Wavelength list
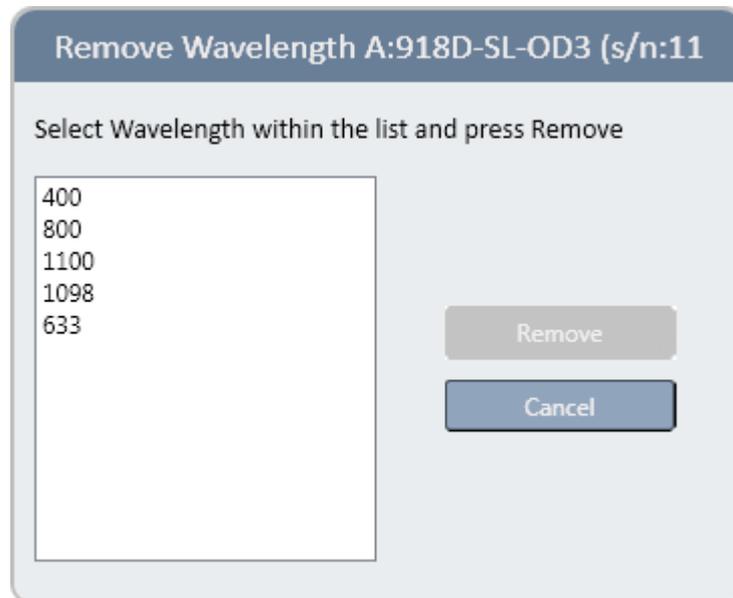
2. Select the wavelength you wish to remove. You can only remove one wavelength at a time.

3. Click Remove to remove the selected wavelength and close the dialog.
   The removed wavelength no longer appears in the Wavelength list.

Select the Range

Photodiode sensors cover a wide range of powers, depending on the type of sensor in use. In order to provide accuracy at each end of the range, the electronics of the device must be configured to work in a range that is most suited to your needs.

Configure the range

- **When you know the approximate range of the expected readings:**
  In the Range list, select a range. The instrument configures itself according to the selected range.
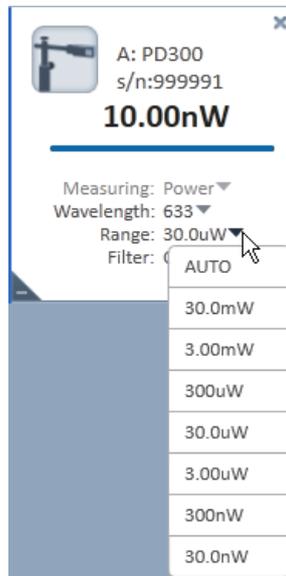
- **When the range of the expected readings is not known, or highly varying readings are expected:**
  In the Range list, select AUTO.

  ❖ AUTO instructs the instrument to configure itself in the lowest range possible that is higher than the latest readings.

  - If the readings exceed 100% of the present range, the instrument reconfigures itself for the next higher range.
  - If the readings fall below 9% of the present range, the instrument reconfigures itself for the next lower range after a short delay. The delay prevents an infinite range-changing loop when readings are close to the end of the scale.

Filter Settings

Most photodiode sensors are equipped with an optional filter that allows them to measure up to 300mW or more without saturating the detector. The exact maximum power is reached when the reading reaches full scale, or when the output current from the sensor reaches 1.3mA, whichever comes first. You can work with or without the filter, depending on which powers you wish to measure.

Configure the instrument to measure

- When the filter is inserted: In the Filter list, select IN

- When the filter is removed: In the Filter list, select OUT
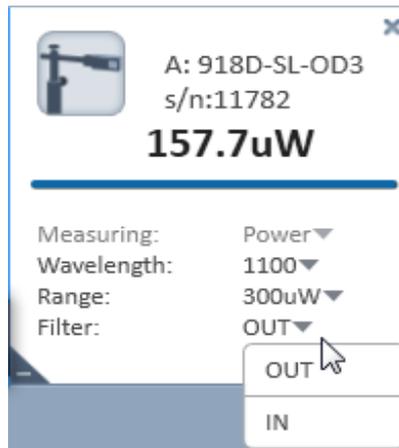
- ❖ Make sure to physically insert or remove the filter, according to the filter setting selected. Failure to do so will result in erroneous readings.

- ❖ For sensors with built-in filter state detection, the Filter list displays the current active setting only

Photodiode Exposure

❖ Photodiode exposure is currently only supported on 1919-R devices.

- For Photodiode sensors, measuring total exposure is based on summing photodiode power measurements over time

- In exposure mode, the devices measure 15 times per second, updating the exposure displayed on the screen 5 times per second

Measure total exposure

1. In the Measuring list, select Exposure.

2. In the Stop Mode list, select either Manual or Timeout.

3. Click Start.
   The accumulated laser power exposure and elapsed time are displayed.

   - Click Stop, to stop measuring the exposure before the chosen period (Manual or Timeout).

   - Click Reset, to reset the reading to zero before another reading

4. To return to the main power measurement screen, in the Measuring list, select Power.
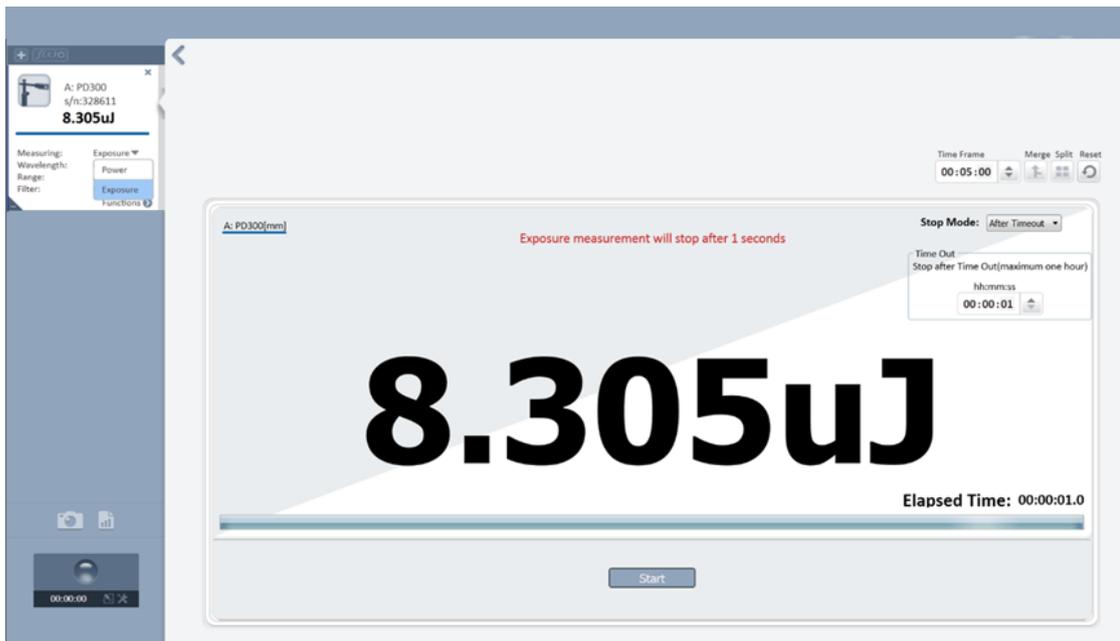
Fast Power

❖ Fast Power is currently only supported on the x938-R meter.

❖ Fast Power is a measurement mode available for use only with Photodiode sensors.

❖ Fast Power measures and logs at a rate of up to **10 kHz**.

❖ Fast Power mode can be used to measure laser-modulation as well as flicker measurement of LED light sources.

Low Frequency Power

❖ Low frequency power is supported on 1919-R and 841-PE-USB / 844-PE-USBdevices.

Low frequency power mode is useful when measuring the average power for pulsed lasers with a frequency in the ~5 - ~100Hz range. Using the regular power mode with such a laser source can cause beating effects and saturation of the electronics, which causes unstable or incorrect readings in many cases. The low frequency power mode solves these problems using a special measurement technique in the firmware that synchronizes to the laser frequency (as supplied by the user). This mode is only supported when using Photodiode sensors (918D/818/819C series) - it is not supported when using Thermopile sensors (which normally do not exhibit such problems, as their response time is much slower than photodiodes).

When switching to low frequency power mode, the firmware inside the device makes several changes to the way the electronics are configured and how it measures the photodiode signals, to accommodate the low frequency pulses being measured.

❖ While the Low Freq. Power Mode will improve overall performance relative to the regular power mode, a certain increase in noise is still likely to be observed. In some cases it may be possible to reduce noise by averaging power measurements over a longer period.

Measure the average power for low frequency pulsed laser sources

1. In the Measuring list, select Low Freq Power.
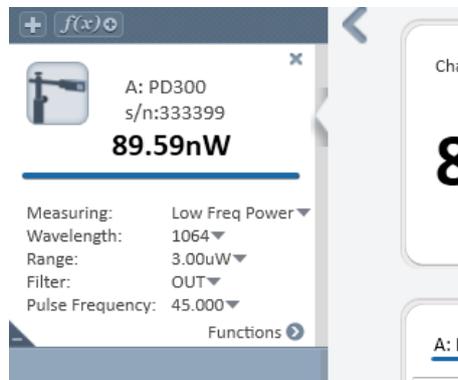
❖ When switching to Low Freq. Power mode, pay special attention when <u>zeroing the sensor</u>.

2. If required, configure the <u>Wavelength</u>, <u>Range</u>, <u>Filter</u>, and <u>Pulse Frequency</u>.

3. In the Pulse Frequency list, select Modify. The Modify Pulse Frequency dialog opens.
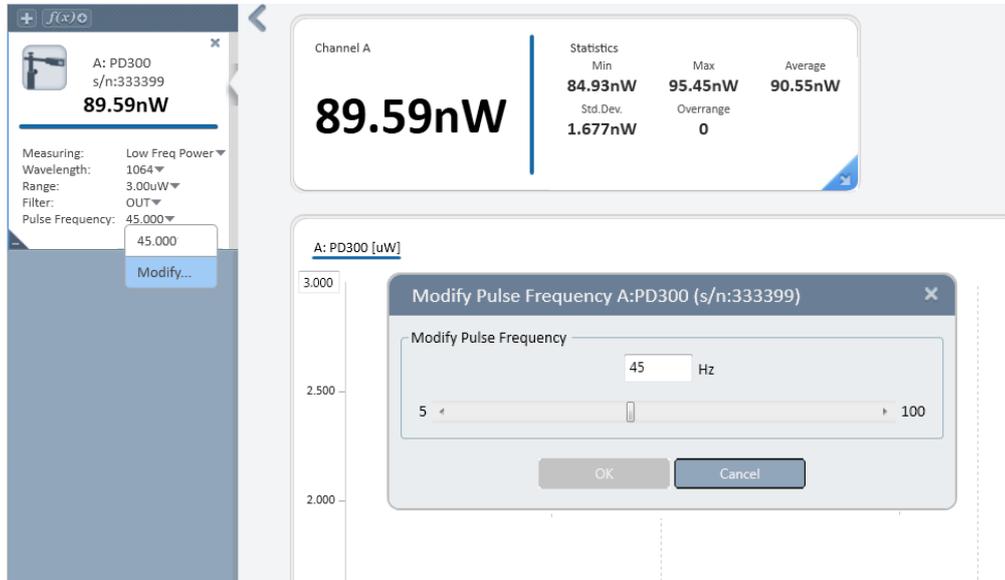
4. In the Modify Pulse Frequency dialog, manually enter the required pulse frequency,
    OR
    Use the scroll bar or arrows to modify the pulse frequency.

    - If the frequency setting is too low, this may result in periodic positive power spikes above the average power level being measured

    - If the frequency is too high, the spikes will be negative, below the average power level

5. Click OK to save the modified pulse frequency, and close the dialog.

    ❖ Due to slight errors in the nominal internal clock frequency of the measurement device, or of the laser pulse frequency, the exact frequency setting required for perfect measurements may not be exactly as expected.

Average the Measurements

To configure an average reading for a photodiode sensor, refer to Average.

Optimize the Readings

PMManager can be optimized to achieve the most accurate and efficient results. This section describes the most commonly used optimizations: offset, zeroing the instrument, and setting line frequency.

Apply an Offset

Newport's unique dual-detector sensors detect and subtract 98% of background light. The residual background signal can be removed using the Offset feature.

For example, the display reads 0.1 µW when the laser is blocked, and reads 20.5 µW when laser power is applied. In this case, the true power is 20.5 - 0.1 = 20.4 µW. To subtract the background, apply an offset while the laser is blocked. The display will now read zero, and the 0.1 µW background will be subtracted from all subsequent readings. The laser power reading will be 20.4 µW.

To apply an offset, see Offset

❖ If you suspect the instrument has a permanent zero offset, disconnect the sensor while the sensor is in power measurement mode. If the instrument still displays a similar reading even when the sensor is not connected, zero the instrument.

Zero the Instrument

To zero the instrument for a photodiode sensor, see Zero the Instrument.

Specify Line Frequency

To specify the line frequency for a photodiode sensor, see Specify Line Frequency.

Adjust Calibration Factors

⚠ **WARNING**	Adjusting the calibration factor makes a permanent change in the sensor. It is strongly recommended that before making any change to the factor, the original factory setting is recorded separately. This makes it easier, if required, to later restore the value to its original setting.

Photodiode detectors are inherently very linear but do vary broadly in sensitivity from wavelength to wavelength. In addition, Newport 918D/818/819C series models are equipped with both a built in and a removable filter to enable measurement of higher powers without detector saturation. The transmission of these filters depends on wavelength. The 918D/818/819C series has a built in calibration adjustment for wavelength. For more information on the 918D/818/819C series built in calibration adjustment, refer to Appendix B – Calibration, Traceability, and Recalibration. The user cannot recalibrate the whole calibration curve, but can adjust the overall calibration, which in turn adjusts all wavelengths proportionately.

Adjust the power calibration factor

1. In Options, select Calibrate. The Adjust Calibration Faction dialog opens.

   The Original area of the dialog box displays the original Measurement and Calibration Factor.

   The Current wavelength is displayed beneath the Original area
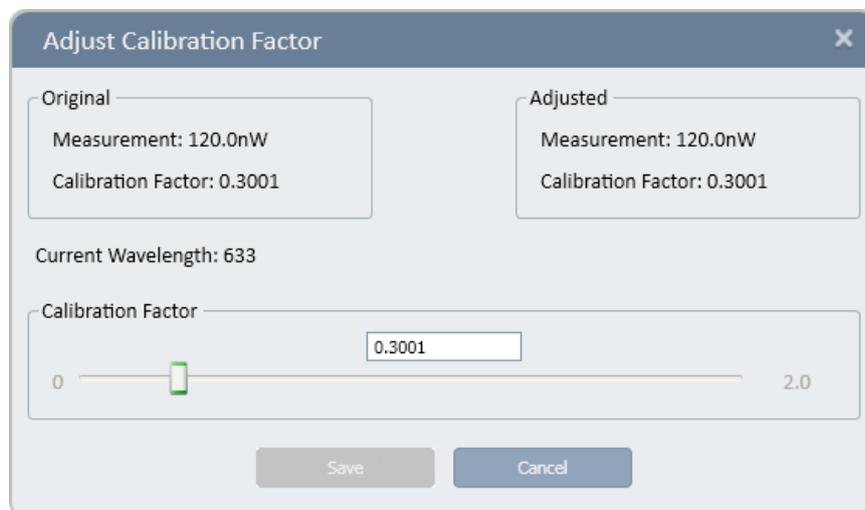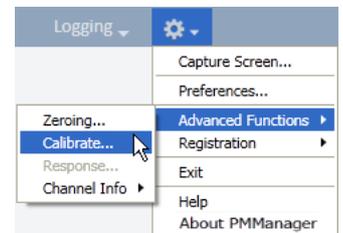
2. Use the Calibration Factor scroll bar to attain an accurate reading in the Calibration Factor field in the Adjusted area,

   OR

   Enter the factor into the text box above the scroll bar.

   ❖ Adjusting the Calibration Factor changes the calibration of all wavelengths by the same factor.

3. Click Save to save the adjustment for the active channel.

Special Sensors

In addition to standard Photodiode sensors, Newport offers sensors that are based on similar technologies that are geared towards other measurement applications.

818-RAD

The 818-RAD series of sensors are geared towards measuring irradiance and dosage. Like other sensors in the 818 series, the 818-RAD is based on a Photodiode. However, unlike the PD300 series, it is calibrated to measure irradiance (W/cm²) and dosage (J/cm²) at some distance from a divergent source. A diffuser is placed over its aperture, thereby eliminating the sensitivity of the Photodiode to the incident angle of the light. This enables the sensor to be used to measure irradiance when light is incident on the sensor from different angles.

Differences between 818-RAD and Standard 818 Sensors

Except for the following differences, use of the 818-RAD similar to power measurement with a standard 818:

- **Mode**: With Photodiode sensors, the available measurement modes are Power or Exposure. With the 818-RAD, the measurement mode can be set to Irradiance or Dosage.

- **Units**: The standard 818 measures power and displays results in Watts (W). The 818-RAD measures irradiance and shows results in Watts per area (W/cm²) or dosage as Joule per area (J/cm²).

- **Ranges**: The standard 818 allows display of power in dBm and ranges are scales of W. The 818-RAD does not allow dBm and ranges are scales of W/cm².

Irradiance Measurement

Irradiance is the power of light per unit area incident on a surface and is displayed as watts per square meter (W/cm²).

Dosage Measurement

Dosage is the integral of irradiance over time and is displayed as joules per square meter (J/cm²). This measurement mode is specific to the 818-RAD.

In dosage mode, the device measures 500 times per second, updating the dosage displayed on the screen every ½ second.

The screen layout is similar to that of the Exposure screen with the following notable exceptions:

- There is no stop mode selection.

- Dosage measurement continues for up to one hour unless stopped earlier by the user.

❖ Note: **Not all devices support or fully support special sensors**.

Chapter 7 - Measuring with Pyroelectric and PD Energy Sensors

Newport Pyroelectric Sensors are no longer available

This section provides an overview of pyroelectric and PD energy sensors and describes how to take measurements with these sensors.

About Pyroelectric and PD Energy Sensors

Newport pyroelectric sensors measure both frequency and energy of pulsed lasers. When a pulsed heat source, such as a laser, is directed at the detector, a temperature gradient is created across the pyroelectric crystal mounted in the sensor. This produces an electric charge, which is proportional to the energy absorbed. The detector sensor has sophisticated circuitry unique to Newport (patented) that determines the baseline before the pulse is received, measures the voltage after a pre-determined interval, amplifies it, and holds it for a pre-determined time.

