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843-R / 843-R-USB

843-R/843-R-USB

Laser Power Meter

User Manual

Newport Corporation

www.newport.com

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Chapter 1. Introduction: How to Use This Manual

Newport's 843-R Power Meter is a simple to use microprocessor-based Laser Power/Energy meter that operates with thermopile, pyroelectric and photodiode sensors. Based on smart connector technology, just connecting the sensor configures and calibrates the instrument.

This manual tells you what you need to know to make full use of the 843-R for all your laser measurement needs. It includes a "Quick Reference", (Chapter 2) to allow you to perform basic measurements immediately, without reading the whole manual.

The main measurement sections, Chapters 4, 5 and 6 include a general description and a section detailing operating options.

Model 843-R-USB is functionally equivalent to the 843-R with the addition of USB communication with the PC. Unless otherwise noted, any mention of the 843-R refers to the 843-R-USB as well.

Chapter 2. Quick Reference

2.1 Getting Started

To connect a sensor to the 843-R Power Meter, simply insert the 15 pin D type connector of the measuring sensor cable into the socket marked "Sensor Input" on the rear panel of the 843-R Power Meter (see Figure 2.1).

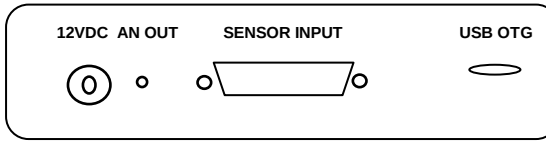


Figure 2.1 843-R Rear Panel

The 843-R Power Meter is equipped with "soft keys." That is, the functions of the keys change as indicated by the legend above each key (see Figure 2.2).

Figure 2.2 843-R Front View

2.2 Functions with No Sensor Connected

2.2.1. Turning On and Off.

To switch the 843-R Power Meter on:

Briefly press the on/off switch (Figure 2.2). The unit will switch on, and the display will appear.

Note:

With the 843-R Power Meter, sensors are hot swappable. Even after the meter is switched on, you can remove one sensor and insert a different one. The 843-R will recognize the switch and reconfigure itself according to the settings of the new sensor.

To toggle the state of the LCD backlight:

The backlight for the 843-R's LCD can be toggled between 3 different levels of illumination. This toggling will be performed by briefly pressing the on/off switch after the 843-R has been switched on.

To switch the 843-R off:

Press the on/off switch and hold it for about 2 seconds until the display blanks.

2.2.2. Configuring the instrument.

To zero instrument:

1. Make sure that the instrument is not in an electrically noisy environment and is undisturbed.
2. Verify that no sensor is connected. If one is connected, then detach before continuing.
3. Press the **Zero** key**.** This will bring you to the Zeroing screen
4. Press the **Start** key. When zeroing finishes press the **Save** key.

To show or hide settings

1. Press the Down arrow until Show Settings is highlighted and press the Enter arrow.
2. Set to Yes to display sensor settings in the measurement screens. Set to No to hide the sensor settings and show a larger graph.

To set Line Frequency

1. Setting Line Frequency correctly removes electrical noise that may be introduced to the measurements.
2. Press the Down arrow until Line Frequency is highlighted and press the Enter arrow.
3. Set to 50Hz or 60Hz, depending on the electrical power grid of the area that you are in.

To select Language

The 843-R can be configured to one of several languages. In order to select the display language:

1. Press the Down arrow until Language is highlighted and press the Enter arrow.
2. Set to English, Japanese, Russian, or Chinese.

To set Date and Time

1. Press the Down arrow until the Date and Time are highlighted and press the Enter arrow.
2. Scroll through and select Month, Day, Year, Hour, and Minutes with the Right arrow. Change the selected item with the Down arrow.

Note:
The present settings are automatically saved for the next time the 843-R is turned on.

2.2.3. Updating the 843-R Firmware.

1. Download the latest 843-R firmware upgrade package from the Newport website: http://www.newport.com and copy to your target directory.
2. Run the upgrade executable and follow the on screen instructions

2.3 Thermal Sensors

2.3.1. Use of the 843-R with thermal type sensors.

Most Thermopile sensors have somewhat different absorption at different wavelengths. In order to compensate for this, each sensor has been calibrated by laser at several wavelengths. When you choose the correct laser wavelength, the correction factor for that wavelength is automatically introduced. Note that the laser wavelength correction in use is displayed in the upper left corner of the display.

To set type of laser being used:

1. From the measurement screen, press the **Setup** key.
2. Press the Down arrow until Laser is highlighted and press the Enter arrow.
3. Select the appropriate laser wavelength and press the **OK** key.

To select a range for power measurement:

1. From the measurement screen, press the **Setup** key.

2. Press the Down arrow until Range is highlighted and press the Enter arrow.
3. Select the appropriate manual range or AUTO to select autoranging and press the **OK** key.

To choose power or energy measurement:

1. In the main measurement screen, press the **Mode** key.
2. Select Power or Energy.
3. Press the **OK** key to return to the measurement screen

2.3.2. Other Settings and Saving the Startup Configuration

1. When measuring power, you can set the period over which to Average the measurements
2. When measuring energy you can set the threshold level in order to screen out false triggers.
3. The present settings are automatically saved for the next time the 843-R is turned on.

2.3.3. Power or Single Shot Energy Measurement

Warning:

Do not exceed maximum sensor limits for power, energy, power density and energy density as listed in Table 5 and **Error! Reference source not found.** in **Error! Reference source not found.** Otherwise, there is a risk of damaging the absorber.

To simulate an analog needle display on the 843-R:

1. Press the **Display** key and select Needle.
2. Press **OK** to continue with measurements.

To expand the graph (Bargraph or Needle) scale ±5x about the present reading:

1. Press the **Zoom** key.
2. Press the **Zoom** key again to return to the full scale graph. See Section 4.3.1.2 for full details.

To subtract background and set current reading to zero:

1. Press the **Offset** key.
2. Press the **Offset** key again to cancel. See Section 4.3.1.2 for full details.

To use the 843-R to measure laser power:

1. Press the **Mode** key and select Power
2. Select AUTO for autoranging or the lowest manual range whose maximum is greater than the expected power readings.
3. Power is measured 15 times per second.

To use the 843-R to measure laser energy:

1. Press the **Mode** key and select Energy
2. Energy measurement is performed in manual ranges only. The correct range to select is the lowest one that is larger than the expected pulse energy to be measured.
3. Thermal sensors measure energy in single shot mode. When the 843-R flashes "READY," on and off, fire the laser.

2.4 Photodiode Sensors

2.4.1. Selecting Wavelengths

1. From the measurement screen, press the **Setup** key.

2. Press the Down arrow until Laser is highlighted and press the Enter arrow.
3. Select the appropriate laser wavelength and press the **OK** key.
4. If the wavelength you want is not among the wavelengths in the six wavelengths listed press the **Modify** key.
5. Use the Right and Down arrows to adjust the wavelength as desired. Then press the **OK** key.

2.4.2. To select a range for power measurement:

1. From the measurement screen, press the **Setup** key.
2. Press the Down arrow until Range is highlighted and press the Enter arrow.
3. Select the appropriate manual range, AUTO to select autoranging, or dBm to display power in a logarithmic scale. Press the **OK** key

2.4.3. Other Settings and Saving the Startup Configuration

1. Select Average in order to set the period over which to average the measurements
2. Select Filter to IN or OUT according to if the Filter is in place or not.
3. The present settings are automatically saved for the next time the 843-R is turned on.

2.4.4. Power Measurement

Warning:

Do not exceed maximum sensor limits for power, energy, power density and energy density as listed in **Error! Reference source not found.** in **Error! Reference source not found.** Sensor Specifications. Otherwise, there is a risk of damaging the sensor.

To simulate an analog needle display on the 843-R:

1. Press the **Display** key and select Needle.
2. Press **OK** to continue with measurements.

To expand the graph (Bargraph or Needle) scale ±5x about the present reading:

1. Press the **Zoom** key.
2. Press the **Zoom** key again to return to the full scale graph. See Section 5.3.1.2 for full details.

To subtract background and set current reading to zero:

1. Press the **Offset** key.
2. Press the **Offset** key again to cancel. See Section 5.3.1.2 for full details.

2.5. Pyroelectric and Photodiode Energy Sensors

2.5.1. Zeroing Instrument against Sensor

For the most accurate calibration, you must zero the pyroelectric sensor against the 843-R it is being used with. Proceed as follows: Make sure the sensor is in a quiet environment and not subject to pulsed radiation. Plug sensor into 843-R and turn on. Press the **Setup** key to enter the Setup screen. Press the **Zero** key to enter the Zero screen. Press the **Start** key. When "Zeroing completed successfully" appears, press the **Save** key and then press the **Exit** key. After you have done zeroing, you do not have to do it again when used with the same type of meter. If you have zeroed it against a different of meter, then a different value has been saved and when used with this 843-R again you should zero it again.

2.5.2. To set type of laser being used:

For metallic types only:

1. From the measurement screen, press the **Setup** key.
2. Press the Down arrow until Laser is highlighted and press the Enter arrow.
3. Select the appropriate laser wavelength and press the **OK** key.
4. If the wavelength you want is not among the wavelengths in the six wavelengths listed press the Modify key.
5. Use the Right and Down arrows to adjust the wavelength as desired. Then press the **OK** key.

For all other types

1. From the measurement screen, press the **Setup** key.
2. Press the Down arrow until Laser is highlighted and press the Enter arrow.
3. Select the appropriate laser wavelength and press the **OK** key.

2.5.3. To select a range for energy measurement:

1. From the measurement screen, press the **Setup** key.
2. Press the Down arrow until Range is highlighted and press the Enter arrow.
3. The correct range to select is the lowest one that is larger than the expected pulse energy to be measured. Press the **OK** key.

2.5.4. Other Settings and Saving the Startup Configuration

1. Select "Pulse Length" and choose the shortest pulse length setting longer than your laser's pulse length. **Warning:** Incorrect readings will result if pulse length is not set up correctly. For sensors with only one Pulse Length, N/A will be displayed.
2. For sensors with an optional diffuser, Select Diffuser and set to IN or OUT according to if the Diffuser is in place or not. For sensors without an optional diffuser, N/A will be displayed.

3. Select Threshold and set to level that will screen out erroneous readings due to false triggers.
4. Select Average in order to set the period over which to average the measurements, or set to NONE.
5. The present settings are automatically saved for the next time 843-R is turned on.

2.5.5. Energy or Average Power Measurement

Warning:

Do not exceed maximum sensor limits for power, energy, power density and energy density as listed in Table 5 and Table 6 in Sensor Specifications. Otherwise, there is a risk of damaging the absorber.

With the pyroelectric sensor, you have been supplied a test slide with the same coating as on your pyroelectric detector. You can also obtain this slide from your dealer. You should use this slide to test the damage threshold with your laser pulses. If the slide shows damage, then either enlarge your beam or lower the laser energy until damage is no longer seen.

Note:

High sensitivity pyroelectric sensors (919E-200U-8-25K, 919E-0.1-12-25K) are very sensitive to vibration, and therefore might read a false trigger when operating in an acoustically non-stable environment. Set the threshold to a high enough value that false triggering does not occur.

To choose Energy or Average Power Measurement

1. To measure average power, press the **Mode** key and select Power.
2. To measure energy pulses, press the **Mode** key and select Energy.
3. If the laser is pulsing at greater than 1Hz, the frequency will be shown on the screen as well.

Warning:

While measuring pulsing lasers, erroneous energy reading will result if energy range, pulse length, or threshold levels are not set up correctly. See Section 6.3 for details.

To simulate an analog needle display on 843-R**:**

1. Press the **Display** key and select Needle.
2. Press **OK** to continue with measurements.

To expand the graph (Bargraph or Needle) scale ±5x about the present reading:

1. Press the **Zoom** key.
2. Press the **Zoom** key again to return to the full scale graph. See Section 5.3.1.2 for full details.

To subtract background and set current reading to zero:

1. Press the **Offset** key.
2. Press the **Offset** key again to cancel. See Section 5.3.1.2 for full details.

2.6 843-R-USB

For those customers that want to interface their power meter with the PC, we offer the 843-R-USB meter. This has all the features of the 843-R and in addition is capable of USB communication with the PC. We also supply a full range of PC software to work with the 843-R-USB including:

- PMManager. A fully functional software application that turns your PC into a laser power/energy meter

- COM object for system integrators to integrate power measurment into their applications
- LabVIEW drivers.

Chapter 3. The 843-R Power Meter Unit

3.1 General Description

The model 843-R laser power/energy meter represents a new level of sophistication, sensitivity, compactness and accuracy, coupled with ease of operation. It can operate with thermal and photodiode sensors. It has smart connector technology. Simply plugging in the sensor configures and calibrates the 843-R to operate with that sensor.

The 843-R's large size TFT 320x240 screen enhances measurement readouts in ways that smaller displays cannot.

The 843-R displays power measurements in both digital and analog form at the same time and also has a needle type display. It can be set to autorange, so you do not have to set scales; or to a manual range if you wish. It will remember what mode you were using before you turned it off and will return to that mode when turned on. You can zoom in on the present reading, or subtract background. The 843-R reads the calibration information that is stored in the sensor's smart connector and is ready to measure from the moment it's powered up. You can also zero the 843-R at the touch of a button.

The 843-R's user interface is self-explanatory; you should not have to refer to this manual very often. Above all, the 843-R has advanced circuitry and digital signal processing for excellent sensitivity, signal to noise ratio, accuracy, and response time. It also has special circuitry to reject electromagnetic interference.

The 843-R has all the infrastructure for field upgrading of the embedded software, should the need arise.

Figure 3.1 843-R displaying power measured with a Thermopile sensor. Displayed in analog needle mode with persistence on.

3.2 Smart Connectors

The 843-R meter is versatile and can operate with either thermal, pyroelectric or photodiode type laser measuring sensors. The sensor configuration and calibration information is stored in an EEROM in the sensor connector plug. This means that when the sensor is plugged in, the 843-R automatically identifies the sensor type, calibration and configuration. The user does not have to adjust anything.

Note:

With the 843-R, sensors are hot swappable. Even after the meter is switched on, you can remove one sensor and insert a different one. The 843-R will recognize the switch and reconfigure itself according to the settings of the new sensor.

When no sensor is plugged in, the 843-R meter gives the user the opportunity to hide or show settings, change the line frequency setting, and set the real time clock. It also shows the serial number of the instrument, last calibration date and firmware version. The user can also re-zero the instrument. See section 3.5.

3.3 Soft Keys

The soft keys have functions defined by the legend above the key. The legend usually indicates what will happen when pressing the key. For example, if "Mode" appears above a key, pressing that key will open a menu to allow user to select between Power and Energy measurement modes. Some functions operate when the key is pressed and are canceled when the key is pressed again. Those keys show reverse highlighting when operational. Pressing the same key again cancels the operation and the highlighting.

Key Functions

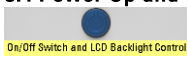
The 843-R has certain conventions as to the meaning of standard key strokes and these are as follows:

Highlighted item: The highlighted item is the item that is presently active.

OK: Returns to the previous screen with the selected setting for immediate use and saved for next startup.

Cancel: Cancels the selection and returns to the previous screen, leaving the settings unchanged.

3.4 Power Up and Shut Down



To turn the 843-R on:

Briefly press the On/Off Switch.

The unit will switch on, and the display will appear. If no sensor is connected, the Setup screen will appear. If a sensor is connected, the appropriate default measurement screen will appear.

To toggle the state of the backlight on and off:

The backlight for the 843-R's LCD can be configured to toggle between low, half, and full intensity (see Section 3.7.1 for full details). This toggling will be performed by briefly pressing the On/Off switch after the 843-R has been switched on.

To switch the 843-R off:

Press the On/Off switch and hold it for about 2 seconds until the display blanks.

The current measurement settings will be saved automatically for the next time the 843-R is powered up.

3.5 843-R Functions that are Independent of Sensor Type

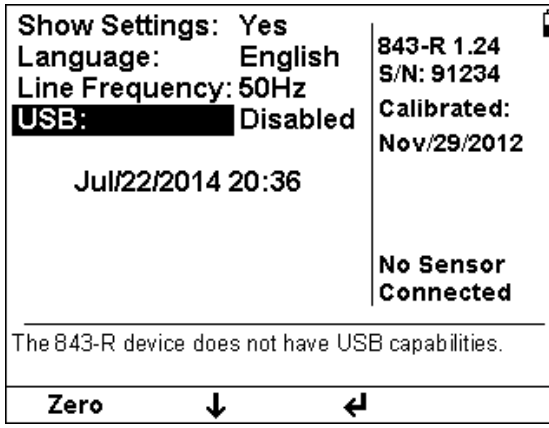


Figure 3.2: 843-R Setup Screen with no sensor connected.

When no sensor is connected, the 843-R setup screen will be displayed. This gives the user the opportunity to hide or show settings, change the line frequency setting, and set the real time clock. It also shows the firmware version, serial number of the instrument, and last calibration date. The user can also re-zero the instrument.

3.5.1. Show or Hide Settings

1. Press the Down arrow (↓) until Show Settings is highlighted and press the Enter arrow (↵).
2. Set to Yes to display sensor settings in the measurement screens. Set to No to hide the sensor settings and show a larger graph.
3. Press the **OK** key to keep the new setting.

3.5.2. Line Frequency

1. Setting Line Frequency correctly removes electrical noise that may be introduced to the measurements
2. Press the Down arrow (↓) until Line Frequency is highlighted and press the Enter arrow (↵).
3. Set to 50Hz or 60Hz, depending on the electrical power grid of the area that you are in.
4. Press the **OK** key to keep the new setting.

3.5.3. Language

1. The 843-R can be configured to one of several languages.
2. Press the Down arrow (↓) until Language is highlighted and press the Enter arrow (↵).
3. Set to English, Japanese, Russian, or Chinese.
4. Press the **OK** key to keep the new setting.

Warning:

In the event that you mistakenly selected a non-English language as the 843-R startup language, the way to switch back to English is as follows:

a. Disconnect the sensor from the 843-R.
b. The 843-R will automatically switch to the Setup screen.
c. Press the Down arrow (↓) once.
d. press the Enter arrow (↵). This will open a window to select the instrument language.
e. Press the Down arrow to select "English".
f. Press the **OK** soft key. The 843-R is now configured for English.

Note:

The present settings are automatically saved for the next time the 843-R Power Meter is turned on.

3.5.4. Analog Output

The 843-R Power Meter has an analog output with a full-scale output of 1 Volt.

For thermal and photodiode sensors in power mode, the analog output is continually updated 15 times per second with the latest power measurement. For thermal sensors in single shot energy mode, the analog output is held fixed until the next pulse triggers.

3.5.5. Clock Settings

The 843-R Power Meter is equipped with a real time clock which will show the date and time. This clock will also allow the 843-R Power Meter to query the sensor attached and notify you if the sensor is due for calibration.

To set Date and Time

1. Press the Down arrow (↓) until the Date and Time are highlighted and press the Enter arrow (↵).
2. Scroll through and select Month, Day, Year, Hour, and Minutes with the Right arrow (→). Change the selected item with the Down arrow (↓).
3. When finished, press the **OK** key to keep the new setting.

3.5.6. Zero Adjustments

In 843-R Power Meter, all adjustments, including zeroing internal circuits, are done from the software. This ensures simple and accurate realignment. It is recommended to re-zero the 843-R Power Meter every 2 months for best performance. The simple zeroing procedure follows.

To zero instrument:

1. If a sensor is connected, disconnect it.
2. Press the **Zero** key to enter the Zeroing screen

3. Make sure that the instrument is not in an electrically noisy environment and is undisturbed
4. Press the **Start** key and wait for message, "Zeroing completed successfully".
5. Press the **Save** key to save the new zero settings.
6. Press the **Exit** key to return to the Setup screen.