Due to this innovative circuitry, Newport pyroelectric sensors can measure very long pulses as well as short ones; low energies as well as high energies. They can also measure at higher repetition rates than ever before possible.

The device to which the sensor is connected converts this signal to a digital value and indicates the energy received by the sensor, as well as the frequency at which the laser is pulsing. Using the energy and frequency information, the **PMManager** application is also able to display average power.

Newport PD energy sensors differ from pyroelectric sensors in that their detector is a photodiode instead of a pyroelectric crystal. They use a similar circuit to the pyroelectric sensors and offer similar functionality. Therefore, throughout this manual, they are included in the generic term "pyroelectric" when referring to software and control functions, even when this is not stated explicitly.

⚠️ **WARNING**	Before using the sensor for frequency or energy measurements, make sure that your laser power, energy, and energy density do not exceed the sensor ratings listed in the specifications table for the specific sensor. Otherwise, you may damage the absorber. Refer to the Newport Laser Power/Energy Measurement, at www.Newportopt.com, for full details on each sensor. A test slide is provided with each pyroelectric sensor, which contains the same coating as the pyroelectric detector. (You can obtain additional slides from your supplier.) Use this slide to test the damage threshold of your laser pulses. If the laser pulses damage the slide, either enlarge the beam or lower the laser energy until no damage is detected. To measure pyroelectric energies properly, it is important that the sensor is not grounded to the optical bench. Make sure that the sensor is isolated electrically from the ground. Each pyroelectric sensor is supplied with an insulating mounting post for this purpose.

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Configure Measurement Settings

If you are planning to repeat similar measurements, you can configure the settings for each individual sensor, and save them to the instrument. The saved settings become the default configuration for that channel, and are displayed each time the channel is opened.

The following sections describe how to select the measurement mode, how to configure measurement settings for pyroelectric sensors, and how to save them as the default configuration for that channel. The measurement setting fields differ for frequency and energy modes.
Measurement settings include: laser wavelength, power range, diffuser, pulse width, and average reading.

Select the measurement mode

In the Measuring list, select Power or Energy.
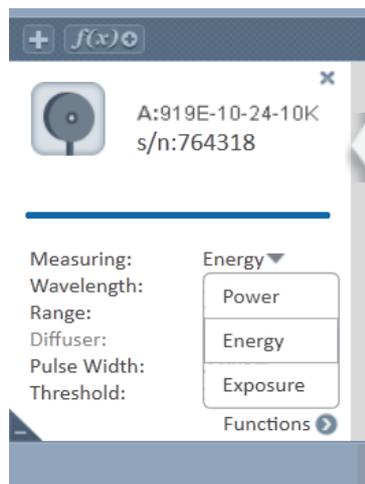
The pyroelectric screen fields displayed depend on the mode selected.

Configure Laser Wavelengths

Metallic and PD Energy Sensors

For metallic and PD energy sensors, the absorption of the detector coating varies somewhat according to wavelength. The correction curve for the absorber is stored in the sensor EEROM.
This correction curve ensures that the power reading is correct at all laser wavelengths.

- To configure laser wavelengths, refer to <u>Configure Laser Wavelengths</u> when measuring with Photodiode sensors

Broadband (BB) Sensors

Broadband (BB) sensors have less variation according to wavelength. For broadband sensors, fixed wavelength ranges are provided, similar to thermopile sensors.

- To configure laser wavelengths, refer to <u>Specify the Laser Wavelength</u> when measuring with Thermopile sensors

Select the Range

Pyroelectric sensors cover a wide range of energies (from tens of nano joules to tens of joules) depending on the type of sensor in use. In order to provide accuracy throughout the range, the electronics of the sensor must be configured to the range you are working in.

Configure the range when you know the approximate range of the expected readings

In the Range list, select a range. The instrument configures itself according to the selected range.
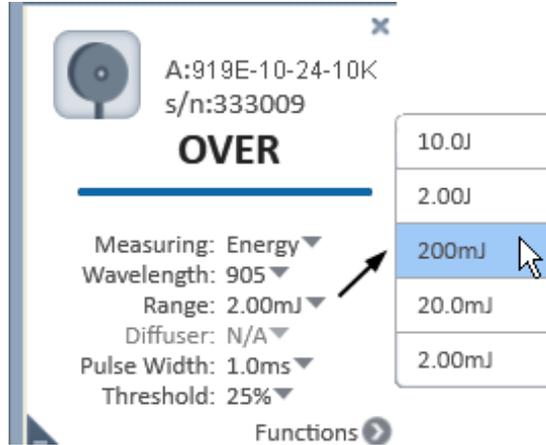
⚠ **WARNING**	While measuring pulsing lasers, an erroneous energy reading will result if the energy range is not set up correctly.

Add a Diffuser

You can add a diffuser to some pyroelectric sensors. A diffuser enables the energy ranges to reach very high levels. When using a sensor that can have a diffuser, configure the diffuser settings in the Measurement Parameters Area.

Specify if a diffuser is in use

In the Diffuser list, do the following:

- Select IN if the diffuser is in use

- Select OUT if the diffuser is not in use
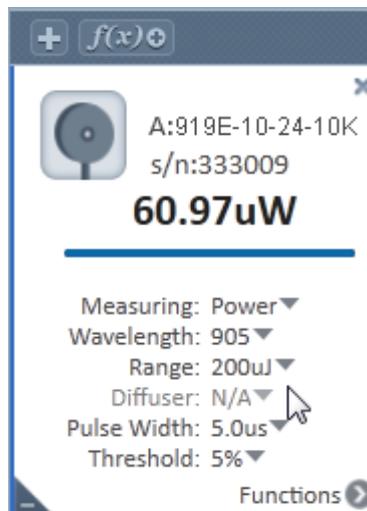
- ❖ When the diffuser setting is changed, a message is displayed, reminding you you to either insert or remove the diffuser

- ❖ This setting is not enabled for sensors that are not equipped with a diffuser - the sensors are configured to measure in Diffuser Out mode.

Configure the Pulse Width

Some pyroelectric sensors can be configured to measure long as well as short pulses. To accomplish this, the user must configure the sensor for long laser pulses or short pulses.

- ❖ If the pulse length is incorrectly set to the short setting for pulses longer than that value, the reading will be erroneously low. If it is set to the longer setting for short pulses, the reading will be correct, but noisier.

Select a pulse width

In the Pulse Width list, select a pulse width.

- ❖ For sensors with only one pulse width setting, the Pulse Width list is unavailable and the sensor is configured to measure in its correct mode
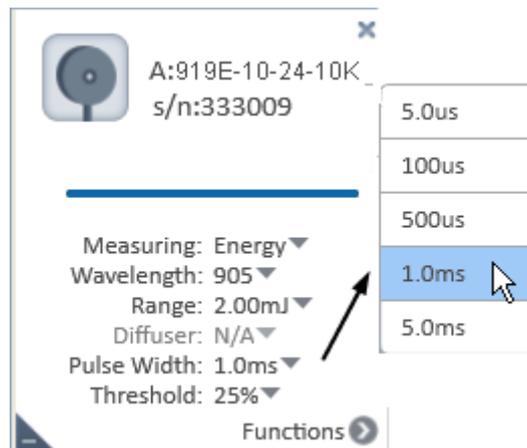
Average the Measurements

The **PMManager** application automatically refines your readings and applies a moving average. For pyroelectric sensors, the **PMManager** application averages the number display, and the graph display.

- ❖ For details see Average

Set the Thresholds

In order to screen out false triggers the user can set a minimum threshold. Threshold is a percentage of the full scale of the presently selected range. Pulses above the threshold are understood to be true readings that should be recorded. Anything below the threshold is assumed to be noise and is filtered out from the recorded set of measurements.

Optimize the Readings

The **PMManager** application can be optimized to achieve the most accurate and efficient results. This section describes the most commonly used optimization of zeroing the instrument with the sensor connected.

Zero the Instrument

Unlike thermopile and photodiode sensors, pyroelectric readings are slightly dependent on the instrument. Therefore, for the most accurate pyroelectric energy measurements, it is necessary to zero the sensor against the instrument with which it is being used. After this is done, the sensor is conditioned to work with that specific instrument. It is not necessary to repeat this procedure unless the sensor will be used with a different instrument. If this procedure is not performed, errors of up to approximately 2% may occur.

❖ For pyroelectric, it is necessary to leave the sensor connected when zeroing the instrument

Zero the instrument

1. Turn off the laser.

2. Make sure the instrument is not in an electrically noisy environment and is undisturbed.

3. Select Zeroing (Settings > Advance Functions > Zeroing). The Zeroing Instrument dialog opens.
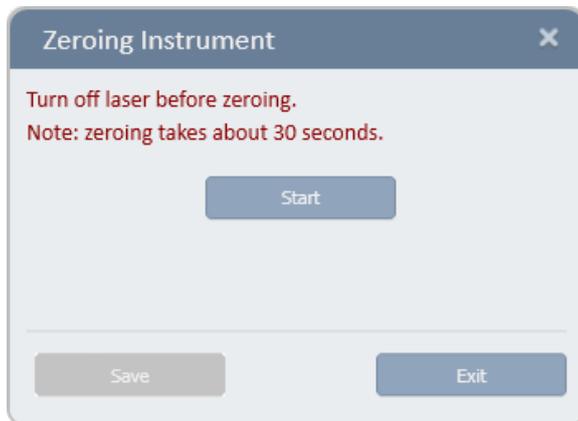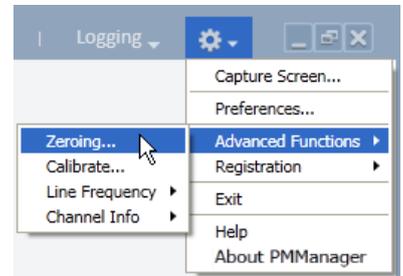
4. Click Start to begin zeroing the instrument.

5. When zeroing is complete, click Save to save the zeroing.

6. In the confirmation message, click OK.

Measure the Total Energy Exposure

For pyroelectric sensors, the **PMManager** application has the ability to sum the total energy of a number of pulses over a given time period or number of pulses. This returns the total energy exposure over the selected period. For example, if the laser is pulsing at 30 times per second, at 1mJ per pulse, and you measure the exposure over 20 seconds, then the total exposure is 30 x 1 x 20 = 600mJ.

❖ The maximum exposure measurement time is one hour

❖ **PMManager** supports exposure with the 1919-R and 841-PE-USB / 844-PE-USB. (843-R-USB devices are not supported.)

Measure the total exposure

1. In the Measuring list, select Exposure.
   The Exposure window opens displaying the default time required for the exposure.
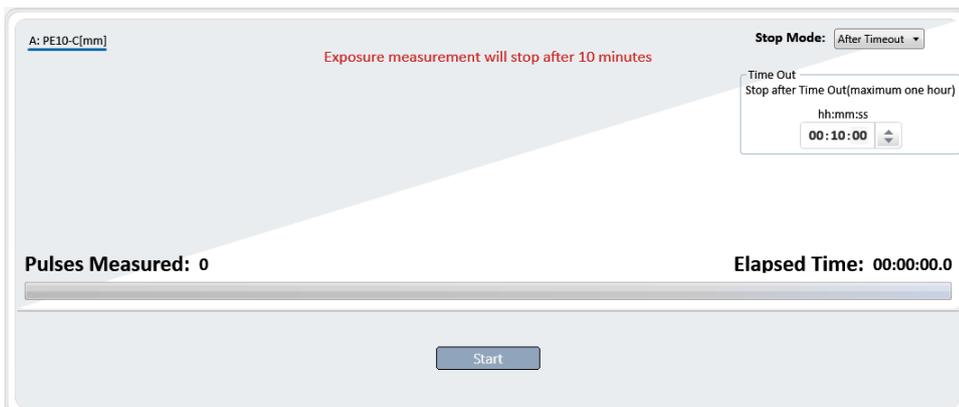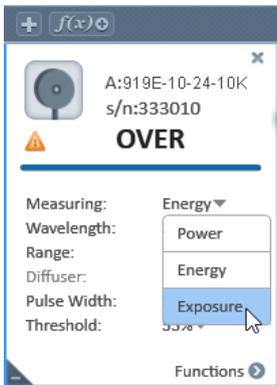
2. Choose a stop mode from the Stop Mode list.

3. Click Start to begin the measurement.

4. Specify the Time Out required for the Stop Mode.

5. Click Stop to discontinue Exposure measurement.

   • The total number of Pulses Measured are displayed

   • The Elapsed Time is displayed
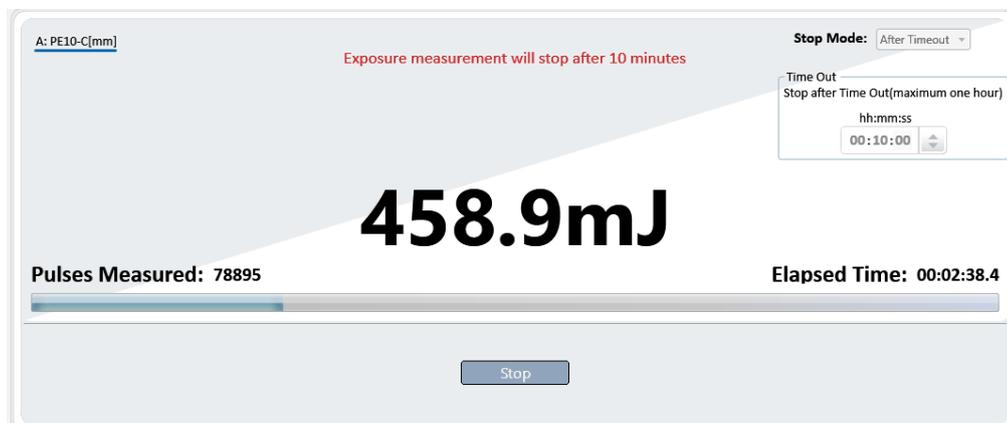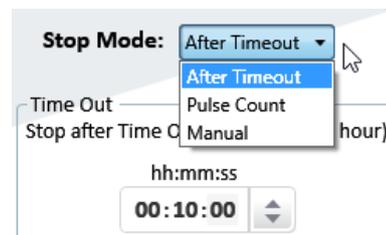
Adjust Calibration Factors

⚠ **WARNING**	Adjusting the calibration factor makes a permanent change in the sensor. It is strongly recommended that before making any change to the factor, the original factory setting is recorded separately. This makes it easier, if required, to later restore the value to its original setting.

The sensitivity of the various Newport pyroelectric sensors varies from one to another, as well as with wavelengths. Therefore, Newport pyroelectric detectors are individually calibrated against NIST traceable standards. In addition, the calibration is corrected in the devices for different wavelengths. For more information on calibration, refer to Appendix B – Calibration, Traceability, and Recalibration.

❖ For metallic sensors, when the calibration is changed at one laser wavelength, the overall calibration of all other wavelengths changes proportionately. For broadband sensors, there is an option to adjust the calibration factor for all wavelengths or only for a selected wavelength.

Adjust the energy calibration factor
1. Select Calibrate (Settings > Advance Functions > Calibrate)

   The Adjust Calibration Factor dialog opens.

   The calibration screen depends whether the Metallic or Broadband sensor is selected.

   - The Original area displays the original Measurement and Calibration Factor.
   - The Current wavelength is displayed beneath the Original area.
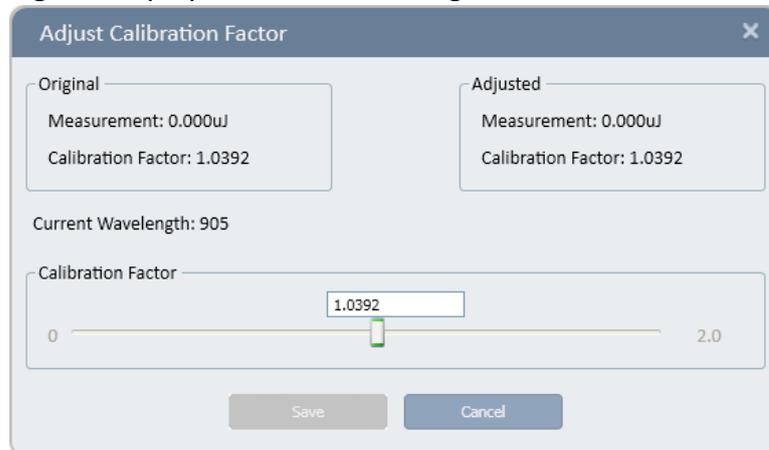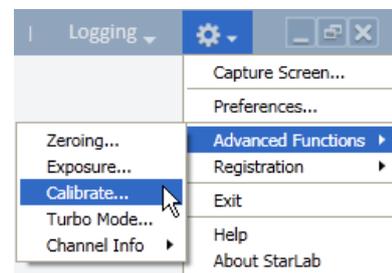
Metallic sensor
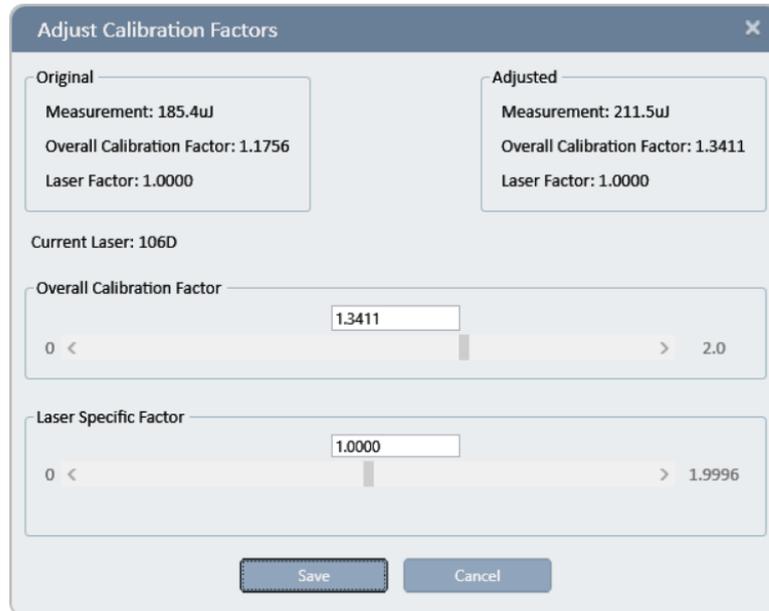
Broadband sensor

2. Use the Calibration Factor scroll bar to attain an accurate reading in the Calibration Factor field in the Adjusted area,
   or
   Enter the desired factor into the text box above the scroll bar.
3. Click Save to save the adjustment for the active channel.

Additional Graphical Display Options

For additional graphic display options, see **PMManager** Window for details.

Chapter 9 - Multiple Channels

This section describes how to work with multiple sensors and channels from various connected devices.

Connect Multiple Sensors

It is possible to attach more than one Newport sensor to a PC as several single channel devices (1938-R / 2938-R/ 841-PE-USB / 844-PE-USB, and 843-R-USB)

PMManager creates a channel for each sensor/device that is selected.

Multiple USB devices can be attached to the PC by using more than one USB port.
Most PCs are equipped with between 2 and 6 USB ports. However, the USB standard specifies that up to 127 devices can be attached to one USB controller. The standard relies on a device called a hub. Hubs provide ports to allow multiple devices to be attached.

- 841-PE-USB / 844-PE-USB devices are bus-powered and therefore require a hub that can provide power to downstream high-power devices

- 1938-R, 2938-R, 1919-R and 843-R-USB are self-powered and do not require power from the USB port

Select Sensors

The **PMManager** application allows you to work with multiple channels from various devices at the same time. The devices may be connected to many types of sensors including thermopile, photodiode, pyroelectric or a combination of different sensor types. In addition to being able to connect the application to numerous channels at once, you can specify which of the connected channels you wish to view.

Select a sensor

1. Open **PMManager**. The Select Device(s) dialog opens.

2. Select one or more sensors with which you wish to work,
   OR
   If all the devices are single sensor types, select the check box above the devices to selects them all.

Select Device Options

This section describes the available device options and an explanation about each option.

☐ *Label to identify device(s)* 🔵 *Device #* Number of devices is displayed inside a blue circle Label displays connected device type/name	When more than one device is selected, each device gets a channel, but they appear together in one graphic window. This is the recommended way to display more than one device. Each device gets a separate graphic window.
More...	Opens the Diagnostic Screen to select a device for the diagnostic routine. Displays all devices, no need to pre-select devices.
🔄	PMManager re-scans ports to find connected devices.
☐ Open sensors in new window	Select to have two PMManager sessions. See Multiple Sessions.
Cancel	Closes the Select Device(s) dialog without selecting any device

Two Channel Displays

❖ For detailed information on the Settings and Functions features of a Channel, see **PMManager Features**.

Newport®

Merge and Split

Split

By default, when starting **PMManager** with multiple channels, the channels are displayed (split) as Line graphs in the Display area.
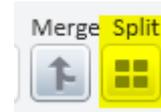
The split feature is available individually in all graph modes. Each graph mode has its own Y settings, but shares the same X setting with the other display.

A channel is selected for focus by clicking its colored horizontal line in its Channel Control window.

Create a Math Channel for a selected device channel by clicking the relevant icon (located above the opened device Channels), see Math Channels.
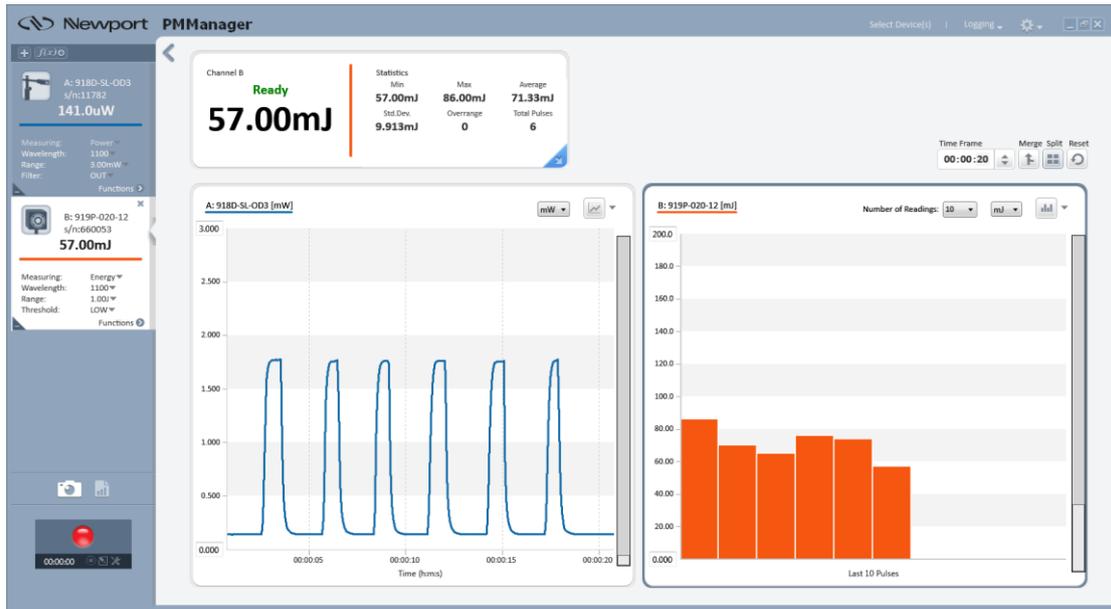
Merge

Click the Merge icon to switch to a merged display.

The X axis is the same for both channels.

The Y axis setting is determined by the setting of the focused channel when the icon is clicked.

The color designation for each channel is not affected.

A merged display automatically reverts to a split display if one of the channels is set to the Track w/Power measurement mode, or if the needle graph is selected. In which case, both channels are displayed in needle mode.
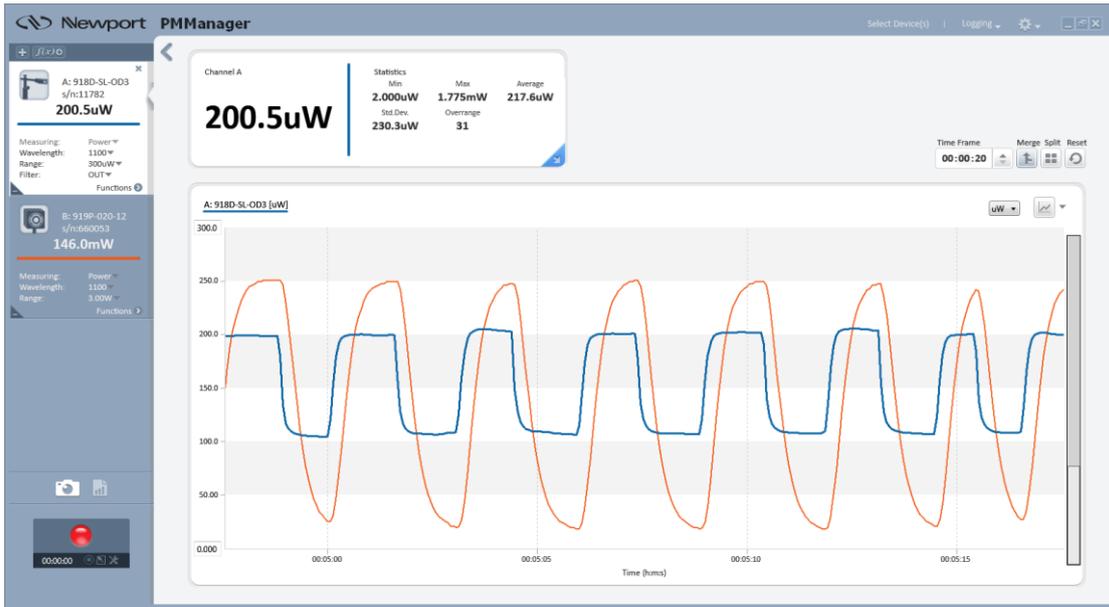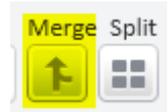
Multiple Sessions

Multiple Sessions refers to having each device appearing in its own "instance" of **PMManager**. This feature is not the standard understanding of two instances of the same program running independently even though there are two tabs displayed in the Task bar.

Enable multiple sessions

1. Connect two devices to the computer.

   Start a **PMManager** session with one device selected.
   Normally, when a session opens, it is maximized to fill the monitor.

2. Reduce the screen size so it does not expand to fill the entire monitor.

3. Click Select Device(s), and select the other device (highlighted).

4. Select the option to Open sensors in new window (highlighted).
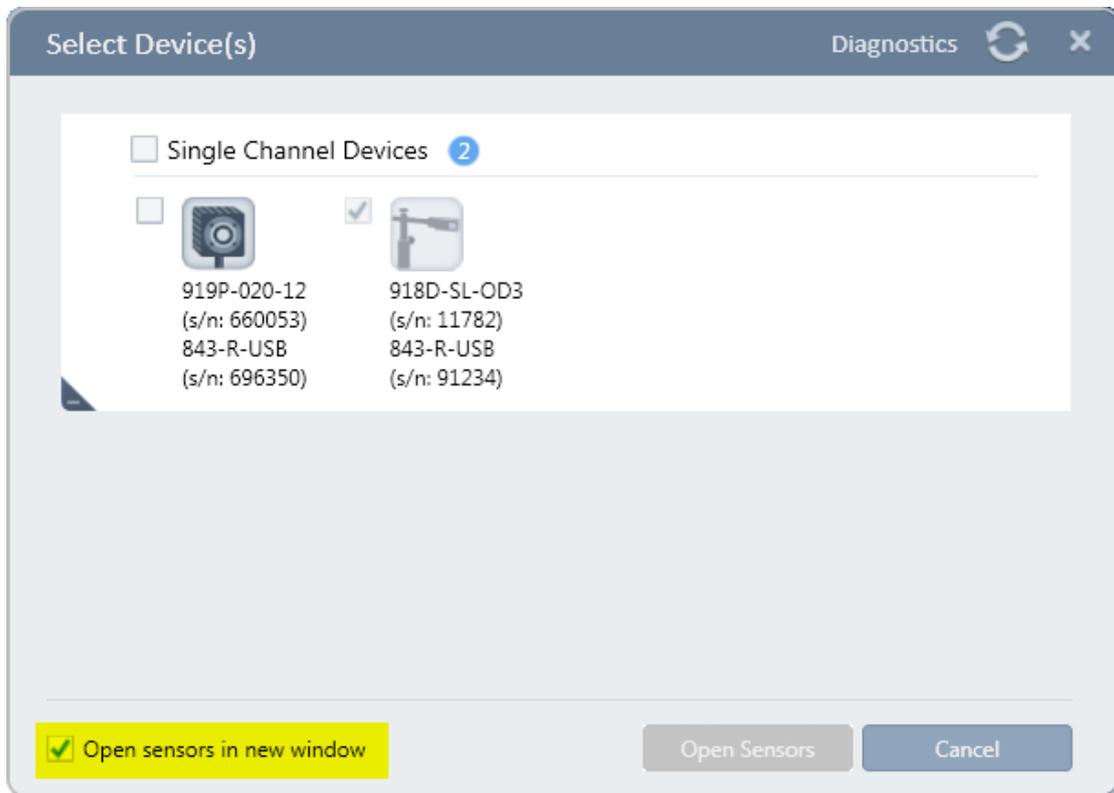
5. Click Open Sensors.

6. In the new open window, click in the upper right corner to reduce the display.

7. Position the screens so their displays are separate.

This display method may have a purpose when certain time-related analyses are required because each X-axis can have its own definition. Each channel is given the same default color.

However, the method does not allow performing Math Channel operations between two channels. Only operations on the same channel are available. See Math Channels. Moreover, the option to Capture Screen, outputs only the selected channel and not both channels.

Track w/Power

When one of the channels is set to the Track w/Power measurement mode, the graphs are forced into split mode display, and a merged display of the graphs is not possible.
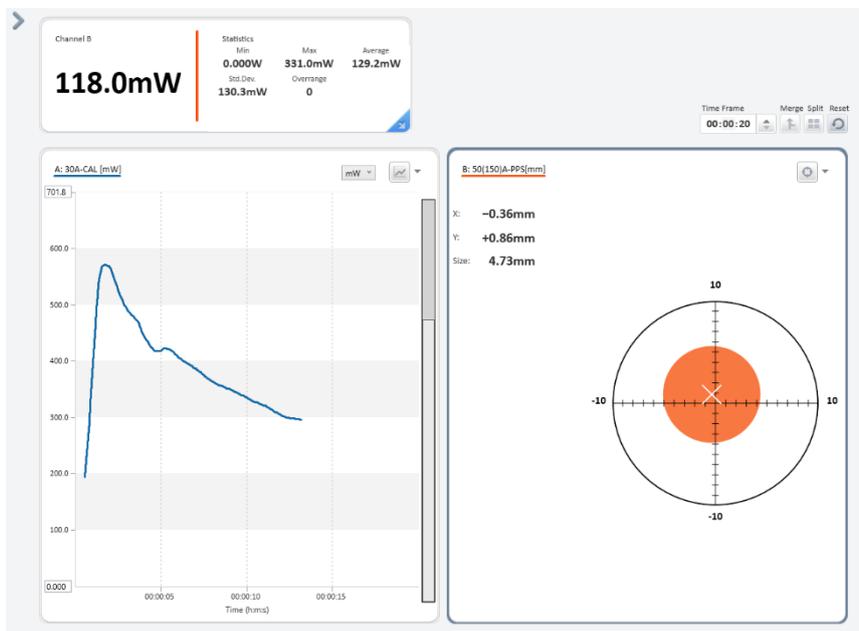
The above image shows the PEPS sensor displayed in Track w/Power mode as the orange Position graph and power from another sensor as the Line graph in blue.

Since the focus is the orange display, the Statistics window displays the results of power measured with the PEPS sensor.

The Graph Setup also corresponds to display in focus. In either case, Merge is disabled.
The option, Apply to All, is unavailable in this display configuration.
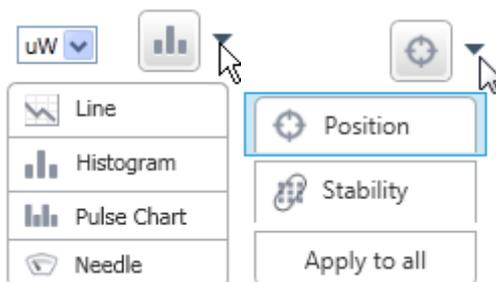
View the List of Active Sensors

View a list of all the currently active sensors

Click Select Device(s) from the menu bar. The checked sensor is the active sensor.
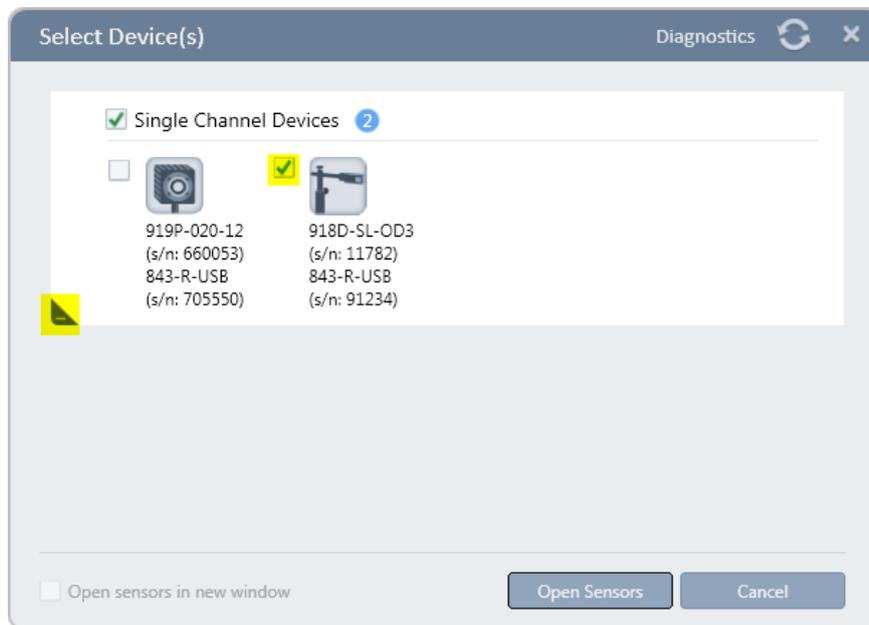
Click the expand/reveal triangle to minimize the list when multiple devices are connected.

Chapter 10 - Math Channels

Math Channels provide a means to perform built-in mathematical operations and user-defined functions involving any number of device channels.

❖ Math channel functionality does not apply to position and size.
   If a sensor in the Track w/Power mode is selected, Math channel functionality will be applied to the power readings.

Add and Close a Math Channel

Add a math channel

Click the Add Math Channel icon. A Math Channel is added to the Channel Area.

In example below, a Math Channel is added to the Channel Area below the second device channel.

Each Math Channel that is opened during a **PMManager** session is assigned a color and given the next available letter (starting with the letter "M").
Multiple Math Channels can be opened on the same device channel.

Close a math channel

Click the "X" that is exposed when hovering the mouse over the area.

Adjust Default Operations

The default operation is A/B when a Math Channel is created. This can be adjusted by selecting other device channels and mathematical operators.

Select an additional device channel from the device channels list.
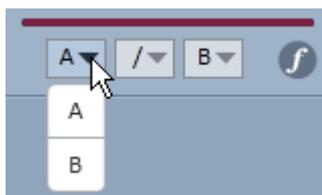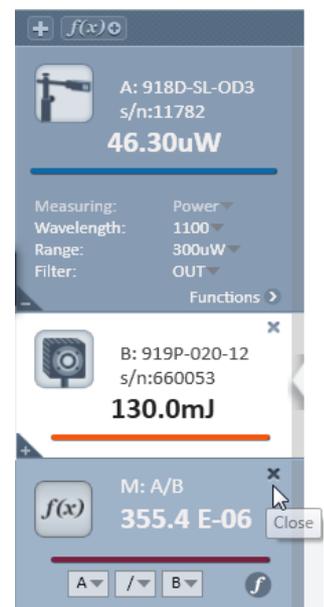
Select an additional mathematical operator from the mathematical operator list.
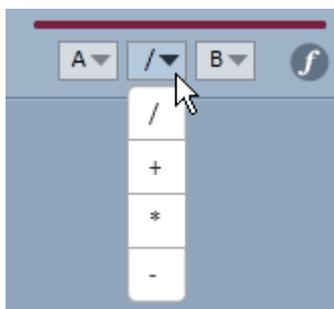
Create a User Defined Formula

In addition to the built-in operations, a Math Channel can perform user created operations.