Note (for Thermal Sensors only)

For best results with thermal sensors, it may be necessary to do the procedure once with the sensor disconnected and a second time with it reconnected.

After completing steps 1 - 6 above, Connect the sensor and make sure it is at room temperature and well shielded from any stray thermal power. It may be best advised to lay the sensor with the absorber face down on the table.

7. Connect the thermopile sensor. Ensure that is at room temperature and well shielded from any stray thermal power. It may be best advised to lay the sensor with the absorber face down on the table. Press the **Zero** key to enter the Zeroing screen
8. Press the **Start** key and wait for message, "Zeroing completed successfully".
9. Press the **Save** key to save the new zero settings.
10. Press the **Exit** key to return to the Setup screen.

Note: For Pyroelectric Sensors

In addition to zeroing the meter as described above, it is important to zero the meter against the sensor you are using the first time. Please see section 2.5.1 on how to do this.

3.6 843-R Measurement Screens

3.6.1. Bargraph

The Bargraph is a ruler-like display in which the graph is filled proportionally to the reading's being a percentage

of full scale. The Bargraph display is available when measuring power or energy.

Press the **Zoom** key to zoom in on a smaller section of the range when readings are fluctuating slightly.

If you notice that noise has gotten into the measurement, you can press the **Offset** key to remove it from the measurement.

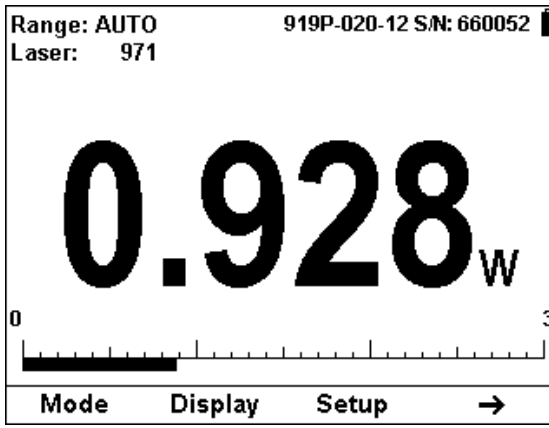


Figure 3.3 Bargraph with Thermopile Sensor.

3.6.2. Needle

A Needle graph simulates an analog display, similar to the style of an analog voltmeter or a car's speedometer. The Needle display is available when measuring power or energy.

Press the **Zoom** key to zoom in on a smaller section of the range when readings are fluctuating slightly.

If you notice that noise has gotten into the measurement, you can press the **Offset** key to remove it from the measurement.

Press the **Persist** key to continue to display previous readings as well as to show the minimum and maximum measurements.

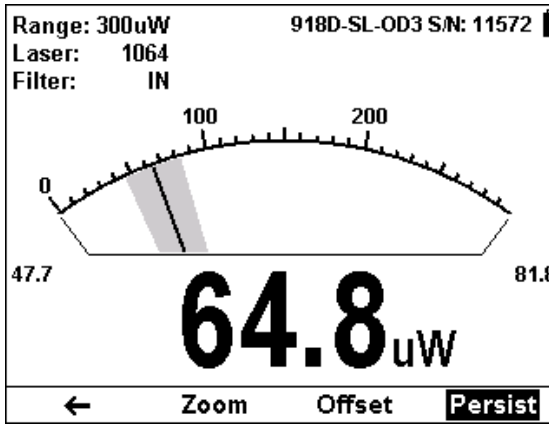


Figure 3.4 Analog Needle with Photodiode Sensor with Persistence Enabled

3.7 Hardware Functions

3.7.1. LCD Backlight

The LCD backlight is actually a set of LED's that illuminate the display from behind. Because the 843-R uses a TFT display, the backlight must be constantly on. It can be operated at full intensity for full illumination; or at low or half level to conserve power consumption. The backlight level is toggled by a short press on the On/Off switch.

The 843-R backlight consumes considerably less power than competing instruments and therefore it can operate from the battery even when the charger is not plugged in. Nevertheless, since it does shorten the time between charges, it is recommended to set the backlight to less than full intensity when the instrument is operated without the charger.

3.7.2. Charging

The 843-R can be operated either by the internal battery or from an AC source with the charger plugged in all the time. Plug the charger into the jack labeled "12VDC" on the back panel (see Figure 3.3). The battery will be

charged at the same rate whether the 843-R is switched on or off, and whatever the backlight level. The battery will fully recharge in around 4-5 hours.

Note: The charger circuit of the 843-R is designed to allow the charger to be plugged in for an extended period without causing damage to the battery.

The approximate time between charges is given in the following table for various configurations:

Sensor Type	Backlight Level	Time Between Charges
Thermopile and Photodiode	Low	19 hours
Thermopile and Photodiode	Half	17 hours
Thermopile and Photodiode	Full	15 hours
Pyroelectric	Low	16 hours
Pyroelectric	Half	15 hours
Pyroelectric	Full	13 hours

The battery charge is indicated by the  icon. The battery charge is shown approximately by each segment of the icon, e.g. if 2 segments are shown the battery is ½ full. When the battery is charging, the segments turn on in sequence. When the battery is low, the charger should be plugged in.

3.7.3. Analog Output

The instrument provides an analog voltage output via the 2.5mm mono jack socket on the rear panel marked "AN OUT" (see Figure 3.3). The 843-R is supplied with the mating adapter plug that connects to this socket. The analog output is useful for driving chart recorders and other analog devices. The voltage is proportional to the

reading on the display and scaled such that full scale equals 1.00V.

The analog output is driven through an impedance of 100 ohm. For best accuracy, 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.

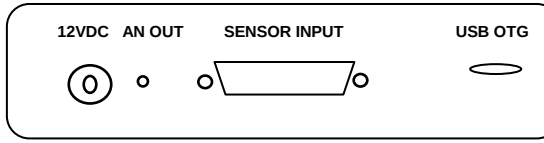


Figure 3.5: 843-R Rear Panel View

In power mode, the analog output is continually updated 15 times per second with the latest power measurement. For thermal sensors in single shot energy mode, the analog output is held fixed until the next pulse triggers.

3.7.4. Field Upgrade

The 843-R has all of the necessary infrastructure for field upgrading of the embedded software, should the need arise. This is done through the USB OTG port that is found on the rear panel of the instrument.

To Update the 843-R Firmware:

1. Download the latest 843-R firmware upgrade package from the Newport website: http://www.newport.com/ and copy to your target directory.
2. Run the upgrade executable and follow the on screen instructions

3.7.5. Sensor Disconnect / Connect Recognition

With the 843-R, sensors are hot swappable. Even after the meter is switched on, you can remove one sensor and insert a different one. The 843-R will recognize the switch and reconfigure itself according to the settings of the new sensor.

3.7.6. USB Communication

The 843-R-USB is capable of USB communication with the PC.

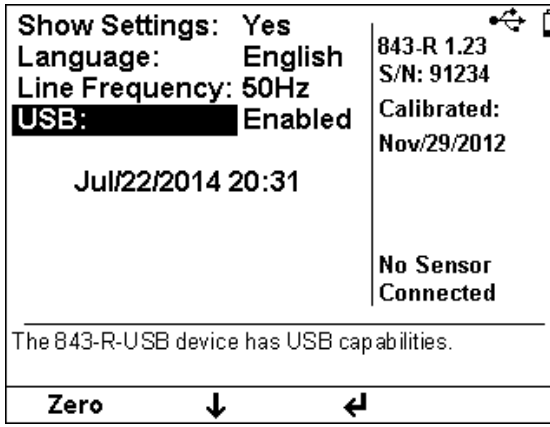


Figure 3.6: 843-R-USB Setup Screen with no sensor connected. Notice that USB is enabled and that the USB icon is in the upper right of the screen.

Chapter 4. Operation with Thermopile Absorber Sensors

Warning:

Before using the sensor for power or energy measurement, check that your laser power, energy and energy density do not exceed the sensor ratings. See Tables 5 and 6 in Chapter 8.

If the sensor is a water-cooled type, ensure that the cooling water is flowing at an adequate rate; see table below. Also, note that the reflectance from the absorber could be as much as 10% and with CO2 lasers, the reflected beam can be quite specular, so it is advisable to provide a beam stop for the reflected beam with the highest power lasers.

Sensor Type	Liters per Minute At Full Power	Min Pressure Bar	US Gallons per Minute
919P-5KW-50	4.5	0.8	1.2

Table 1 Minimum Flow Rates for Water-Cooled Sensors

4.1 Thermopile Absorber Sensors

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 meter's electronics amplifies this signal and indicates the power level received by the sensor. At the same time, signal processing software causes the meter to respond faster than the actual thermal rise time of the detector disc, thereby reducing the response time of the 843-R. Energy of a single pulse is measured on the 843-R by digitally integrating the pulse power over time.

4.1.1. Supported Models

The 843-R Power Meter is compatible with our new line of 919P Thermal Sensors. Older models of thermal sensors are not compatible.

4.2 Startup Configuration

On power up, the 843-R meter checks its own memory as well as the sensor's to decide on the measurement configuration. For example, if in the last session, the sensor was used to measure power in the Bargraph screen in autoranging with a YAG laser and averaging for 10 seconds, this will be the setup used the next time the system is powered up.

These settings can all be easily changed, as will be described fully in the following sections.

4.3 Power Measurement

Thermopile sensors measure power continuously at an update rate of 15 times per second. To best ensure measurement accuracy, center the laser beam carefully on the absorber surface.

Power measurements can be displayed in Bargraph or Needle graphical formats. Updating measurement parameters is performed in the easy-to-reach Setup screen.

4.3.1. Bargraph Display

4.3.1.1. Screen Layout

The Bargraph is a ruler-like display in which the graph is filled proportionally to the reading's being a percentage of full scale.

The Bargraph display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- Large numeric display shown prominently in the middle of the screen.
- Bargraph displayed close to the bottom.
- Softkey legends at the bottom of the screen.

4.3.1.2. Softkey Functionality

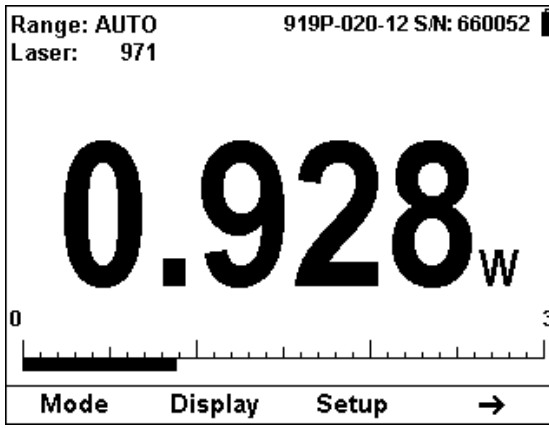


Figure 4.1 Bargraph display with first set of Softkeys

- **Mode:** Press this key to change the selected measurement mode.
  - Press the Up/Down arrow (↕) to set the measurement mode to Power or Energy.

- Press **OK** to return to the measurement screen with the new selection.
- Press **Cancel** to ignore any changes and continue in Power measurement mode.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.
  - Press OK to return to the measurement screen with the new selection.
  - Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Power measurement parameters. This will be described in Section 4.3.3 Power Setup Screen.

- **Right Arrow (→):** Press this for additional Bargraph screen functions.

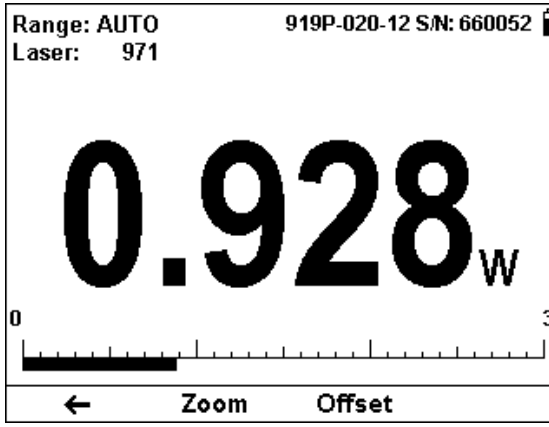


Figure 4.2 Bargraph display with second set of Softkeys

- **Left Arrow (←):** Press this for previous set of Bargraph functions.

- **Zoom:** Press this key to focus the Bargraph on the present reading. The Bargraph will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Bargraph is 20 watts, and your reading is 15 watts, pressing **Zoom** will make the Bargraph scale range between approximately 13 and 17 watts. Small fluctuations in power are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom** key again to return to the unexpanded Bargraph display.

- **Offset:** If the ambient environment has a thermal background, so that the 843-R shows a nonzero power reading even when there is no laser, you can subtract the background using the Offset function. For example, the 843-R display reads 0.1 Watts when the laser is blocked, and 20.5 Watts with laser power applied. In this case, the true power is 20.5 - 0.1 = 20.4 Watts. To subtract the background, press the **Offset** key while the laser is blocked. The 843-R will now read zero, and the 0.1 Watt background will be subtracted from all subsequent readings. The laser power reading displayed will thus be 20.4 Watts.

  When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

  If you suspect that the 843-R has a permanent zero offset, the instrument's internal zero should be reset. See Section 3.5.5.

4.3.2. Needle Display

4.3.2.1. Screen Layout

A Needle graph simulates an analog display, similar to the style of an analog voltmeter or a car's speedometer. By making use of the persistence feature, you can know what the full range of measurements actually is, including the maximum and minimum readings of the present set of measurements.

The Needle display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- Needle displayed prominently in the middle of the screen.
- Large numeric display.
- Softkey legends at the bottom of the screen.

4.3.2.2. Softkey Functionality

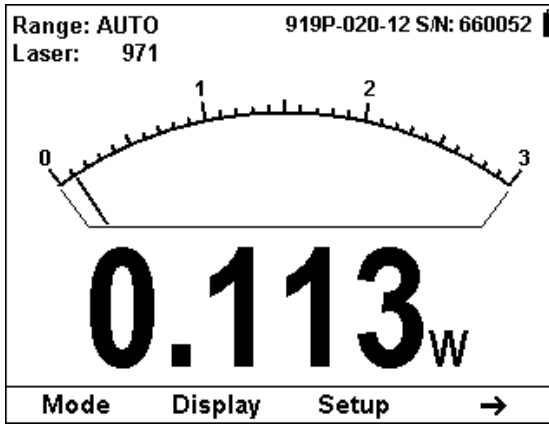


Figure 4.3 Needle display with first set of Softkeys

- **Mode:** Press this key to change the selected measurement mode.
  - Press the Up/Down arrow (↕) to set the measurement mode to Power or Energy.
  - Press **OK** to return to the measurement screen with the new selection.
  - Press **Cancel** to ignore any changes and continue in Power measurement mode.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.
  - Press OK to return to the measurement screen with the new selection.

- Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Power measurement parameters. This will be described in Section 4.3.3 Power Setup Screen.

- **Right Arrow (→):** Press this for additional Needle screen functions.

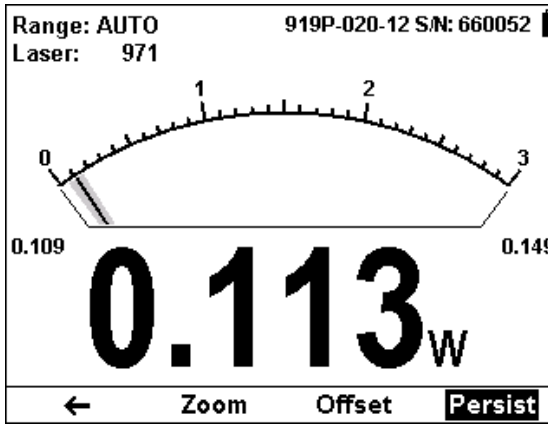


Figure 4.4 Needle display with second set of Softkeys and Persistence active

- **Left Arrow (←):** Press this for previous set of Needle functions.

- **Zoom:** Press this key to focus the Needle on the present reading. The Needle arc will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Needle is 20 watts, and your reading is 15 watts, pressing **Zoom** will make the Needle scale range between approximately 13 and 17 watts. Small fluctuations in power are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom** key again to return to the unexpanded Needle display.

- **Offset:** If the ambient environment has a thermal background, so that the 843-R shows a nonzero power reading even when there is no laser, you can subtract the background using the Offset function. For example, the 843-R display reads 0.1 Watts when the laser is blocked, and 20.5 Watts with laser power applied. In this case, the true power is 20.5 - 0.1 = 20.4 Watts. To subtract the background, press the **Offset** key while the laser is blocked. The 843-R will now read zero, and the 0.1 Watt background will be subtracted from all subsequent readings. The laser power reading displayed will thus be 20.4 Watts.

  When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

  If you suspect that the 843-R has a permanent zero offset, the instrument's internal zero should be reset. See Section 3.5.5.

4.3.3. Power Setup Screen

The 843-R Power Meter can be set to various chosen settings while operating. These configuration settings are automatically saved for the next time the meter is turned on with this sensor.

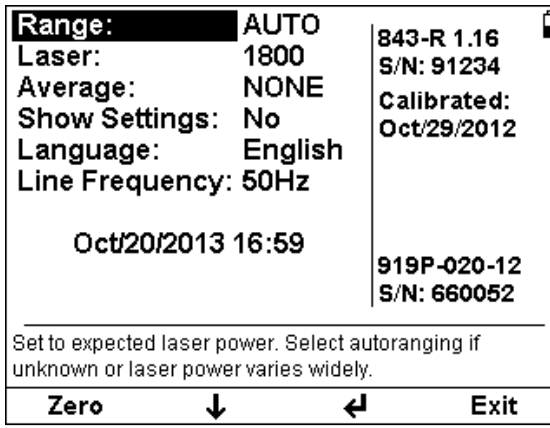


Figure 4.5 Setup Screen

4.3.3.1. Power Range

Autorange

In autorange mode, you do not have to change scales. When the reading of the meter is more than 100% of full scale of the present range, the 843-R will reconfigure itself to the next higher range. The ranges are arranged in factors of 1, 10, 100, etc. When the reading falls below 7% of full scale of the present range, the 843-R will reconfigure itself one range down. This change only occurs after a few seconds delay, thereby providing overlap (hysteresis) that limits the 843-R from flipping back and forth when reading close to the end of the scale.

Manual Range

There are certain disadvantages to autorange since it changes scale even if you don't want it to do so. If you want to measure in the same range all the time, it is better to use manual range.

The correct range to select is the lowest one that is larger than the largest expected measurement.

To Set the Power Range

1. Press the Down arrow (↓) until Range is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the available ranges until you reach the one that is correct for your measurement needs.
3. Press the **OK** key to keep the new setting.

4.3.3.2. Laser

Most Thermopile sensors have somewhat different absorption at different wavelengths. In order to compensate for this, each sensor has been calibrated by laser at several wavelengths. When you choose the correct laser wavelength, the correction factor for that wavelength is automatically introduced. Note that the laser wavelength correction in use is displayed in the upper left corner of the display.

To set type of laser being used:

1. Press the Down arrow (↓) until Laser is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the available lasers until you reach the appropriate laser wavelength.
3. Press the **OK** key.

4.3.3.3. Average

How Averaging Works

When a laser output is fluctuating or unstable, it is useful to measure the average power over a certain period. The 843-R gives you this exclusive feature, allowing averaging over periods varying from 1 second to 1 hour.

As soon as the main power measurement screen (See Figure 4.2) is entered and the instrument is set to average mode, the instrument displays the average of readings over the period since the screen was entered up to the present. When the time period of the average is reached, the average becomes a running average over the average period backward in time. For instance, if the average period is 1 minute, at 30 seconds, the average is over 30 seconds, at 1 minute it is over 1 minute, at 5 minutes, it is over the period from 4 to 5 minutes (1 minute back from the present).