Create a user defined formula

1. Open a Math Channel. Designated as "M" Math Channel

2. Click the Formula icon to open the formula field.

3. Enter the function in the formula field.
   Example: Enter (B*A)/A^2
   Use "^" for power. Sin() and other functions can also be used.

4. If there is a mistake in the formula, the cursor moves to the location of the error, enabling you to correct the error.

Formula icon

View the math result in the Statistics area

Click the colored line of the Channel "M" in the Channel Area. The example below displays the built-in function, A/B, merged with the channels shown on the previous page.

The vertical axis control was used to bring the plots into view
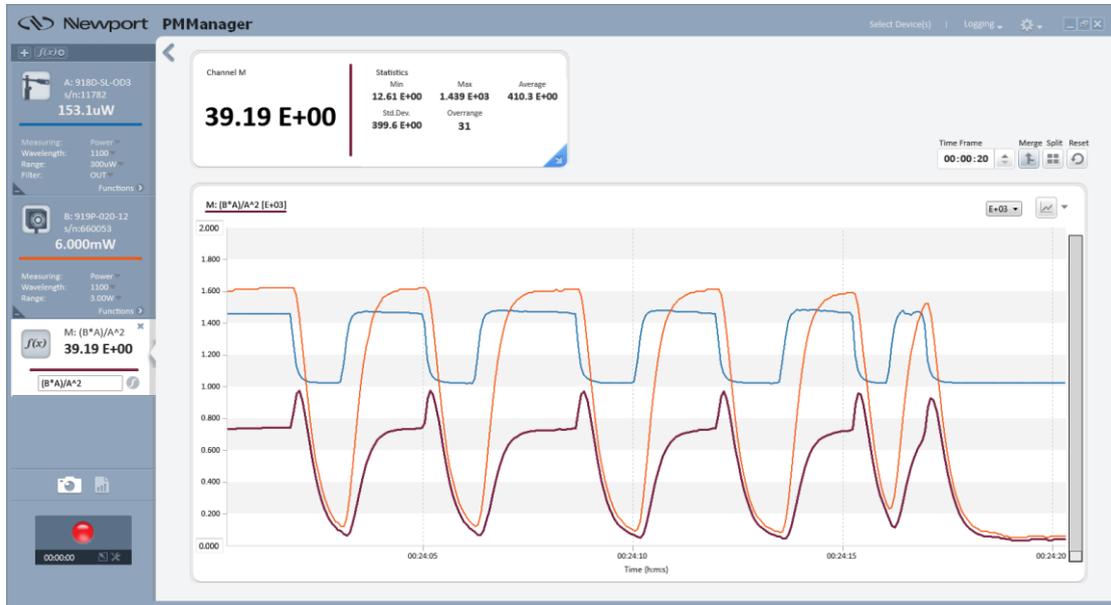
Chapter 11 - Log Files

This section describes how to work with log files in conjunction with Newport devices.

The logging options are accessible via the Logging menu or the Log Control.

Logging Menu

Log Control

Log Settings

Default Log Files

• Windows 8 and Windows 10 save log files in the **PMMManager** folder
  C:\Users\<user>\Documents**PMMManager**).

  ❖ If the user changes the default file location, the system retains the new default location even
  after reinstallation of a new version of the software.

Change the log file name and location

1. Click the Log Settings icon. The Log Settings dialog opens.

11. Click Browse.

12. If required, change the log file name and location.

Configure Log File Settings

It is possible to log just one screen of data, specify the duration of the log or the number of measurements to be taken.

Log One Screen of Data Only

Log one screen of data

1. Click the Log Settings icon . The Log Settings dialog opens.
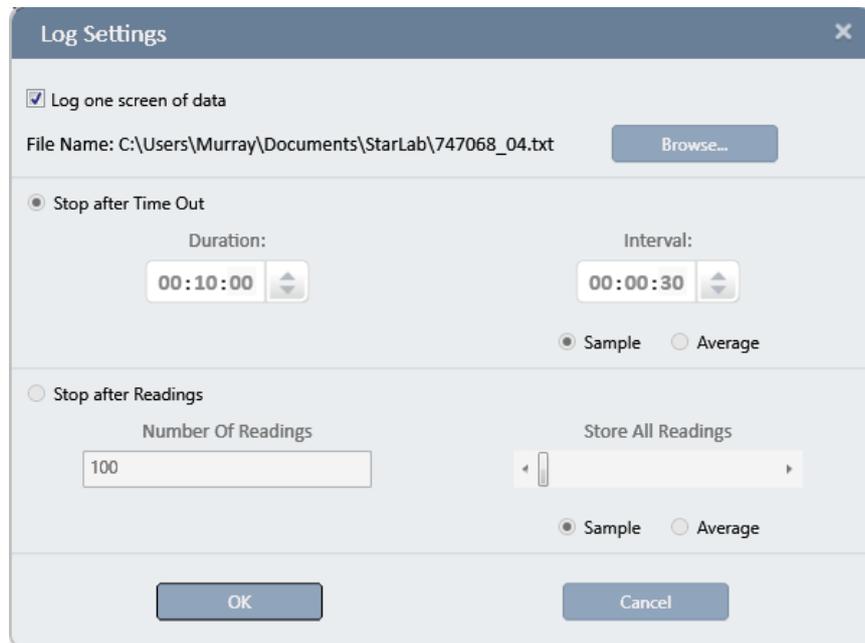
2. Check the Log one screen of date option.

3. Click Browse and select a file location to save the log data - otherwise, the log data is saved to the default file and location, as displayed in the File Name area.

   ❖ See Default Log Files

Configure Log Duration

Configure the log duration

1. Click the Log Settings icon. The Log Settings dialog opens.
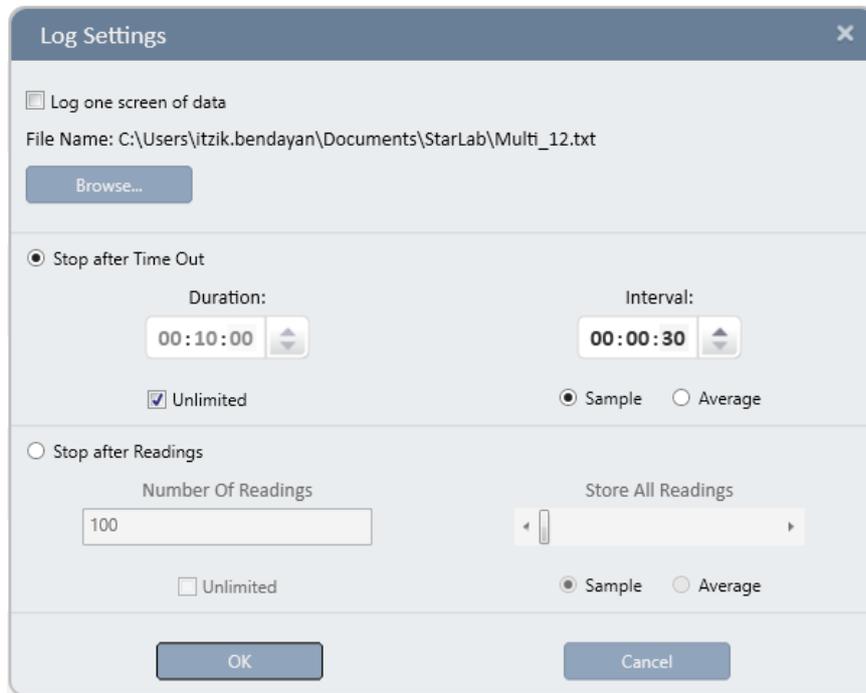
2. Clear the Log one screen of data option.

3. Select Stop after Time Out.

4. Specify the Duration or alternatively set to unlimited

5. When logging power readings, a time interval can be set for measurements configured to stop after time out. The interval determines how often a measurement is taken and added to the log.

   When the interval is set to 00:00:00, all available measurements are logged.

   Select Sample, to log one sample per interval,
   OR
   Select Average, to log an average of all the readings in an interval.

6. Click Browse and select a file location to save the log data,
   OR
   The log data will be saved to the default file, as displayed in the File Name area.

7. Click OK to save the log settings.

Configure the Number of Measurements

Configure logging to end after a specified number of pulses

1. Click the Log Settings icon . The Log Settings dialog opens.

2. Clear the Log one screen of data option.

3. Select Stop after Measurements.

4. Enter the number of pulses you want to measure in the Number of Readings field.

5. In the Stop after Measurements area, drag the scroll of Store All Readings bar to the right to set the value. As you move the scroll bar, the heading above the bar changes to One out of # pulses. You can choose one in 3, 10, 30, 100, 300, or 1000 pulses,
OR
Drag the scroll bar to the left. The text above the bar changes to Store all Readings.

6. Select Sample to log one sample per interval,
OR
Select Average to log an average of all the readings in an interval.

7. Click Browse and select a file location to save the log data - otherwise, the log data is be saved to the default file, as displayed in the File Name area.

8. Click OK to save the log settings.

Begin and End a Log

Begin a log

Click the Begin Log icon (red circle).

Begin Log

- The Log Control icons change to display a Stop and Pause icon.

- The time left before logging stops indicates the time remaining in the   time range that was selected for the measurement.

- Hover the mouse over the button to display the logging type.

  ❖ No changes can be made to the settings in the Measurement Parameters or Graph Configuration Areas throughout the log process duration.

Pause a log

Click the Pause Log icon.

Restart a log

Click the Begin Log icon.
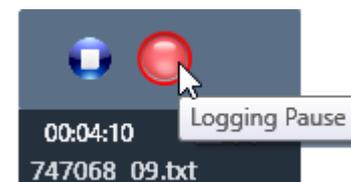
End a log

1. Wait for the log time to elapse,

   or,

   Click the Stop icon stop.

1. Click the show/hide arrow to view the Open File in Log Viewer, or to open the file location where the log is stored. The drop-down Logging Menu at the top of the screen can also be used to open a log file.
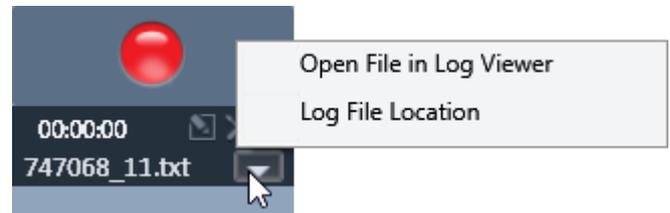
   It is possible to <u>add a note</u> to a displayed log file. See <u>View Log Files</u>.

Add Notes to a Log File

Add notes to log files

1. Open the file in Log View.
   The Note dialog is located at the top, below the Title bar.
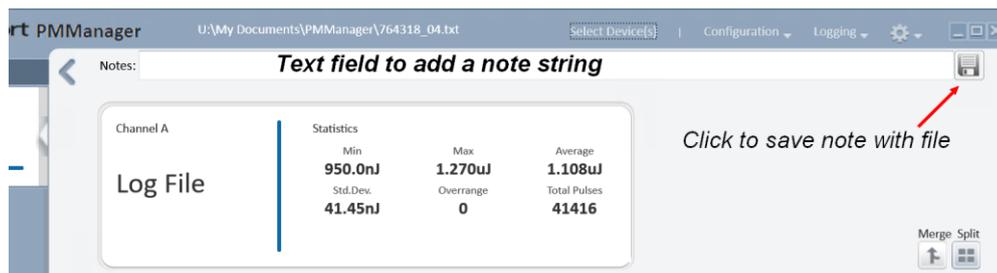
2. Enter a note into the text field.

3. Click the icon to save the note to the log file.

Choose the Log File Format

Log files are stored by the **PMManager** application as tab-delimited text files.

Two file formats are available in the software:

- Standard
- Excel Friendly

The two formats differ only in the way the timestamp is recorded in the file.

Standard Format Log Files

Standard Format is the default format. It is used in older versions, and is retained in newer versions of **PMManager** for backwards compatibility.

In this format, the timestamp is recorded as hours, minutes, seconds, and fractions of a second.

For example: 12:34:56.789 (for the 841-PE-USB / 844-PE-USB and 843-R-USB devices using Thermopile and Photodiode sensors), where 12 is the hours, 34 is the minutes, 56 is the seconds, and 789 is the fraction of a second. For the 841-PE-USB / 844-PE-USB devices using Pyroelectric and PD energy sensors, the timestamp appears as 12:34:56.789321, where 789321 is the fraction of a second with microsecond precision.

Excel Friendly Format Log Files

This format should be used when using Microsoft Excel to process data stored in the log files.

In this format, the timestamp is recorded in seconds and fractions of a second, in a manner more suited to Excel than the Standard format.

For example: 45240.789 (for the 841-PE-USB / 844-PE-USB and 843-R-USB devices using Thermopile and Photodiode sensors) where 45240 is the number of whole seconds (equaling 12 hours and 34 minutes), and 789 is the fraction of a second.

For the 841-PE-USB / 844-PE-USB and 843-R-USB devices using Pyroelectric and PD energy sensors, the timestamp appears as 45240.789321, where 789321 is the fraction of a second with microsecond precision.

Select the Log File Format

You can define a resolution window where all channel measurements within a time window are written to the log file and will have the same time stamp. Provided that this window is large enough, it will eliminate the cases whereby some measurements have no values in specific time stamps.

1. Open the Logging Preferences (Option > Preferences > Logging).
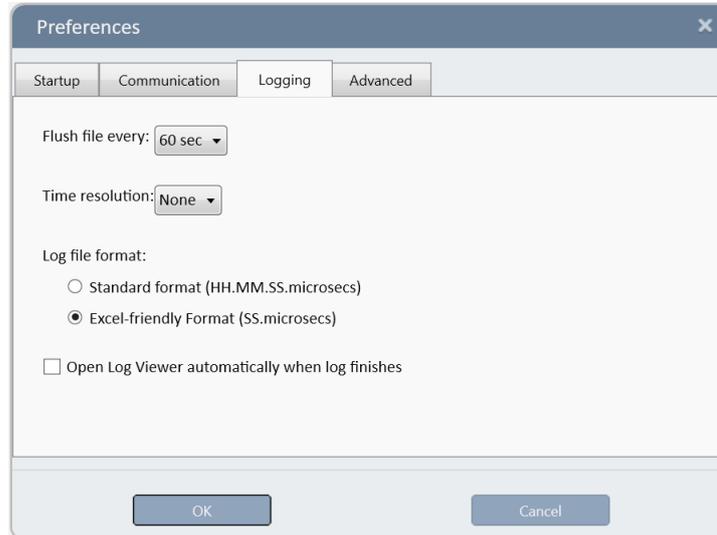
2. Select either Standard Format or Excel Friendly Format.

❖ With the 841-PE-USB / 844-PE-USB, 1938-R, 2938-R, 1919-R, and 843-R-USB devices, using a pyroelectric or PD energy sensor, timestamps are stored in the log file with microsecond precision (six decimal places after the decimal point) and have a resolution of 1us.
Using a thermopile or photodiode sensors, timestamps are stored with millisecond precision.

Chapter 12 - View Log Files

Log files may be viewed graphically in the **PMManager** application's Log Viewer, as text in NotePad, or as a spreadsheet in Microsoft Excel.

Upload Files

The process for uploading files differs depending upon the device.

Upload files from 1938-R, 2938-R and 1919-R devices

To upload files from the devices, simply remove the USB flash drive from the device and attach it to a computer.

The devices store the files in a directory called Log Files. The log files in **PMManager**-friendly format can be opened directly from the USB flash drive similar to any other file that **PMManager** stores on the computer.

Access the Log Viewer

Open a log file in PMManager log viewer

1. Open the File menu and select Open. The Open File dialog opens.
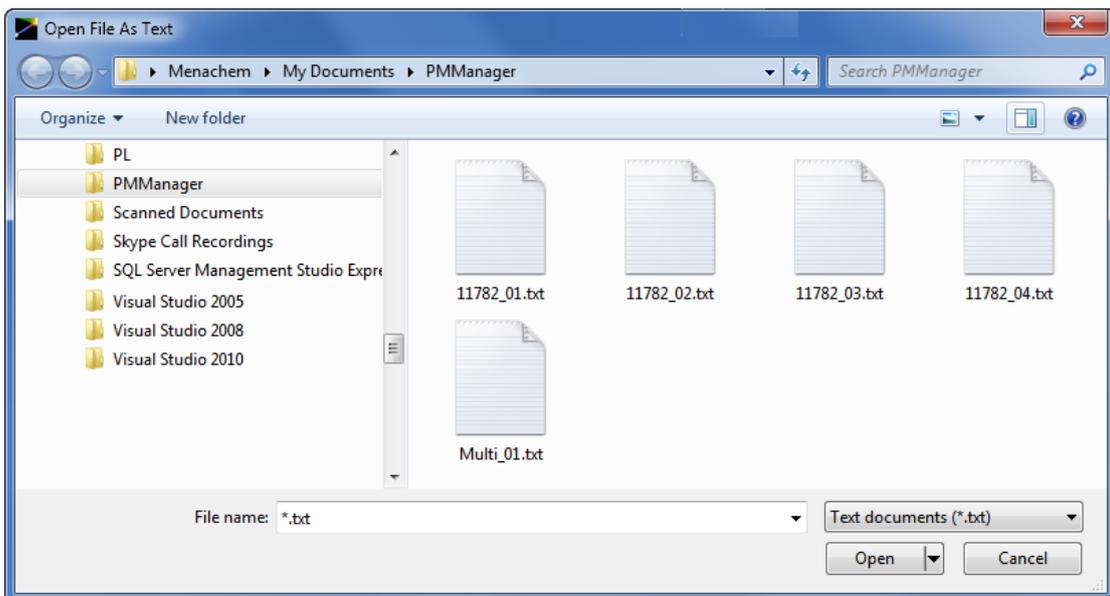
❖ For details of the default location for log files, see <u>Default Log Files</u>.

2. Select the required file and click Open. The log file opens in the **PMManager** application's Log Viewer.
   In this example, a log file having a Multi prefix is selected denotes multiple channels were logged. Numeric prefixes indicate a one-channel log file.

Log Viewer Window

This section describes how to change the perspective or resolution of a displayed graph, and how to set log format preferences.
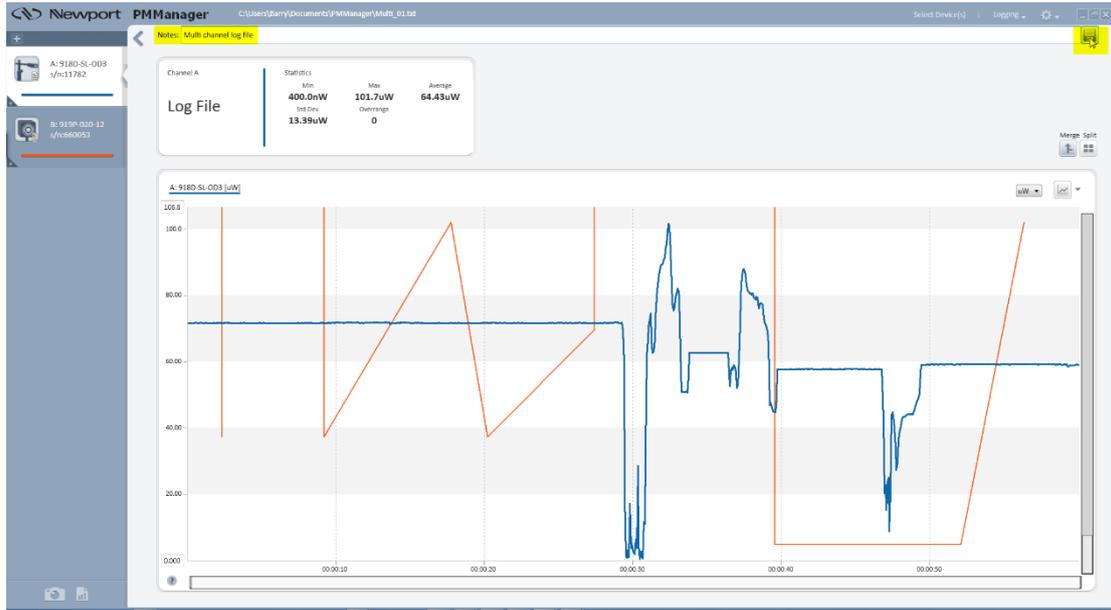
Zoom In, Zoom Out

Changing the perspective or resolution of a displayed graph can be done by a combination of editing the limits of the Y-axis and/or manipulating the scroll bar Thumb.

❖ Zooming features for displayed graphs or log files for Track w/Power Stability measurements are discussed in Features of the **PMManager** Window.

Method 1

Method 1 is illustrated in the Line Graph setup procedure. The zooming is affected by editing the min and max values of the Y-axis and by pressing on, and sliding the Thumb (as indicated by the "hand") to position the display within the new limits.

Method 2

The top and bottom borders of Thumb are identified with double vertical arrows. Pressing on, and dragging a border affects the zoom by changing the min and max Y-axis values.

- Y-max values by the black arrow: Dragging the border down, decreases the value. Dragging the border upwards, increases the value.

- Y-min values by the white arrow: Dragging the border down, decrease the value. Dragging the border upwards, increases the value.

- Position the new zoom display, if needed, with the "hand" use of the Thumb.
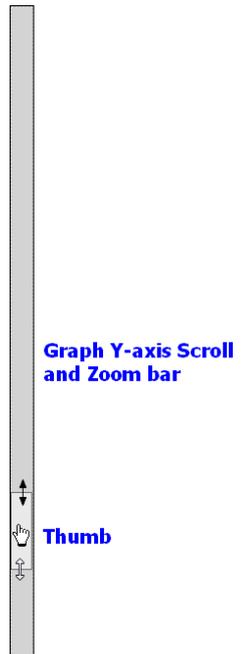
Reset the zoom

Change the settings in the channel area or the range in the graph configuration area.

Specify logging format preferences

The default format of a logging file is set in the Logging tab preferences.

1. In the Options menu, select Preferences. The Preferences dialog opens.

2. Click Logging.
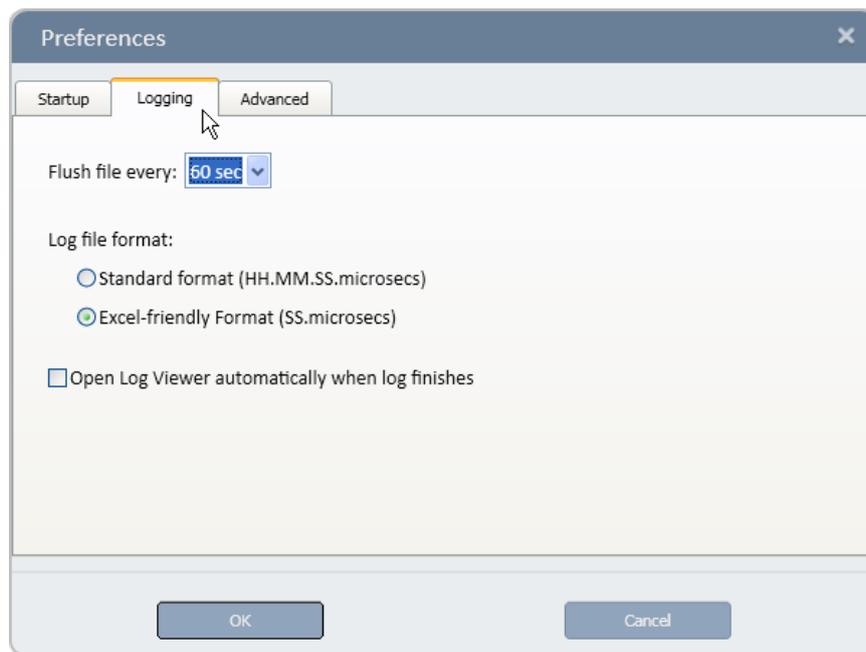
3. Select the log file format.

4. If required, select the option to open the log file automatically when logging ends.

5. Click OK to save the settings.

View Log Files in NotePad

This section describes how to view log files in NotePad.

Open a log file in NotePad

1. Open the File menu and select Open File As Text.
   The Open File dialog opens.

2. Navigate to the log files directory.

3. Select the required file, and click Open.
   The log file opens in NotePad.

Log Files Entries

- Portion of a 2-channel log file in NotePad displaying power or energy without tracking

```
;PC Software:PMManager Version 3.10 Build 8
! ****** Warning: Do not modify this file. Changes may prevent   *******
! ****** the PMManager Log reader from opening the file correctly. *******
;Logged:28/08/2014 at 15:36:43
;File Version:5
;Graph Mode:Split
;Notes:Standard Time Format

;Channel A:843-R-USB Photodiode 918D-SL-OD3 (s/n:11782)  EF1.24 (s/n:91234)

;Channel A:Details
;Name:918D-SL-OD3
;Graph Type:Line
;Graph Color:RGB(14,104,168)
;Units:W
;Settings:Measuring:Power
;Settings:Wavelength:1100
;Settings:Range:300uW
;Settings:Filter:OUT

;Channel A:Statistics
;Min:3.500uW
;Max:290.6uW
;Average:114.9uW
;Std.Dev.:69.99uW
;Overrange:0
;--------------------


;First Pulse Arrived : 28/08/2014 at 15:36:43.370000
    Timestamp              Channel A
      0:00:00.000          2.259e-004
      0:00:00.066          2.263e-004
      0:00:00.132          2.270e-004
      0:00:00.198          2.273e-004
      0:00:00.264          2.266e-004
      0:00:00.330          2.257e-004
```

The first paragraph identifies the **PMManager**, graph mode, logging time, and any note that was added by the Add Notes to a Log File option.

The next paragraphs contain the information that describe the devices, sensors, channel association, parameters per channel when the log measurement was made, followed by statistics for each channel.

The next section is the data that was measured. Using the First Pulse Arrived value, 11:05:23.980000 as a basis, the times in the first column are the incremental changes in the X-axis.
After new readings on both channels have been logged, the math channel is evaluated.

- Portion of a 1-channel, Track w/Power log file in NotePad

```
;PC Software:PMManager Version 3.10 Build 8
! ****** Warning: Do not modify this file. Changes may prevent    ********
! ****** the PMManager Log reader from opening the file correctly. ********
;Logged:28/08/2014 at 15:41:39
;File Version:5
;Graph Mode:Split
;Notes:Excel Friendly Time Format

;Channel A:843-R-USB Photodiode 918D-SL-OD3 (s/n:11782)  EF1.24 (s/n:91234)

;Channel A:Details
;Name:918D-SL-OD3
;Graph Type:Line
;Graph Color:RGB(14,104,168)
;Units:W
;Settings:Measuring:Power
;Settings:Wavelength:1100
;Settings:Range:300uW
;Settings:Filter:OUT

;Channel A:Statistics
;Min:10.40uW
;Max:209.3uW
;Average:125.6uW
;Std.Dev.:39.77uW
;Overrange:0
;------------------

;First Pulse Arrived : 28/08/2014 at 15:41:39.826000
  Timestamp        Channel A
        0.000      8.220e-005
        0.067      8.170e-005
        0.134      8.150e-005
        0.200      8.160e-005
        0.267      8.120e-005
```

A log file for Track w/Power is similar in form to other log files, but with added information. The log file includes power, position, and size data, whichever graph is shown. When Stability graph is shown, the final data from the Data area are included.

Open Log Files in Excel

Open a log file in Microsoft Excel, so that the log file can be processed as a spread sheet.

Open an Excel log file from within the PMManager application

1. Select either Open or Open File As Text from the File menu. The Open File dialog opens.

2. Select the directory in which the log file is stored.

3. Click the filename of the required file.

4. Right-click the file icon in the upper window.

5. From the pop-up menu, select Open With – Microsoft Office Excel.
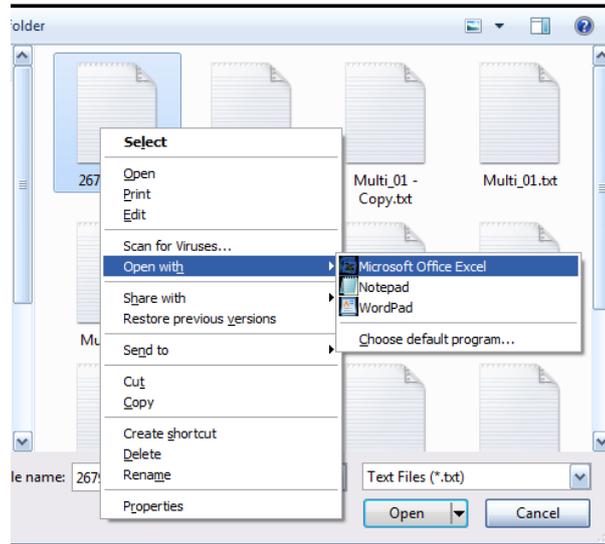
Open an Excel log file from outside the PMManager application

1. Use the Windows Explorer to locate and select the log file.

2. Right-click the file name, and select Open With from the pop-up menu, and select Microsoft Excel from the sub menu.

3. The log file opens inside Excel as a spread sheet with two active columns: Energy in joules and Timestamp in seconds.

Open a standard format log file in Excel

A log file stored in the standard format can also be opened using Microsoft Excel, but it is more difficult than opening a log file stored in Excel Friendly format. For more details, refer to the Microsoft Excel Help section.

1. From the Windows taskbar, select Start – All Programs – Microsoft Excel to open Microsoft Excel from Windows. Microsoft Excel opens.

2. In Excel, from the menu select File – Open. The File Open dialog opens.

3. In the Files of Type area, select Text files.

4. Navigate to the directory in which the log file is located (see section Default Location and Name for Log Files; by default, the **PMManager** application directory is under \Program Files\Newport Optronics). Select the log file icon and click Open. The Text Import Wizard opens.
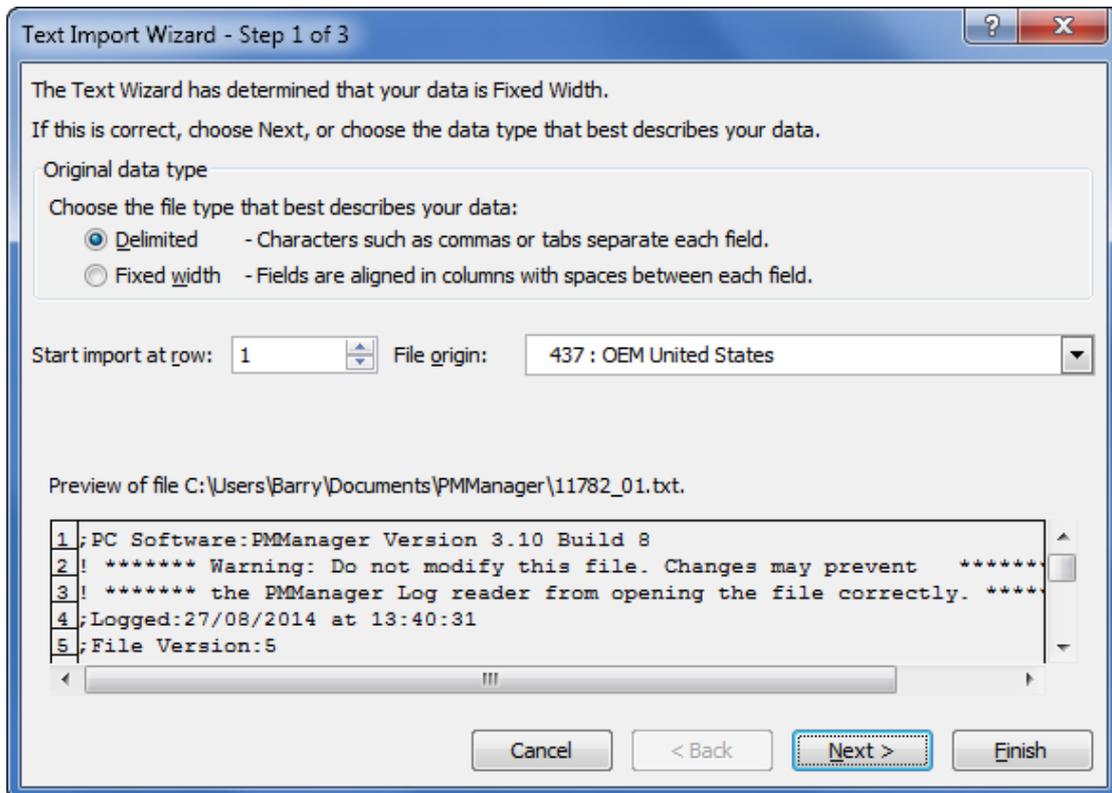
5. In the Original data type area, select Delimited (the default) and click Next.

The second stage of the Text Import Wizard is displayed.
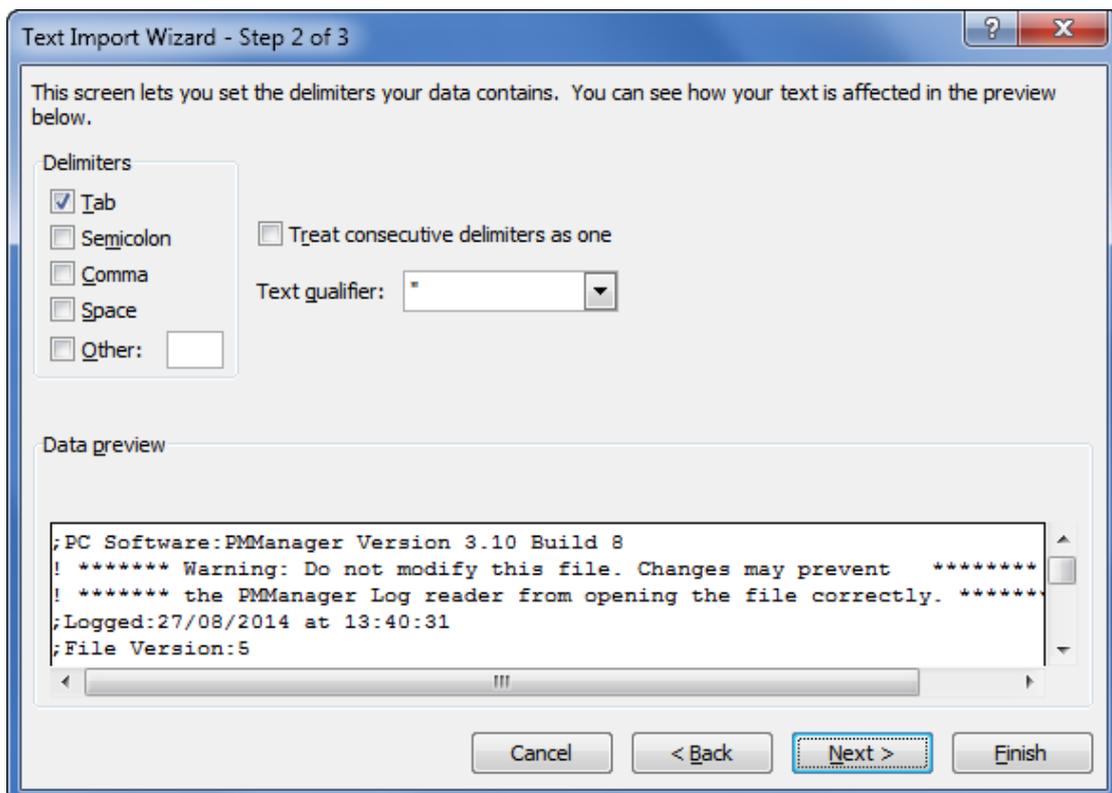
6. In the Delimiters area, check Tab (the default.)

7. Click Finish. The log file opens as a spread sheet.

	A	B	C	D	E	F	G
1	;PC Software:PMManager Version 3.10 Build 8						
2	! ******** Warning: Do not modify this file. Changes may prevent ********						
3	! ******** the PMManager Log reader from opening the file correctly. ********						
4	;Logged:28/08/2014 at 15:36:43						
5	;File Version:5						
6	;Graph Mode:Split						
7	;Notes:Standard Time Format						
8							
9	;Channel A:843-R-USB Photodiode 918D-SL-OD3 (s/n:11782) EF1.24 (s/n:91234)						
10							
11	;Channel A:Details						
12	;Name:918D-SL-OD3						
13	;Graph Type:Line						
14	;Graph Color:RGB(14,104,168)						
15	;Units:W						
16	;Settings:Measuring:Power						
17	;Settings:Wavelength:1100						
18	;Settings:Range:300uW						
19	;Settings:Filter:OUT						
20							
21	;Channel A:Statistics						
22	;Min:3.500uW						
23	;Max:290.6uW						
24	;Average:114.9uW						
25	;Std.Dev.:69.99uW						
26	;Overrange:0						
27	;--------------------						
28							
29							
30	;First Pulse Arrived : 28/08/2014 at 15:36:43.370000						
31	Timestamp	Channel A					
32	0:00:00.000	2.26E-04					
33	0:00:00.066	2.26E-04					
34	0:00:00.132	2.27E-04					
35	0:00:00.198	2.27E-04					
36	0:00:00.264	2.27E-04					

Chapter 13 - Preferences and Features

Save Sensor Settings

PMManager provides a range of sensor optimization options that can be adjusted to deliver the most accurate readings. Whenever you change the value of a parameter in Settings, it is saved as the value for this parameter to be used the next time this sensor is connected.