To Set the Average Period:

1. Press the Down arrow (↓) until Average is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the list of average periods until you reach the one that is correct for your measurement needs. Set the average period to NONE to disable averaging.
3. Press the **OK** key to keep the new setting.

4.3.3.4. Other Settings

Show or Hide Settings

1. Press the Down arrow (↓) until Show Settings is highlighted and press the Enter arrow (↵).
2. Set to Yes to display sensor settings in the measurement screens. Set to No to hide the sensor settings and show a larger graph.
3. Press the **OK** key to keep the new setting.

Language

1. The 843-R can be configured to one of several languages.
2. Press the Down arrow (↓) until Language is highlighted and press the Enter arrow (↵).
3. Set to English, Japanese, Russian, or Chinese.
4. Press the **OK** key to keep the new setting.

Line Frequency

The 843-R has built-in circuitry to screen out electrical noise from the local power grid that can introduce errors to the measurements.

Set Line Frequency to your power grid's frequency to screen out the noise correctly.

1. Press the Down arrow (↓) until Line Frequency is highlighted and press the Enter arrow (↵).
2. Set to 50Hz or 60Hz, depending on the electrical power grid of the area that you are in.
3. Press the **OK** key to keep the new setting.

Clock Settings

The 843-R is equipped with a real time clock which will show the date and time. This clock will also allow the 843-R to query the sensor attached and notify you if the sensor is due for calibration.

To set Date and Time

1. Press the Down arrow (↓) until the Date and Time are highlighted and press the Enter arrow (↵).
2. Scroll through and select Month, Day, Year, Hour, and Minutes with the Right arrow (→). Change the selected item with the Down arrow (↓).
3. When finished, press the **OK** key to keep the new setting.

4.3.3.5. Additional On Screen Information

On the right hand side of the Setup screen the following information is provided to the user

- Instrument
  - Firmware Version
  - Serial Number
  - Date of Last Calibration
- Sensor
  - Name
  - Serial Number
  - Date of Last Calibration (if supported by the sensor

4.4 Energy Measurement

4.4.1. Measuring Energy with Thermopile Sensors

Although thermopile sensors are used primarily to measure power, they can measure single shot energy as well, where they integrate the power flowing through the disc over time and thus measure energy. Since the typical time it takes for the disc to heat up and cool down is several seconds, these thermal sensors can only measure one pulse every several seconds at most. Thus they are suitable for what is called "single shot" measurement. Although the response time of the sensor discs is slow, there is no limit to how short the pulses measured are since the measurement is of the heat flowing through the disc after the pulse.

4.4.1.1. Standard Case of Energy Measurement

To measure energy of a single pulse, first set up the Energy Range, Laser, and Threshold as described in **Section 4.4.4 Energy Setup Screen**.

1. Wait until READY is flashed on the screen. This indicates that the sensor is ready for a new measurement
2. Fire the laser. The display will go blank while the energy is being integrated.
3. After about 2 - 4 seconds (depending on the sensor), the correct energy will be displayed.
4. Return to Step 1 for the next measurement. Note: If you fire another pulse before "READY" appears, the reading may be inaccurate or may not be displayed.

4.4.1.2. Measuring Pulses of Very Low Energy

When it is necessary to measure pulses of very low energy, i.e., less than 0.5% of the maximum range of the instrument, the following two alternative methods allow greater accuracy to be obtained.

1. A continuous train of pulses may be fired, and the average power measured using "Power" mode. The energy per pulse can be calculated by:

   Average Energy per pulse = Average power / Pulse Repetition Rate

2. A train of a known number of pulses may be fired, and the total energy measured in "Energy" mode. This train should not exceed 5 seconds duration. The energy per pulse can be calculated by:

Average Energy per pulse = Total Energy / Number of Pulses

In both of the above methods, the pulse repetition rate must exceed 3Hz. Higher rates will generally give improved accuracy, but care should be taken not to exceed maximum power ratings.

4.4.1.3. Measuring Energy of Rapidly Repeating Pulses

With a typical thermopile sensor, the 843-R will only measure individual pulses every 5 seconds or so. You can also calculate the average energy of rapidly repeating pulses by measuring average power on the power setting and using the formula:

Average Energy per Pulse = Average Power / Pulse Repetition Rate

4.4.2. Bargraph Screen

4.4.2.1. Screen Layout

The Bargraph is a ruler-like display in which the graph is filled proportionally to the reading's being a percentage of full scale.

The Bargraph display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- READY will be flashed on the screen to indicate that the 843-R is ready to measure the next laser pulse to be fired.
- Large numeric display shown prominently in the middle of the screen.
- Bargraph displayed close to the bottom.
- Softkey legends at the bottom of the screen.

4.4.2.2. Softkey Functionality

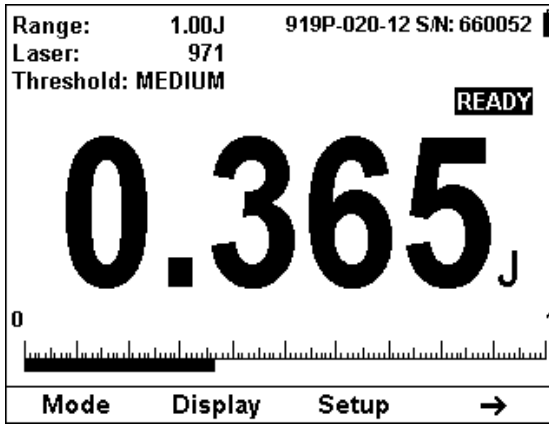


Figure 4.6 Bargraph display with first set of Softkeys

- **Mode:** Press this key to change the selected measurement mode.
  - Press the Up/Down arrow (↕) to set the measurement mode to power or energy.
  - Press **OK** to return to the measurement screen with the new selection.
  - Press **Cancel** to ignore any changes and continue in Power measurement mode.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.

- Press OK to return to the measurement screen with the new selection.
- Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Energy measurement parameters. This will be described in Section 4.4.4 Energy Setup Screen.

- **Right Arrow (→):** Press this for additional Bargraph screen functions.

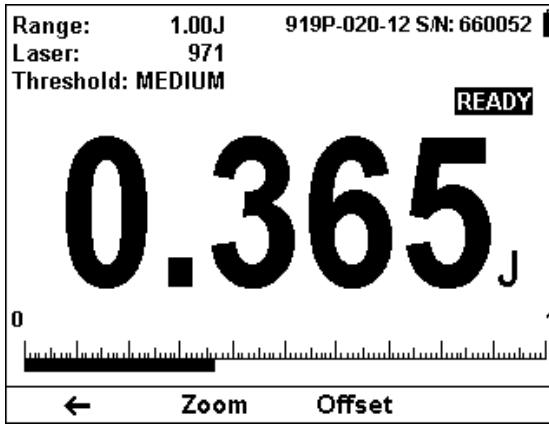


Figure 4.7 Bargraph display with second set of Softkeys

- **Left Arrow (←):** Press this for previous set of Bargraph functions.

- **Zoom:** Press this key to focus the Bargraph on the present reading. The Bargraph will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Bargraph is 30 Joules, and your reading is 15 Joules, pressing **Zoom** will make the Bargraph scale range between approximately 12 and 18 Joules. Small fluctuations in energy are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom**

key again to return to the unexpanded Bargraph display.

- **Offset:** Unlike power, offset subtraction is not necessary to achieve accurate energy measurements. However it can be used to facilitate comparison between readings. For example, the first laser pulse is 1 Joule. To subtract this from future readings, press the **Offset** key. If the next pulse is actually 3 Joules, 2 Joules will be displayed on the screen, thereby indicating the difference between the two laser pulses.

  When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

4.4.3. Needle Screen

4.4.3.1. Screen Layout

A Needle graph simulates an analog display, similar to the style of an analog voltmeter or a car's speedometer. By making use of the persistence feature, you can know what the full range of measurements actually is, including the maximum and minimum readings of the present set of measurements.

The Needle display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- READY will be flashed on the screen to indicate that the 843-R is ready to measure the next laser pulse to be fired.
- Needle displayed prominently in the middle of the screen.
- Large numeric display.
  Softkey legends at the bottom of the screen

4.4.3.2. Softkey Functionality

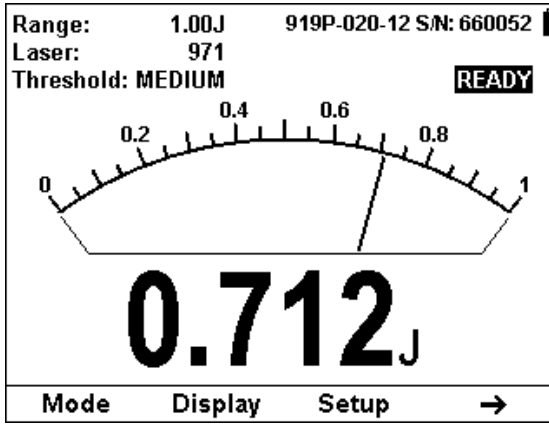


Figure 4.8 Needle display with first set of Softkeys

- **Mode:** Press this key to change the selected measurement mode.
  - Press the Up/Down arrow (↕) to set the measurement mode to power or energy.
  - Press **OK** to return to the measurement screen with the new selection.
  - Press **Cancel** to ignore any changes and continue in Power measurement mode.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.
  - Press OK to return to the measurement screen with the new selection.
  - Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Energy measurement parameters. This will be described in Section 4.4.4 Energy Setup Screen.

- **Right Arrow (→):** Press this for additional Needle screen functions.