For more information on configuring and optimizing measurement settings for the various sensor types, see the following:

- Measuring with Thermopile Sensors

- Measuring with Photodiode Sensors

- Measuring with Pyroelectric and PD Energy Sensors

Preferences

1. Click the Preferences icon [icon] in the title bar, and select Preferences.

The Preferences dialog opens consisting of four-tabs:

- StartUp

- Communication

- Logging

- Advanced

StartUp
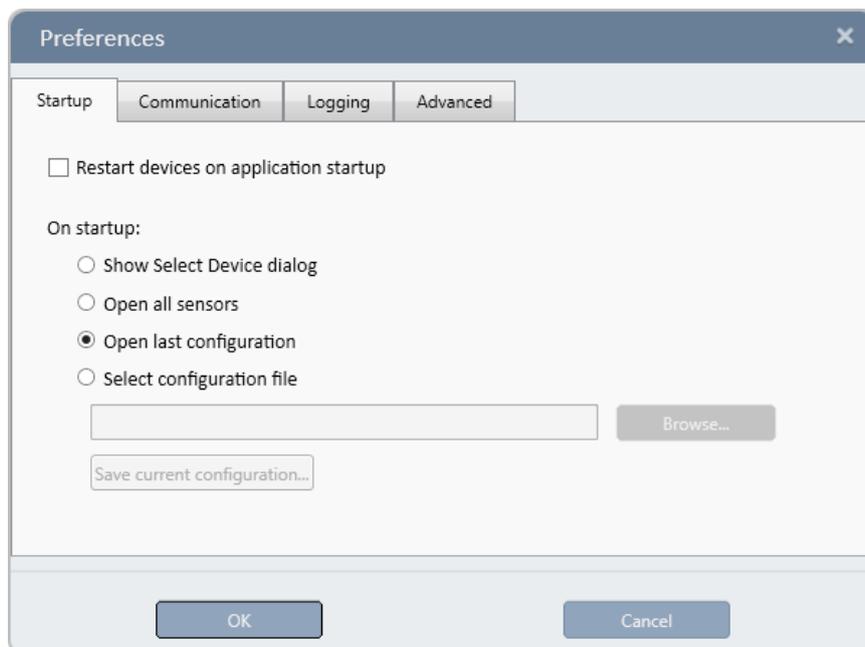
The table below describes the Startup options

Option	Description
Restart devices on application startup	When **PMManager** begins, all connected devices are restarted
Show Select Device dialog	When selected, always show Select Device(s) window when **PMManager** starts.
Open all sensors	When selected, connects to all devices without showing Select Device(s) window
Open last configuration	When selected, uses previous **PMManager** configuration settings.
Select configuration file	When selected, enables the buttons Browse and Save current configuration. • Use browse to load an existing config file • To create a new config file, enter the file name in the text field, and click Save current config

In addition to Open last configuration and Open fixed configuration in the StartUp preferences you can also save, and later open, multiple configurations from the Configuration drop down menu.
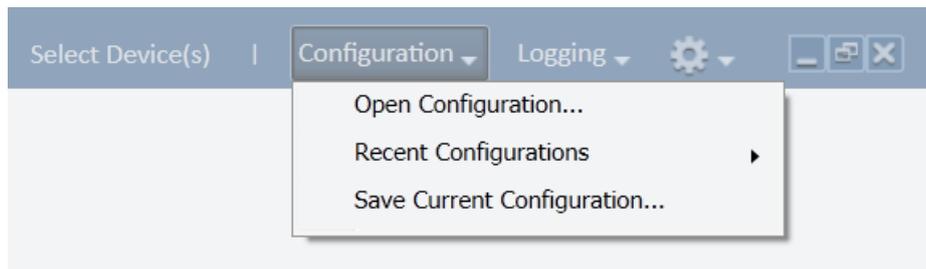
Communication

There are four communication options.

- Use USB Devices
- Use Wireless Devices
- Use Ethernet Devices
- Use RS232 Devices

When an option is selected, that device(s) is included in the Select Devices(s) searching.

Click to select which found device(s) are to be used in the current session.

In addition to selecting and configuring the type of communication via the Preferences menu, you can also do this via the icons at the top of the Select Devices window.

Logging

Navigate to the Logging tab to specify the logging preferences
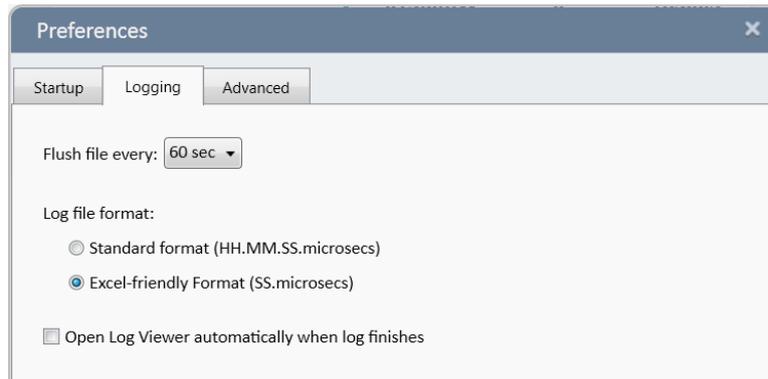
The table below describes the Logging options

Option	Description
Flush file every	Set **PMManager** to zero log file every 60 (default), 10, and 3 seconds
Log file format	Set log format as either Excel-type (default) or standard
Open Log Viewer automatically when log finishes	Have Log View automatically open when log is finished

Display
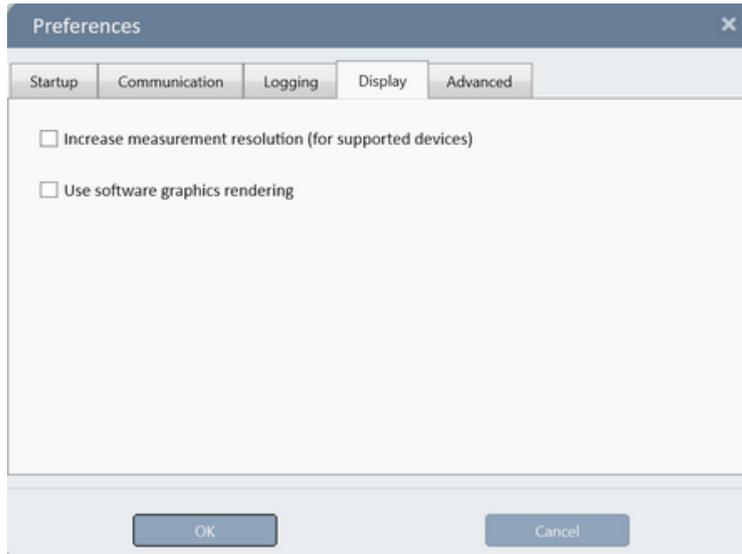
The table below describes the Display options

Option	Description
Increase Measurement Resolution	Increase the number of digits displayed and logged when measuring with Photodiode sensors connected to select devices that support an increased measurement resolution
Use software graphics rendering	Use of this option if **StarLab** displays any graphic anomalies

Advanced

Navigate to the Advanced tab to specify how **PMManager** handles firmware downgrade and software graphics rendering.
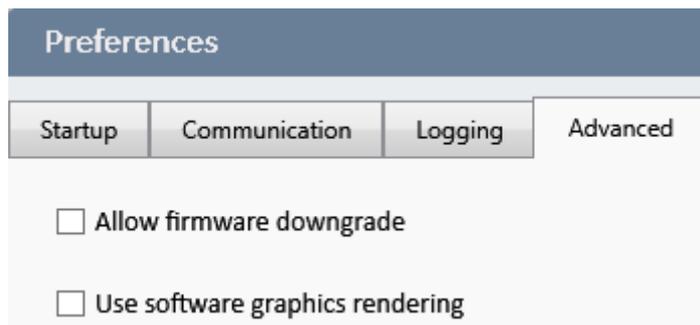
Option	Description
Allow firmware downgrade	Allows loading a firmware version that is lower than the installed firmware in the device. See, Upgrade Internal Software
Use software graphics rendering	Use of this option if **PMManager** displays any graphic anomalies

Export and Print a Screen Capture

It is possible to capture a **PMManager** window as .png file or send it to print.

❖ The entire screen is captured except the Function dialog.

This option works with active measurement sessions and when viewing a log file.

Export a screen capture as a PNG file

1. Click the camera icon. A dialog opens overlaying the screen that includes the captured screen and option buttons.

2. To save to a PNG file, click .
   The Save dialog opens. By default the files are saved in the StartLab folder:
   \User\My Documents**PMManager**.
   If required, change file location.

3. Enter a file name.

4. Click Save.

5. Enter the file name in the File name field.

Export a screen capture to a printer

1. Click the . A dialog opens overlaying the screen that includes the captured screen and option buttons.

2. Click to print directly to the default printer. The Default printer is always selected.

3. To print to a different printer, de-select the option and click Print. The standard Windows dialog opens to select a different printer.

❖ When opened, the Functions dialog is adjacent to the channel dialog. You can select the Functions dialog and move it anywhere on the screen. However, the dialog closes when you click anywhere else on the screen so that the dialog loses focus. Thus, regardless of its position, the Function dialog is not included in the Capture Screen option.

Diagnostics

The device's internal software must be upgraded when a newer version of the internal software is released; or a fault is detected with the device.

PMManager provides diagnostics tools that check device status and upgrade a device's internal software.

Upgrade Internal Software

Upgrade a device's internal firmware

1. Open the Select Device(s) dialog screen and click Diagnostics in the title bar.

2. Click the Upgrade button

2. Click Browse to locate the file.
   PMManager recognizes the correct file if it is located in the selected folder.
3. Click Start to begin the upgrade.
   The upgrade progress (erasing, programming, finished) is displayed in progress bars.

   PMManager generates a message if the device is loaded with a more recent version of firmware.

   ⓘ **Downgrading may cause degradation in performance and is not recommended.**
   See Allow firmware downgrade.

When complete, click Done to close the update window.

The Upgrade option becomes disabled and a flashing message is displayed, at the bottom of the Diagnostics window, with instructions on how to repeat the upgrade if required.

Please visit Newport's website (www.Newportopt.com), for the latest device firmware information.

Upgrade Sensor Software

The PEPS series of Thermopile sensors contain software to support their position and size measurement capabilities. Similarly, new thermopile sensors also contain software in the sensor itself.

Upgrade the sensor software

1. Click Upgrade Sensor. The Upgrade Sensor Software dialog window opens.
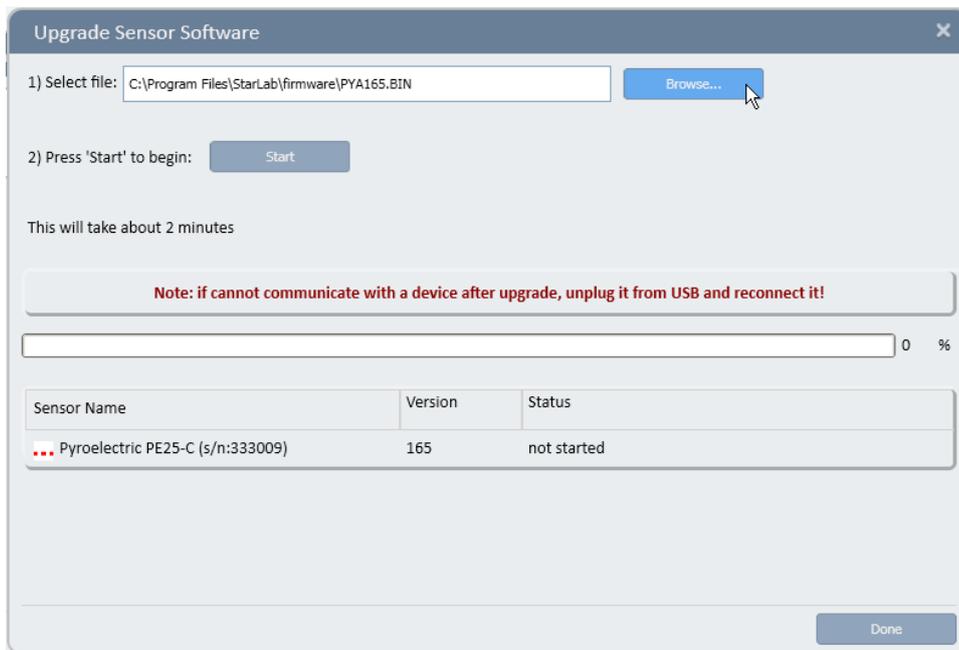
2. Click Browse to locate and select the bin file for the sensor.
3. Click Start to begin the upgrade.
   - If the bin file has already been upgraded, a message asks if you wish to continue.
   - The upgrade progress (erasing, programming, finished) is displayed in progress bars

Access Help

Access the PMManager Help

1. Do one of the following:

   - Select Options Cogwheel -> Help

   - The **PMManager** Help module appears.

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Appendix A - Device Specifications

This appendix provides specification information about the following devices:
 1938-R / 2938-R, 841-PE-USB / 844-PE-USB, 843-R-USB and 1919-R

1938-R / 2938-R Specifications

❖ The only difference between the 2938-R (two channel device), and the 1938-R (one channel device) is the number of channels that each of the devices support.

Thermal Sensor Input	Specifications
Input Ranges	8nA - 25mA full scale in 20 ranges
A to D Sampling rate	15Hz
A to D resolution	23 bits plus sign
Electrical accuracy (up to 1.5mA)	±0.25% ± 20pA new; ±0.5% ±50pA after 1 year
Electrical accuracy (above 1.5mA)	±0.5%
Electrical input noise level	500nV + 0.0015% of input range @3Hz.
Dynamic range	10 decades
Photodiode Sensor Slow Mode Input	**Specifications**
Input Ranges	8nA - 25mA full scale in 20 ranges
A to D Sampling rate	15Hz
A to D resolution	23 bits plus sign
Electrical accuracy (up to 1.5mA)	±0.25% ± 20pA new; ±0.5% ±50pA after 1 year
Electrical accuracy (above 1.5mA)	±0.5%
Electrical input noise level	0.1pA + 0.0015% of input range @3Hz.
Dynamic range	10 decades
Photodiode Sensor Fast Mode Input	**Specifications**
Input Ranges	8nA - 25mA full scale in 20 ranges
A to D Sampling rate	20kHz (10kHz in dual channel mode)
A to D resolution	12 bits
Electrical accuracy (up to 1.5mA)	±0.25% ± 20pA new; ±0.5% ±50pA after 1 year
Electrical accuracy (above 1.5mA)	±0.5%
Electrical input noise level	0.1pA + 0.0015% of input range @3Hz.
User Adjustable Analog Filters	2nd stage analog filter can be set to BW: None, 0.5Hz, 5Hz, 100Hz, 1kHz, 10kHz, 50kHz, 250kHz
Dynamic range	10 decades

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Pyroelectric Sensor Input	Specifications
Newport Pyroelectric Sensors are no longer available	
Input range	0 - 5V full scale
A to D sampling rate	25kHz
A to D resolution	12 bits no sign (0.025% resolution)
Electrical accuracy	±0.25% new; ±0.5% after 1 year
Electrical input noise level	4mV

General	Specifications
Detector compatibility	Thermopile (919P, PEPS series) Photodiode (918D, 818, 819C/D series, 818-MSCOPE) Pyroelectric (919E, LIAD series)
Analog output	User selected 1v, 2v, 5v, or 10v full-scale; 0.03% resolution. 100 ohms impedance
Polarity of analog output	Inner connector positive and outer connector negative (shield)
Analog output accuracy	±0.2% (of reading) ±0.3% of full scale volts
Dimensions	216W x 296D x 147H (mm)
Mass	2.8 kg
Display	1024x600 pixel TFT LCD; Active area 154x91mm (7") Touch Screen Interface
Display digit height	18mm
LCD Backlight	LED's. Backlight level is user adjustable.
Loudspeaker	Yes - For audio warnings
Battery (Lithium coin cell battery)	For clock Backup 3 Volts ENERGIZER Model CR2032 Non-rechargeable battery. Do not attempt to charge.
Operating Temperature Range	0 – 40 degrees C

Communications	Specifications
USB to External Flash Drive	For data logging
Ethernet	10/100 Ethernet (10Base-T/100Base-TX)
Ethernet protocols supported	Telnet, HTTP, UDP, DHCP
Other I/O's	External Trigger, TTL Output, Analog out

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841-PE-USB / 844-PE-USB Specifications

Thermal, Photodiode Sensor Input	Specifications
Measurement range	Varies according to sensor in use. See Newport Laser Power/Energy Measurement, at www.Newportopt.com, for full details of each sensor.
Input range	15nA - 1.5mA full scale in 16 ranges
A to D sampling rate	15Hz
A to D resolution	18 bits plus sign (0.0009% resolution)
Electrical accuracy	±0.25% ±20pA new; ±0.5% ±50pA after 1 year
Electrical input noise level	500nV or 1.5pA + 0.0015% of input range @3Hz
Dynamic range	9 decades (1:10^9)

Pyroelectric Sensor Input	Specifications
Measurement range	Varies according to sensor in use - **Newport Pyroelectric Sensors are no longer available**
Input range	0 - 6V full scale
A to D sampling rate	10KHz
A to D resolution	12 bits no sign (0.025% resolution)
Electrical accuracy	±0.25% new; ±0.5% after 1 year
Electrical input noise level	2mV
Logging rates	10KHz

General	Specifications
Analog output	User selected 1v, 2v, 5v, or 10v full-scale; 0.03% resolution. 100 ohms impedance
Polarity of analog output	Inner connector positive and outer connector negative (shield)
Analog output accuracy	±0.4% ±2mV
Number of channels	1 channel
Dimensions (m)	**841:** 117mm x 68mm x 32mm / **844:** 105mm x 80mm x 29mm
Mass	**841:** 0.43 Kg / **844:** 0.164 Kg
USB specifications	Full speed, bus-powered, high power device, one interrupt IN endpoint

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845-PE-RS Specifications

Thermal, Photodiode Sensor Input	Specifications
Measurement range	Varies according to sensor in use. See Newport Laser Power/Energy Measurement, at www.Newportopt.com, for full details of each sensor.
Input range	15nA – 4.0mA full scale in 16 ranges
A to D sampling rate	15Hz
A to D resolution	16 bits plus sign (0.015% resolution)
Electrical accuracy	±0.25% ±20pA new; ±0.5% ±50pA after 1 year
Electrical input noise level	500nV or 1.5pA + 0.0015% of input range @3Hz
Dynamic range	9 decades (1:10^9)
Pyroelectric Sensor Input	**Specifications**
Measurement range	Varies according to sensor in use - **Newport Pyroelectric Sensors are no longer available**
Input range	0 - 6V full scale
A to D sampling rate	500Hz
A to D resolution	12 bits no sign (0.025% resolution)
Electrical accuracy	±0.25% new; ±0.5% after 1 year
Electrical input noise level	2mV
Logging rates	500Hz (Baud Rate 115200) 50Hz (Baud Rate 9600)
General	**Specifications**
Analog output	100 ohms output impedance, SMA Connector. User selected 1v, 2v, 5v, or 10v full-scale; 0.03% resolution. Two modes: Digital and Raw
Polarity of analog output	Inner connector positive and outer connector negative (shield)
Analog output accuracy	±0.4% ±2mV
Number of channels	1 channel
Dimensions (m)	114mm x 80mm x 29mm
Mass	0.176 Kg
RS232 specifications	Connector: D sub Female 9pin. 8 data bits, 1 stop bit, no parity, 115200 baud default (baud is user configurable)
Power Supply	12v 2A AC/DC power supply with 2.5x5.5mm Screw Lock Connector, and Center Positive Polarity
Power Consumption	50mA at 12v for Thermal, Photodiode and 75mA at 12v for Pyro

843-R-USB Specifications

Thermal, Photodiode Sensor Input	Specifications
Input range	15nA - 1.5mA full scale in 16 ranges
A to D sampling rate	15Hz
A to D resolution	18 bits plus sign
Electrical accuracy	±0.25% ±20pA new; ±0.5% ±50pA after 1 year
Electrical input noise level	500nV or 1.5pA + 0.0015% of input range @3Hz
Dynamic range	9 decades (1:10^9)

Pyroelectric Sensor Input	Specifications
Newport Pyroelectric Sensors are no longer available	
Input range	0 - 6V full scale
A to D sampling rate	500Hz
A to D resolution	12 bits no sign (0.025% resolution)
Electrical accuracy	±0.25% new; ±0.5% after 1 year
Electrical input noise level	2mV

General	Specifications
Detector compatibility	Thermopile (including PEPS), photodiode and pyroelectric (PE-C)
PC interface (optional)	USB
Analog output	1v full-scale; 0.03% resolution. 100 ohms impedance
Polarity of analog output	Inner connector positive and outer connector negative (shield)
Analog output accuracy	±0.2% (of reading) ±0.3% of full scale volts
Dimensions (m)	114w x 41d x 212h
Mass	0.47 Kg
Display	320 x 240 pixel TFT LCD; Active area ~70 x ~52 mm
Display digital height	15 mm
LCD lighting	LED: Operates from charger or battery Lighting level can be adjusted between 3 levels using on/off button.
Bargraph segments	310
Battery	2x Li-Ion 3.7V, 5.2Amp-hour battery pack built-in

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Charger input	DC 12-16v, 1W Charge time approx. 5 hours Automatically stops charging when battery is full
Operation between charges	• With low backlight: Thermal, Photodiode 19, Pyroelectric 16 • With medium backlight: Thermal/Photodiode 17, Pyroelectric 15 • With high backlight: Thermal/Photodiode 15, Pyroelectric 13

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1919-R Specifications

Thermal, Photodiode Sensor Input	Specifications
Input range	15nA - 1.5mA full scale in 16 ranges
A to D sampling rate	15Hz
A to D resolution	18 bits plus sign
Electrical accuracy	±0.25% ±20pA new; ±0.5% ±50pA after 1 year
Electrical input noise level	500nV or 1.5pA + 0.0015% of input range @3Hz
Dynamic range	9 decades (1:10^9)

Pyroelectric Sensor Input	Specifications
Newport Pyroelectric Sensors are no longer available	
Input range	0 - 6V full scale
A to D sampling rate	500Hz
A to D resolution	12 bits no sign (0.025% resolution)
Electrical accuracy	±0.25% new; ±0.5% after 1 year
Electrical input noise level	2mV

General	Specifications
Detector compatibility	Thermopile (including PEPS), photodiode and pyroelectric (PE-C)
PC interface (optional)	USB; RS232 (max baud rate 115200)
Analog output	1v full-scale; 0.03% resolution. 100 ohms impedance
Polarity of analog output	Inner connector positive and outer connector negative (shield)
Analog output accuracy	±0.2% (of reading) ±0.3% of full scale volts
Dimensions (m)	114w x 41d x 212h
Mass	0.47 Kg
Display	320 x 240 pixel TFT LCD; Active area ~70 x ~52 mm
Display digital height	15 mm
LCD lighting	LED: Operates from charger or battery Lighting level can be adjusted between 3 levels using on/off button.
Bargraph segments	310
Battery	2x Li-Ion 3.7V, 5.2Amp-hour battery pack built-in
Charger input	DC 12-16v, 1W Charge time approx. 5 hours Automatically stops charging when battery is full

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Operation between charges	• With low backlight: Thermal, Photodiode 19, Pyroelectric 16 • With medium backlight: Thermal/Photodiode 17, Pyroelectric 15 • With high backlight: Thermal/Photodiode 15, Pyroelectric 13 ❖ Battery charge will be depleted faster if a USB flash drive is left plugged in the 1919-R meter.

Data Logging	Specifications
Log period	1 sec to 1000 hours
Max points stored onboard per file	Limited only by USB capacity
Max points direct to PC file in real time	Unlimited
Max points stored onboard	Limited only by USB capacity
Real time logging of power	15Hz Onboard, USB, RS232
Real time logging of energy	5000Hz Onboard, USB; 30Hz RS232

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Appendix B – Calibration, Traceability, and Recalibration

Newport develops three main types of sensors: thermopile, photodiode, and pyroelectric. Each type of sensor needs to be calibrated and recalibrated in a specific way.

Newport Thermopile Sensors

Newport develops two kinds of thermopile sensors – Surface Absorbers and Volume Absorbers. This section describes the range of both kinds of Newport thermopile sensors.

Surface Absorbers

BB (Broadband) Absorber

A special refractory coating is used to provide high absorption from the UV through to the IR on standard, high power density, broadband monitor sensors. This coating withstands very high power densities (up to 20 kW/cm²) without changing calibration. The absorption ability of this coating is above 90% for most of its range.

EX (Excimer) Absorber

The EX Absorber provides high absorption in the UV, and can withstand both the pulse energies and the average power of excimer lasers. These discs also have excellent absorption for 10.6m and other wavelengths. Consequently, they can also be used for other types of lasers.

LP1 (long pulse) Absorber

This absorber has a very high damage threshold for long pulse (ms) or continuous lasers and is therefore offered for use with high power and energy lasers. It is calibrated for the spectral range 250-2200nm with some sensors also being calibrated for 2940nm. It is not suitable for long wavelength CO_2 operation.

LP (Long Pulse) Absorber

The LP Absorber has a particularly high damage threshold for long pulse (ms), or continuous lasers and is therefore offered for use with high power sensors. It is calibrated for use with the YAG laser at 1.064m, or the CO_2 laser at 10.6m, and absorbs about 90% at these wavelengths.

Volume Absorbers

P (Pulse) Type Absorber

The models with the P suffix, are used with pulsed lasers, and have a special absorbing glass with an absorbance of 95 +2% over the operating range. Since the surface is glass, its reflectivity does not change even if damaged or melted locally.

HE/HE1 (High Energy) Absorber

The HE and HE1 Absorbers have a particularly high damage threshold for pulsed and repetitively pulsed lasers, of both the short and long pulse variety. The HE and HE1 Absorbers are useful where the highest pulse energies and average powers are used.

SV Absorber

The SV Absorber is the absorber of choice for difficult applications with short pulses having both high average power density and high energy density.

The absorption of the various Newport absorbers as a function of wavelength is shown below:

Thermal Sensors
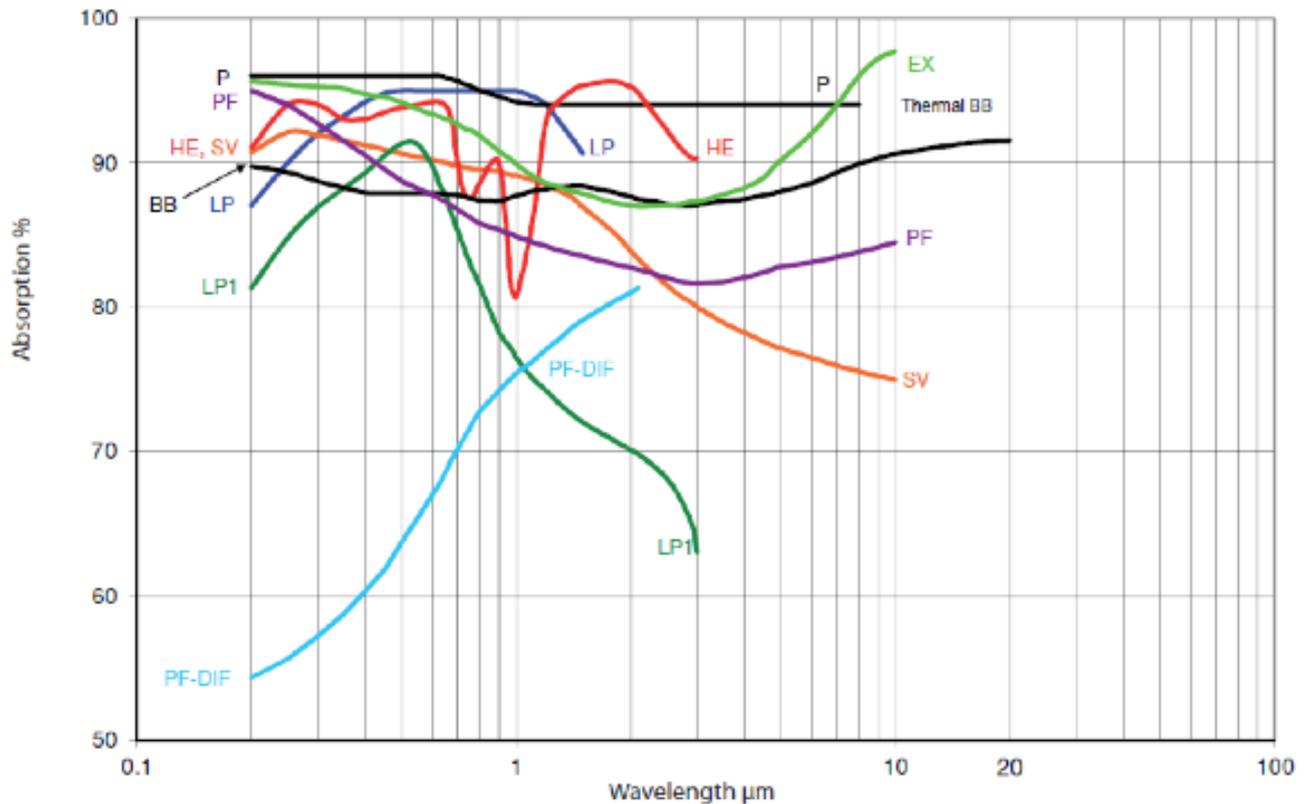
Factory Calibration of Thermopile Sensors

The absorption of the various Newport thermal absorbers can vary from disc to disc. Therefore, all Newport absorbers are individually calibrated against NIST traceable standards. Newport power/energy meters with the broadband or P type absorbers are individually calibrated by laser at several wavelengths against a NIST calibrated standard meter. The meter can be switched to give the exact calibration at the various wavelengths, for example, Argon, YAG, and where applicable, CO2.

The EX type detector is calibrated by measuring the ratio of absorption in the UV to that at 515nm. In both cases, the total absorption is measured using an integrating sphere. The detector is then calibrated with an argon laser and given a correction factor from this ratio.

Linearity and Accuracy of Thermopile Sensors

Linearity

The linearity of most Newport thermal detectors is specified to be 1% over the specified power range of each particular instrument, and is periodically tested by Newport.

For models whose linearity is not tested over their entire range, samples are randomly chosen and periodically tested over their entire range. The test is performed with a high power laser that covers the

entire detector range using a rear leak detector for comparison. The rear leak detector is a low power Newport detector that has previously been tested for linearity. In all cases, the linearity of the detectors is traceable to electrical standards.

Accuracy of Calibration

Since the instruments are calibrated against NIST standards, the accuracy is generally 1% at the power level at which the calibration has been performed. This accuracy has been verified by checking the scatter of the results when several instruments are calibrated against the same standard. The maximum measurement error is less than the sum of the specified accuracy and linearity. Since the linearity is also 1%, the maximum error in measurement is generally less than 2%.

See http://www.Newportopt.com/laser-measurement-instruments/laser-power-energy-meters/tutorial/calibration-procedure for a complete analysis of Newport calibration accuracy.

Adjust the power calibration for one wavelength only

1. Apply known laser power and wait for measurement to stabilize.

2. Select Calibrate (Options > Advanced Functions > Calibrate)

   The Adjust Calibration Factors dialog opens.
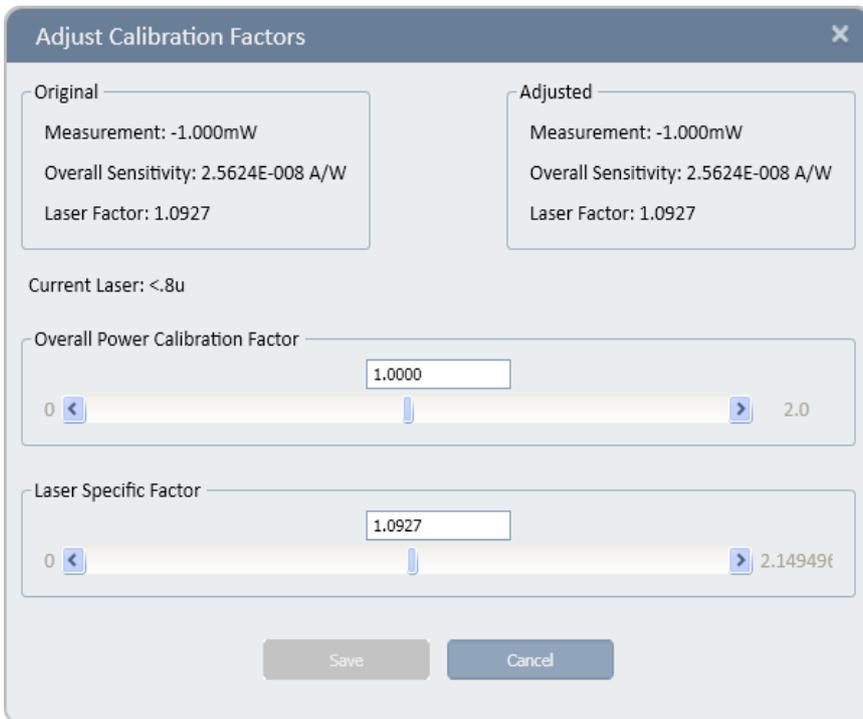
   The Original area displays the original Measurement, Overall Sensitivity and Laser Factor fields. The Current wavelength is displayed beneath the Original area.

3. Adjust the Laser Specific Factor until the Adjusted measurement equals the power applied to the sensor.
   Adjusting the Laser Specific Factor effects both the Measurement and the Laser Factor values.

4. Click Save to save the adjustment for the active channel.

   ❖ For units that have different calibration factors (e.g., CO2, YAG, or VIS), select the correct laser wavelength from the main Configuration Area before calibration. Only the calibration of the

chosen laser wavelength changes.

For more information on calibrating all wavelengths proportionately, refer to <u>Factory Calibration of Thermopile Sensors</u>.

❖ Changing power calibration also changes energy calibration proportionately. However, changing the energy calibration does not change the power calibration.

Recalibration from a Known Source of Laser Energy

Newport sensors are equipped with one overall energy calibration factor.

Recalibrate from a known source of laser energy

1. Apply the known laser energy. Select Calibrate (Options > Advanced Functions > Calibrate)

   The Adjust Calibration Factor dialog opens
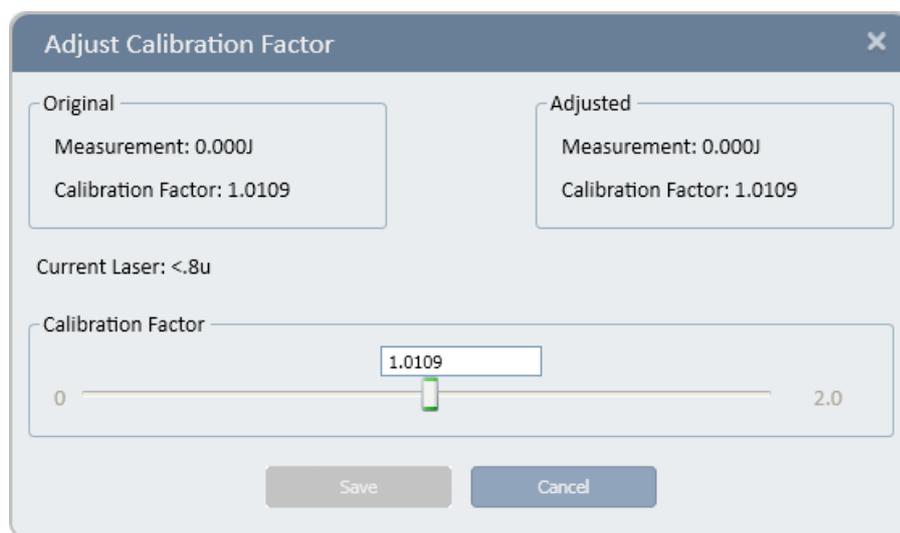
   The Original area displays the original Measurement and Calibration Factor fields.