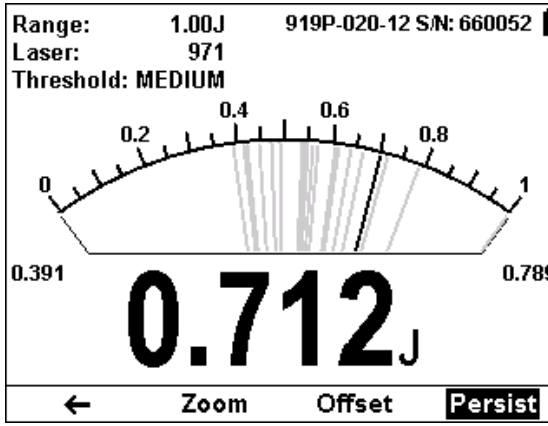


Figure 4.9 Needle display with second set of Softkeys and Persistence active

- **Left Arrow (←):** Press this for previous set of Needle functions.

- **Zoom:** Press this key to focus the Needle on the present reading. The Needle arc will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Needle is 30 Joules, and your reading is 15 Joules, pressing **Zoom** will make the Needle scale range between approximately 12 and 18 Joules. Small fluctuations in energy are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom** key again to return to the unexpanded Needle display.

- **Offset:** Unlike power, offset subtraction is not necessary to achieve accurate energy measurements. However it can be used to facilitate comparison between readings. For example, the first laser pulse is 1 Joule. To subtract this from future readings, press the **Offset** key. If the next pulse is actually 3 Joules, 2 Joules will be displayed on the screen, thereby indicating the difference between the two laser pulses.

When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

4.4.4. Energy Setup Screen

The 843-R Power Meter can be set to various chosen settings while operating. These configuration settings are automatically saved for the next time the meter is turned on with this sensor.

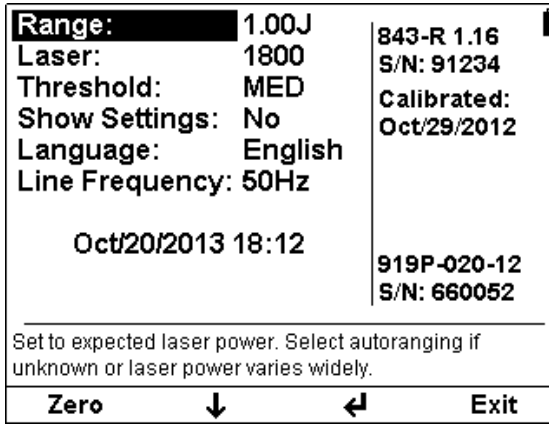


Figure 4.10 Setup Screen

4.4.4.1. Energy Range

Energy measurment is always made in a set manual range. The correct range to select is the lowest one that is larger than the largest expected measurement.

To Set the Energy Range

1. Press the Down arrow (↓) until Range is highlighted and press the Enter arrow (↵).

2. Using the Down arrow (↓), scroll through the available ranges until you reach the one that is correct for your measurement needs.
3. Press the **OK** key to keep the new setting.

4.4.4.2. Laser

Most Thermopile sensors have somewhat different absorption at different wavelengths. In order to compensate for this, each sensor has been calibrated by laser at several wavelengths. When you choose the correct laser wavelength, the correction factor for that wavelength is automatically introduced. Note that the laser wavelength correction in use is displayed in the upper left corner of the display.

To set type of laser being used:

1. Press the Down arrow (↓) until Laser is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the available lasers until you reach the appropriate laser wavelength.
3. Press the **OK** key.

4.4.4.3. Minimum Energy Threshold

If the 843-R is used in a noisy environment or where there is a high level of background thermal radiation, the instrument may trigger spuriously on the noise or background radiation. It would then fail to measure the intended pulse. Since there is always some degree of noise or background radiation, the instrument is designed not to respond to pulses below some preset minimum size. This "Minimum Energy Threshold" is typically set to 0.3% of full scale of the selected range. If this level is found to be too sensitive for the user's particular environment, it may be altered by the user. The threshold should not, however, be raised higher than necessary.

This will cause a degradation in the accuracy of energy measurements of pulses below about 4 times the threshold level. The factory setting of energy threshold is "Medium". If the unit triggers on noise, set the threshold to "High". If you are measuring small energies and the unit does not trigger, set the threshold to "Low".

To Set the Minimum Threshold Level:

1. Press the Down arrow (↓) until Threshold is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the list of threshold levels until you reach the one that is correct for your measurement needs.
3. Press the **OK** key to keep the new setting.

4.4.4.4. Other Settings

Show or Hide Settings

1. Press the Down arrow (↓) until Show Settings is highlighted and press the Enter arrow (↵).
2. Set to Yes to display sensor settings in the measurement screens. Set to No to hide the sensor settings and show a larger graph.
3. Press the **OK** key to keep the new setting.

Language

1. The 843-R can be configured to one of several languages.
2. Press the Down arrow (↓) until Language is highlighted and press the Enter arrow (↵).
3. Set to English, Japanese, Russian, or Chinese.
4. Press the **OK** key to keep the new setting.

Line Frequency

The 843-R has built-in circuitry to screen out electrical noise from the local power grid that can introduce errors to the measurements.

Set Line Frequency to your power grid's frequency to screen out the noise correctly.

1. Press the Down arrow (↓) until Line Frequency is highlighted and press the Enter arrow (↵).
2. Set to 50Hz or 60Hz, depending on the electrical power grid of the area that you are in.
3. Press the **OK** key to keep the new setting.

Clock Settings

The 843-R is equipped with a real time clock which will show the date and time. This clock will also allow the 843-R to query the sensor attached and notify you if the sensor is due for calibration.

To set Date and Time

1. Press the Down arrow (↓) until the Date and Time are highlighted and press the Enter arrow (↵).
2. Scroll through and select Month, Day, Year, Hour, and Minutes with the Right arrow (→). Change the selected item with the Down arrow (↓).
3. When finished, press the **OK** key to keep the new setting.

4.4.4.5. Additional On Screen Information

On the right hand side of the Setup screen the following information is provided to the user

- Instrument
  - Firmware Version
  - Serial Number
  - Date of Last Calibration
- Sensor
  - Name
  - Serial Number
  - Date of Last Calibration (if supported by the sensor

Chapter 5. Operation with Photodiode Sensors

Warning:

Before using the sensor for power measurement, check that your laser power or energy and energy density does not exceed the sensor ratings. See Table 5 and Table 6 in Chapter 8.

5.1 Photodiode Sensors

When a photon source, such as laser, is directed at one of the 918D or 818DB series photodiode detectors, a current is created proportional to the light intensity and dependent on the wavelength.

The 843-R Power Meter amplifies this signal and indicates the power level received by the sensor. Due to the superior circuitry of the 843-R, the noise level is very low, and the 918D / 818 series sensors with the 843-R meter have a large dynamic range, from nanowatts to 2 watts.

Newport's 818 and 918D series photodiode sensors come with an attenuation filter, while the 818-xx-L-FC/DB series low cost fiber optic detectors do not. Some of the 819C/D series integrating sphere detectors utilize the 918D series detector, which has an integrated filter. Please refer to their user manuals and web sites for the specifications. A general guideline is to use the filter when the power level of the source is more than a few mW, to avoid sensor saturation. When saturated, the legend "OVER" will appear on the screen.

5.2 Startup Configuration

On power up, the 843-R Meter checks its own memory as well as the sensor's to decide on the measurement configuration. For example, if in the last session, the sensor was used to measure power in the Bargraph screen in autoranging with a 1064 laser and averaging for

10 seconds, this will be the setup used the next time the system is powered up.

These settings can all be easily changed, as will be described fully in the following sections.

5.3 Power Measurement

Photodiode sensors measure power continuously at an update rate of 15 times per second. To best ensure measurement accuracy, center the laser beam carefully on the absorber surface.

Power measurements can be displayed in Bargraph or Needle graphical formats. Updating measurement parameters is performed in the easy-to-reach Setup screen.

5.3.1. Bargraph Display

5.3.1.1. Screen Layout

The Bargraph is a ruler-like display in which the graph is filled proportionally to the reading's being a percentage of full scale.

The Bargraph display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- Large numeric display shown prominently in the middle of the screen.
- Bargraph displayed close to the bottom.
- Softkey legends at the bottom of the screen.

5.3.1.2. Softkey Functionality

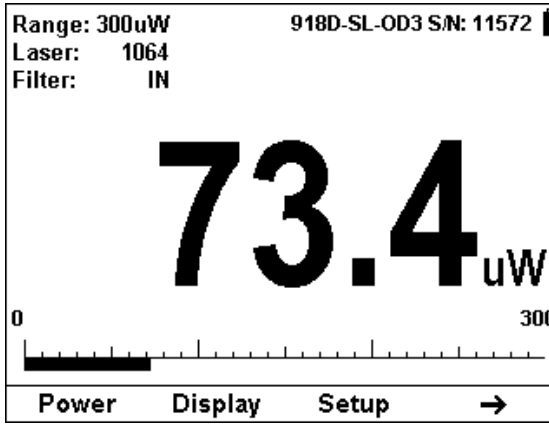


Figure 5.1 Bargraph display with first set of Softkeys

- **Power:** With Photodiode sensors, the only measurement mode available is Power. Pressing this key will affect no change.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.
  - Press OK to return to the measurement screen with the new selection.
  - Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Power measurement parameters. This will be described in Section 5.3.3 Power Setup Screen.

- **Right Arrow (→):** Press this for additional Bargraph screen functions.

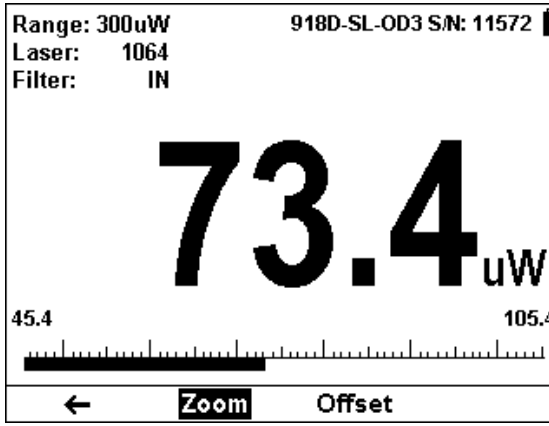


Figure 5.2 Bargraph display with second set of Softkeys and Zoom active

- **Left Arrow** (←)**:** Press this for previous set of Bargraph functions.