   The Current wavelength is displayed beneath the Original area.

2. Adjust the Calibration Factor until the Adjusted measurement equals the energy applied to the sensor.

3. Click Save to save the adjustment for the active channel.

❖ For units that have different calibration factors (e.g., CO2, YAG, or VIS), select the correct laser wavelength from the main Configuration Area before calibration.

❖ Changing energy calibration at one wavelength will affect all other wavelengths proportionately. However, changing the energy calibration will not change the power calibration.

Newport Photodiode Sensors

This section discusses calibration of Newport photodiode sensors.

Factory Calibration of Photodiode Sensors

Photodiode detectors are inherently very linear but also have a large variation in sensitivity with wavelength. In addition, the Newport model 918D/818/819C series is equipped with both a built in filter and removable filter to allow measurement of higher powers without detector saturation. These filters also have a transmission that depends on wavelength. Therefore, the 918D/818/819C series has a built in calibration adjustment for wavelength.

The sensitivity of various Newport photodiode sensors can vary from one to another as well as with wavelengths. Therefore, Newport photodiode detectors are individually calibrated against NIST traceable standards over the entire operating range of wavelengths for both filter out and filter in. The calibration curve is normalized to the correct absolute calibration at 632.8 nm using a HeNe laser against a reference meter traceable to NIST.

The spectral sensitivity curve of the detector and the spectral transmission curve of the filters are fed into the sensor EEROM. This information is used to set the gain to the proper value at wavelengths other than the wavelength at which the instrument was calibrated. When the user selects his wavelength on the instrument, the correction factor for that wavelength is applied.

Linearity and Accuracy of Photodiode Sensors

Since the instruments are calibrated against NIST standards, the accuracy is generally ±2% at the wavelength that the calibration has been performed. The maximum error in measurement will be less than the sum of:

calibration accuracy + linearity + inaccuracy due to errors in the wavelength curve + variations in gain with temperature

The linearity of the photodiode detector is extremely high and errors due to this factor can be ignored.

User Recalibration

Adjust Calibration Factors of Photodiode Sensors

Adjust the power calibration factor

1. Apply the known laser power.

2. Select **Calibrate** (Options > Advanced Functions > Calibrate)

The **Adjust Calibration Factor** dialog opens
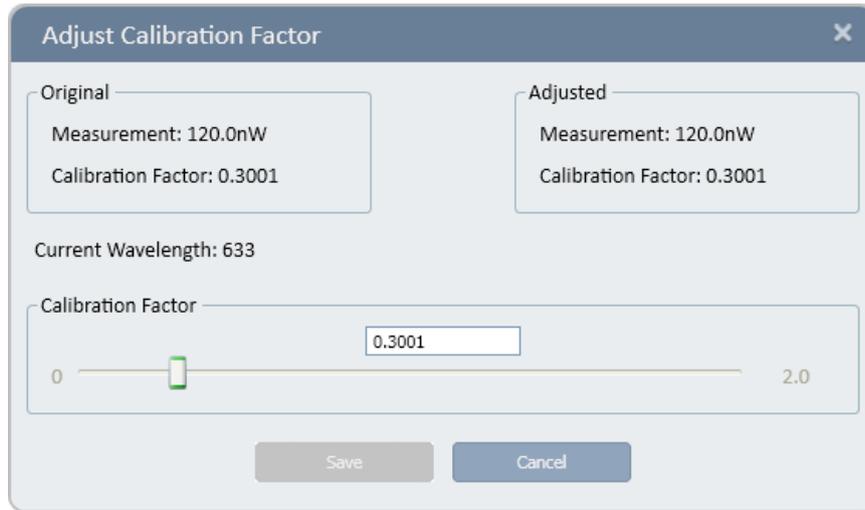
The **Original** area displays the original **Measurement** and **Calibration Factor**.
The Current wavelength is displayed beneath the Original area.

❖ A different wavelength can be selected in the Measurement Parameters Area.

3. Adjust the Calibration Factor until the Adjusted measurement equals the power applied to the sensor.

4. Click Save to save the adjustment for the active channel.

❖ The relative readings at different wavelengths are fixed by the wavelength calibration curve stored in the sensor EEROM. When changing the calibration at one wavelength, the calibration at all other wavelengths changes proportionately.

Newport Pyroelectric PD Energy Sensors

This section discusses calibration of Newport pyroelectric sensors. Two types of absorber surface are used in Newport pyroelectric measuring sensors:

• Metallic
• Broadband

Metallic

Metallic sensors do not have a BB suffix in the sensor name. They have a partially reflective multi-layer metallic coating that absorbs approximately 50% of the laser pulse (see image below).
The metallic coating permits very high repetition rates, up to 5000Hz, as well as relatively high damage threshold.

Broadband

Broadband sensors have a BF suffix (or with legacy sensors the BB suffix) in the sensor name. They have a broadband dark absorbing coating to provide high absorptivity from the UV through the IR. This coating can withstand energy densities, up to 0.8J/cm² for short pulses and 2J/m² for long pulses, without changing calibration.

The absorption of this coating is above 90% for most of its range (see image below)

This coating is available for the PE50 and PE25 as well as diffuser versions of the same.
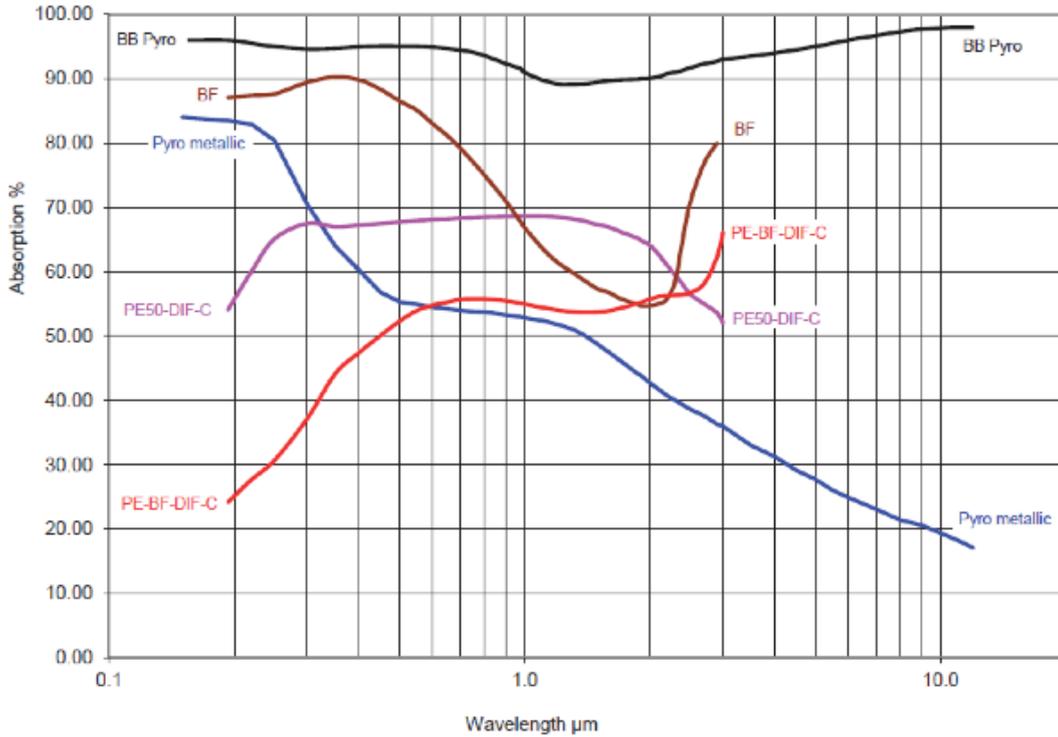
Absorption of Newport Pyroelectric Absorbers
Absorption (%) vs. Wavelength (nm)

Calibration

The sensitivity of the various Newport pyroelectric sensors varies from one to another, as well as with wavelengths. Therefore, Newport pyroelectric detectors are individually calibrated against NIST traceable standards. In addition, the calibration is corrected in the device for different wavelengths.

Newport pyroelectric detectors are calibrated using a 1.06μm repetitively pulsed laser referenced to a NIST traceable thermal power meter. The average energy is set to the average power of the standard power meter, divided by the laser frequency. The metallic PE25 and PE50 sensors are also calibrated with an excimer laser at 248nm to correct the rather large absorption variations in that spectral region with those sensors.

The spectral absorption of the detector coating is measured spectroscopically and the absorption curve is used to correct the calibration for other wavelengths. When the user selects his wavelength in the **PMManager** application, the correction factor for that wavelength is applied.

Accuracy of Calibration

Since the instruments are calibrated against NIST standards, the accuracy is generally 3% at the energy level and wavelength at which the calibration has been performed. This accuracy has been verified by checking the scatter of the results when several instruments are calibrated against the same standard. The maximum error in measurement will be less than the sum of the specified accuracy, linearity, and inaccuracy due to errors in the wavelength curve. The non-linearity is approximately 2%.
For error due to wavelength, see table below.

In addition to the above errors, the reading of a pyroelectric sensor changes with frequency. The device has a built-in correction for this error. For frequencies above 50% of maximum frequency, inaccuracies in this correction can increase the total error up to 3%.

The maximum error in measurement will be less, and in general will be considerably less, than the sum of the above mentioned errors.

See http://www.Newportopt.com/laser-measurement-instruments/laser-power-energy-meters/tutorial/calibration-procedure for a complete analysis of Newport calibration accuracy.

| Coating Type		
Wavelength	**Error**	
	Broadband	**Metallic**
190 - 350nm	±2%	±2%
400 - 800nm	±2%	±2%
1064nm	0	0
2 - 3µm	±2%	±2%
10.6µm	±5%	±15%

Recalibration from a Known Source of Laser Energy

**Recalibrate from a known source of laser energy**

1. Apply the known laser power.

2. Select Calibrate (Options > Advanced Functions > Calibrate)

   The Adjust Calibration Factor dialog opens.

   The calibration dialog depends whether the Metallic or Broadband sensor is selected.
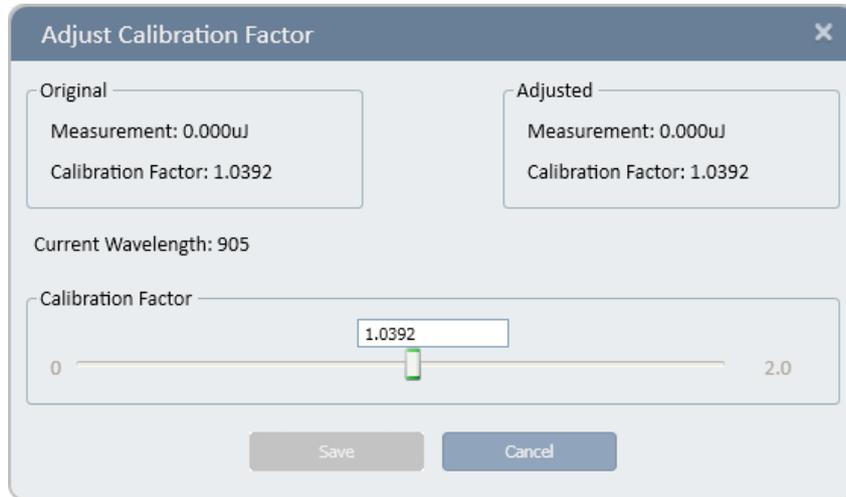
Metallic sensor
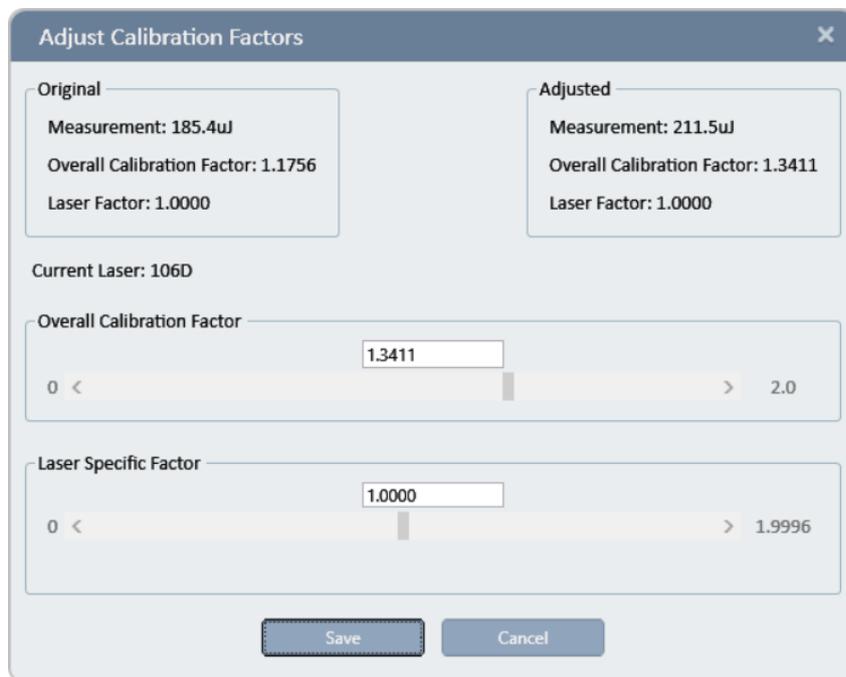
Broadband sensor

- The Original area displays the original Measurement and Calibration Factor
- The Current wavelength is displayed beneath the Original area

  ❖ A different wavelength can be selected in the Measurement Parameters area.

3. Adjust the Calibration Factor until the Adjusted measurement equals the power applied to the sensor.

4. Click Save to save the adjustment for the active channel.

❖ For metallic sensors, when the calibration is changed at one laser wavelength, the overall calibration of all other wavelengths changes proportionately.
For broadband sensors, there is an option to adjust the calibration factor for all wavelengths or only for a selected wavelength.

Periodic Recalibration

All Newport equipment is factory-calibrated according to NIST-traceable standards. Due to the drifting nature of electronic components, equipment should be returned to a service center for recalibration on a periodic basis.

PMManager provides an indication when recalibration is due in the following three examples:

## When Selecting a Device

An orange warning triangle adjacent to a sensor icon indicates the sensor and or the instrument should be factory recalibrated.
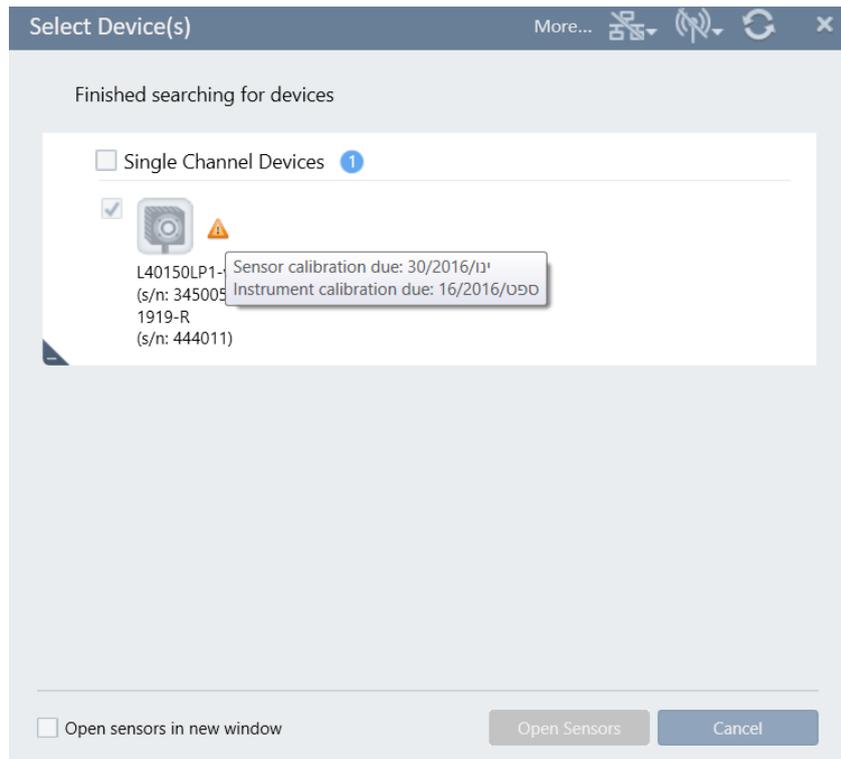
Click More
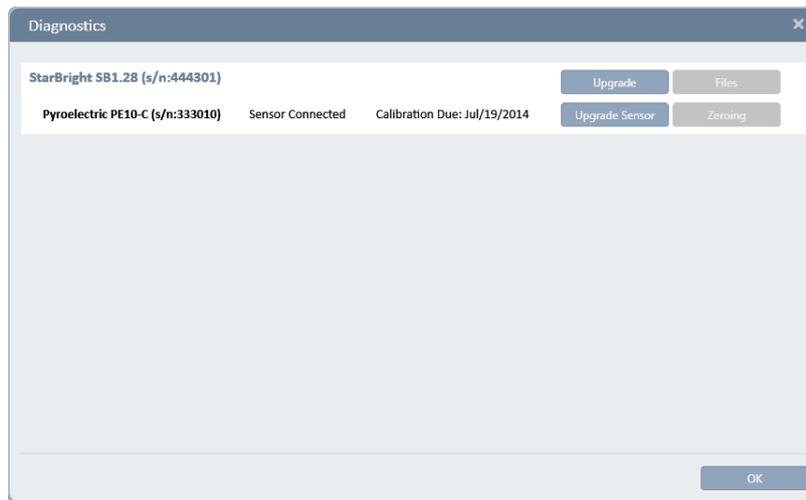
View the Channel Icon
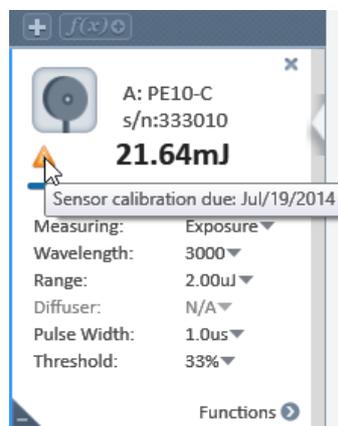
Appendix C – Safety and Compliance

CE Compliance

All Newport devices, as installed on a CE compliant PC, will comply with all pertinent CE requirements relating to safety, sensitivity to interference, EMC and emissions.

PMManager User
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For the latest version, please visit our website: https://www.newport.com/c/optical-meters