- **Zoom:** Press this key to focus the Bargraph on the present reading. The Bargraph will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Bargraph is 20 mW, and your reading is 15 mW, pressing **Zoom** will make the Bargraph scale range between approximately 13 and 17 mW. Small fluctuations in power are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom** key again to return to the unexpanded Bargraph display.

- **Offset:** If the ambient environment has a thermal background, so that the 843-R shows a nonzero power reading even when there is no laser, you can subtract the background using the Offset function. For example, the 843-R display reads 0.1 mW when the laser is blocked, and 20.5 mW with laser power applied. In this case, the true power is 20.5 - 0.1 = 20.4 mW. To subtract the background, press the **Offset** key while the laser is blocked. The 843-R will now read zero, and the 0.1 mW background will be subtracted from all subsequent readings. The laser power reading displayed will thus be 20.4 mW.

When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

If you suspect that the 843-R has a permanent zero offset, the instrument's internal zero should be reset. See Section 3.5.5.

5.3.2. Needle Display

5.3.2.1. Screen Layout

A Needle graph simulates an analog display, similar to the style of an analog voltmeter or a car's speedometer. By making use of the persistence feature, you can know what the full range of measurements actually is, including the maximum and minimum readings of the present set of measurements.

The Needle display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- Needle displayed prominently in the middle of the screen.
- Large numeric display.
- Softkey legends at the bottom of the screen.

5.3.2.2. Softkey Functionality

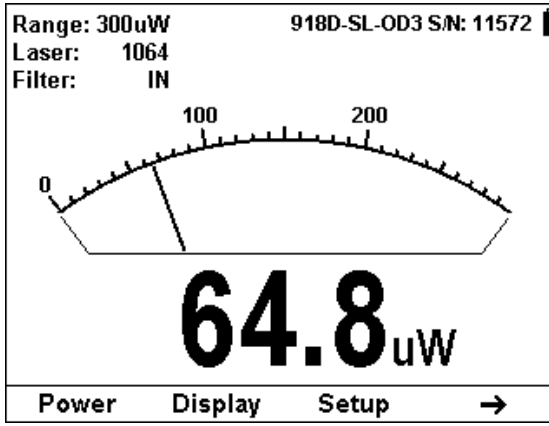


Figure 5.3 Needle display with first set of Softkeys

- **Power:** With Photodiode sensors, the only measurement mode available is Power. Pressing this key will affect no change.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.
  - Press OK to return to the measurement screen with the new selection.
  - Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Power measurement parameters. This will be described in Section 5.3.3 Power Setup Screen.

- **Right Arrow (→):** Press this for additional Needle screen functions.

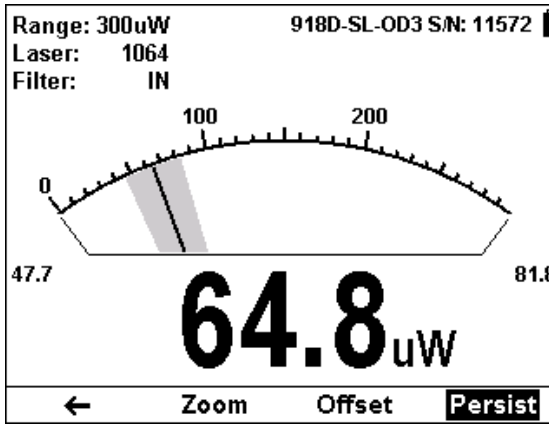


Figure 5.4 Needle display with second set of Softkeys and Persistence active

- **Left Arrow (←):** Press this for previous set of Needle functions.

- **Zoom:** Press this key to focus the Bargraph on the present reading. The Bargraph will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Bargraph is 20 mW, and your reading is 15 mW, pressing **Zoom** will make the Bargraph scale range between approximately 13 and 17 mW. Small fluctuations in power are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom** key again to return to the unexpanded Bargraph display.

- **Offset:** If the ambient environment has a thermal background, so that the 843-R shows a nonzero power reading even when there is no laser, you can subtract the background using the Offset function. For example, the 843-R display reads 0.1 mW when the laser is blocked, and 20.5 mW with laser power applied. In this case, the true power is 20.5 - 0.1 = 20.4 mW. To subtract the background, press the **Offset** key while the laser is blocked. The 843-R will now read zero, and the 0.1 mW background will be

subtracted from all subsequent readings. The laser power reading displayed will thus be 20.4 mW.

When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

If you suspect that the 843-R has a permanent zero offset, the instrument's internal zero should be reset. See Section 3.5.5.

5.3.3. Power Setup Screen

The 843-R Power Meter can be set to various chosen settings while operating. These configuration settings are automatically saved for the next time the meter is turned on with this sensor.

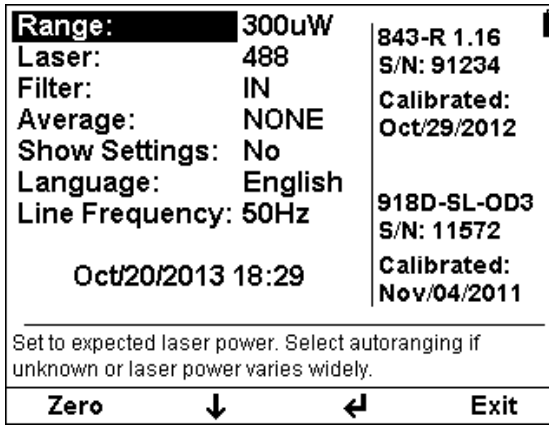


Figure 5.5 Setup Screen

5.3.3.1. Power Range

Autorange

In autorange mode, you do not have to change scales. When the reading of the meter is more than 100% of full

scale of the present range, the 843-R will reconfigure itself to the next higher range. The ranges are arranged in factors of 1, 10, 100, etc. When the reading falls below 7% of full scale of the present range, the 843-R will reconfigure itself one range down. This change only occurs after a few seconds delay, thereby providing overlap (hysteresis) that limits the 843-R from flipping back and forth when reading close to the end of the scale.

Manual Range

There are certain disadvantages to autorange since it changes scale even if you don't want it to do so. If you want to measure in the same range all the time, it is better to use manual range.

The correct range to select is the lowest one that is larger than the largest expected measurement.

Logarithmic Scale

The 843-R allows the measurement to be made in units of dBm that is a logarithmic scale. This is useful if you expect the readings to vary over several ranges and want to everything in one scale.

The formula for dBm units is defined as 10 x Log (reading in mW). Therefore, at 1mW the reading will be 0 dBm, at 10mW it will be 10 dBm, at 100mW it will be 20 dBm etc.

To Set the Power Range

1. Press the Down arrow (↓) until Range is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the available ranges until you reach the one that is correct for your measurement needs.
3. Press the **OK** key to keep the new setting.

5.3.3.2. Laser

Photodiode sensors have a different sensitivity at different wavelengths. Moreover, the filters used in the sensor have a different transmission at different wavelengths. In order to compensate, each sensor has a built in calibration curve (with 1nm resolution) over the entire measurement range.

When you choose the correct laser wavelength, the correction factor for that wavelength is automatically introduced.

To set type of laser being used:

1. Press the Down arrow (↓) until Laser is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the available lasers until you reach the appropriate laser wavelength.
3. If your wavelength is listed, use the Down arrow (↓) to scroll through the wavelengths until reached and press the **OK** key.
4. If the wavelength you want is not among the wavelengths in the six wavelengths listed press the **Modify** key.
5. Use the Right (→) and Down (↓) arrows to adjust the wavelength as desired. Then press the OK key.

5.3.3.3. Filter

When the sensor is equipped with an attenuator filter, as is the case for the 818 or 918D series, the calibration module contains two sets of calibration data, with and without the filter on. When the Filter function is turned on, the calibration data with the filter in is used.

Warning:

If a Newport photodiode sensor is used in the "Filter IN" setting and the filter is not installed or vice versa the readings will be completely incorrect.

If the power of your laser exceeds the maximum for filter in, you can purchase a thermal or integrating sphere sensor for that wavelength. Consult your Newport agent for details.

To choose the filter setting:

1. Press the Down arrow (↓) until Filter is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), toggle between OUT and IN to reach the appropriate Filter setting.
3. If you choose wish to work with filter IN, be sure to place the removable filter on the detector sensor.
4. If you choose wish to work with filter OUT, be sure to remove the removable filter from the detector sensor.
5. Press the **OK** key to keep the new setting.

5.3.3.4. Average

How Averaging Works

When a laser output is fluctuating or unstable, it is useful to measure the average power over a certain period. The 843-R gives you this exclusive feature, allowing averaging over periods varying from 1 second to 1 hour.

As soon as the main power measurement screen (See Figure 5.1) is entered and the instrument is set to average mode, the instrument displays the average of readings over the period since the screen was entered up to the present. When the time period of the average is reached, the average becomes a running average over the average period backward in time. For instance, if the average period is 1 minute, at 30 seconds, the average is over 30 seconds, at 1 minute it is over 1 minute, at 5 minutes, it is over the period from 4 to 5 minutes (1 minute back from the present).

To Set the Average Period:

1. Press the Down arrow (↓) until Average is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the list of average periods until you reach the one that is correct for your measurement needs. Set the average period to NONE to disable averaging.
3. Press the **OK** key to keep the new setting.

5.3.3.5. Other Settings

Show or Hide Settings

1. Press the Down arrow (↓) until Show Settings is highlighted and press the Enter arrow (↵).
2. Set to Yes to display sensor settings in the measurement screens. Set to No to hide the sensor settings and show a larger graph.
3. Press the **OK** key to keep the new setting.

Language

1. The 843-R can be configured to one of several languages.
2. Press the Down arrow (↓) until Language is highlighted and press the Enter arrow (↵).
3. Set to English, Japanese, Russian, or Chinese.
4. Press the **OK** key to keep the new setting.

Line Frequency

The 843-R has built-in circuitry to screen out electrical noise from the local power grid that can introduce errors to the measurements.

Set Line Frequency to your power grid's frequency to screen out the noise correctly.

1. Press the Down arrow (↓) until Line Frequency is highlighted and press the Enter arrow (↵).
2. Set to 50Hz or 60Hz, depending on the electrical power grid of the area that you are in.
3. Press the **OK** key to keep the new setting.

Clock Settings

The 843-R is equipped with a real time clock which will show the date and time. This clock will also allow the 843-R to query the sensor attached and notify you if the sensor is due for calibration.

To set Date and Time

1. Press the Down arrow (↓) until the Date and Time are highlighted and press the Enter arrow (↵).
2. Scroll through and select Month, Day, Year, Hour, and Minutes with the Right arrow (→). Change the selected item with the Down arrow (↓).
3. When finished, press the **OK** key to keep the new setting.

5.3.3.6. Additional On Screen Information

On the right hand side of the Setup screen the following information is provided to the user

- Instrument
  - Firmware Version
  - Serial Number
  - Date of Last Calibration
- Sensor
  - Name
  - Serial Number
  - Date of Last Calibration (if supported by the sensor

5.4 Special Cases of Power Measurement

5.4.1. Measuring dB loss using the dB Offset function

Since dBm is a logarithmic measurement, the ratio between two measurements will be the difference between the dBm measurements. For instance, if you want to measure the loss in a fiber optic cable where the measurement before the cable is 1mW = 0dBm and the measurement after the cable is 0.1mW = -10dBm. The ratio is then 1:10 = 0.1 and the dB loss is 0 – (-10) = 10dB.

The dB offset function allows you to easily measure this. To do so do as follows:

1. When measuring the reference value press "dB Offset". The value changes to 0 dB (note that now the units are dB, a relative value instead of dBm, an absolute value).
2. Now make your second measurement and the value of the difference in dB = ratio in numerical units will be shown.

Note:

If there is a zero offset in the reference value, you cannot subtract this using the dB offset function. Instead, before the start of the measurement, press "Offset" and subtract the zero offset. Then follow

steps 1 and 2 above. The zero offset subtracted when "Offset" was pressed will be saved in the dBm scale and you can now use the dB Offset setting to measure true ratio without zero offset problems.

5.4.2. Measuring Very Low Powers

When measuring very low powers, such as picowatt measurements using Newport's photodiode sensor, there will be a rather large zero offset coming from the detector as well as a considerable noise fluctuation. Nevertheless, you can measure these low values by using the average function and pressing offset to eliminate the detector zero offset. In order to measure very low powers do as follows:

1. In the Setup screen, set the appropriate Average period. Return to the measurement screen.
2. Now block the power source you wish to measure, wait for a few measurement periods and press "Offset" to subtract the zero offset.
3. Now unblock the power source and measure.

Chapter 6. Operation with Pyroelectric Sensors

Warning:

Before using the sensor for power or energy measurement, check that your laser power, energy and energy density do not exceed the sensor ratings as listed in the table with the sensor specifications. Otherwise, there is a risk of damaging the absorber.

With the pyroelectric sensor, you have been supplied a test slide with the same coating as on your pyroelectric detector. You can also obtain this slide from your dealer. You should use this slide to test the damage threshold with your laser pulses. If the slide shows damage, then either enlarge your beam or lower the laser energy until damage is no longer seen.

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. The 919E sensor has been supplied with an insulating mounting post for this purpose.

6.1. Pyroelectric & Photodiode Energy Sensors

6.1.1. Supported Models

843-R supports the 919E series of sensors. Older models of Pyroelectric Energy Sensors are not supported.

6.1.2. Pyroelectric sensors – method of operation

When a pulsed heat source, such as a laser, is directed at the detector sensor, a temperature gradient is created across the pyroelectric crystal mounted in the sensor. An electric charge is produced 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. They can measure low energies as well as high. They can also measure at higher repetition rates than was possible before.

The 843-R meter amplifies this signal 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, 843-R is also able to display average power.

6.1.3. Photodiode Energy Sensors – method of operation

The 919E-20U-10-20K operates in a similar fashion to the Pyroelectric-based sensors except it has a Photodiode detector instead of Pyroelectric. Because of its great sensitivity, it can operate down to about 1nJ of energy. It has complete wavelength correction over its entire measurement range of 200 - 1100nm.

6.2. Startup Configuration

On power up, the 843-R meter checks its own memory as well as the sensor's to decide on the measurement configuration. For example, if in the last session, the sensor was used to measure energy in the Bargraph screen in the 200uJ range with a 1064 laser with no averaging, this will be the setup used the next time the system is powered up.

These settings can all be easily changed, as will be described fully in the following sections.

6.3. Measuring Energy with Pyroelectric Sensors

The Pyroelectric sensor is capable of measuring pulses up to very high repetition rates on the order of kilohertz or higher. The 843-R meter will sample pulses at up to 25,000 pulses depending on the sensor. However, the display can only display at rates up to 10Hz.

Energy measurements can be displayed in Bargraph or Needle graphical formats. Updating measurement parameters is performed in the easy-to-reach Setup screen.

6.3.1. Bargraph Screen

6.3.1.1. Screen Layout

The Bargraph is a ruler-like display in which the graph is filled proportionally to the reading's being a percentage of full scale.

The Bargraph display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- Large numeric display shown prominently in the middle of the screen.
- Frequency displayed above the energy reading, on the right side of the screen.
- Bargraph displayed close to the bottom.
- Softkey legends at the bottom of the screen.

6.3.1.2. Softkey Functionality

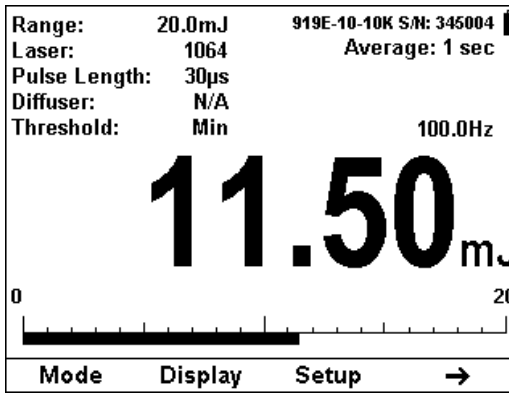


Figure 6.1 Bargraph display with first set of Softkeys

- **Mode:** Press this key to change the selected measurement mode.
  - Press the Up/Down arrow (↕) to set the measurement mode to Energy or Power.
  - Press **OK** to return to the measurement screen with the new selection.
  - Press **Cancel** to ignore any changes and continue in Power measurement mode.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.
  - Press OK to return to the measurement screen with the new selection.
  - Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Energy measurement parameters. This will be described in Section 6.3.3 Energy Setup Screen.

- **Right Arrow (→):** Press this for additional Bargraph screen functions.

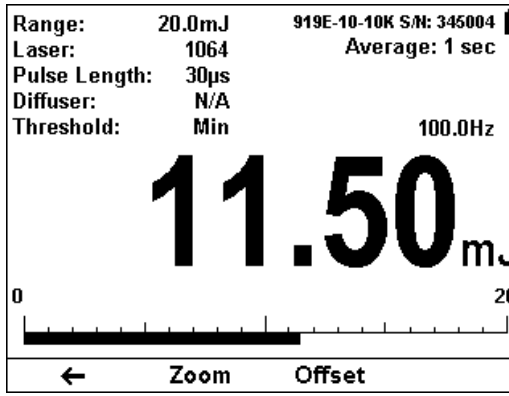


Figure 6.2 Bargraph display with second set of Softkeys

- **Left Arrow (←):** Press this for previous set of Bargraph functions.

- **Zoom:** Press this key to focus the Bargraph on the present reading. The Bargraph will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Bargraph is 20 Joules, and your reading is 15 Joules, pressing **Zoom** will make the Bargraph scale range between approximately 13 and 17 Joules. Small fluctuations in energy are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom** key again to return to the unexpanded Bargraph display.

- **Offset:** Offset can be used to facilitate comparison between readings. For example, the first laser pulse is 1 Joule. To subtract this from future readings, press the **Offset** key. If the next pulse is actually 3 Joules, 2 Joules will be displayed on the screen, thereby indicating the difference between the two laser pulses.

  When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

6.3.2. Needle Screen

6.3.2.1. Screen Layout

A Needle graph simulates an analog display, similar to the style of an analog voltmeter or a car's speedometer. By making use of the persistence feature, you can know what the full range of measurements actually is, including the maximum and minimum readings of the present set of measurements.

The Needle display is composed of the following components:

- Parameter settings, the sensor's name and serial number, and battery status indicator at the top of the screen.
- Needle displayed prominently in the middle of the screen.
- Frequency displayed above the needle, on the right side of the screen.
- Large numeric display.
- Softkey legends at the bottom of the screen

6.3.2.2. Softkey Functionality

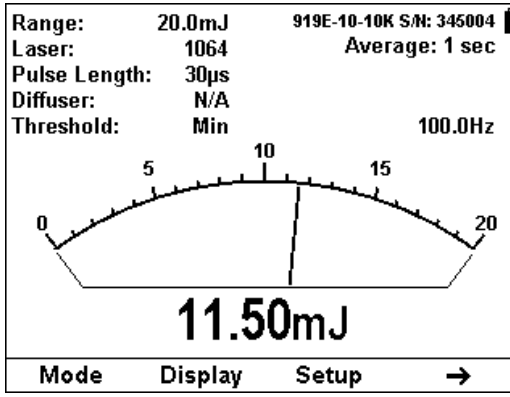


Figure 6.3 Needle display with first set of Softkeys

- **Mode:** Press this key to change the selected measurement mode.
  - Press the Up/Down arrow (↕) to set the measurement mode to Energy or Power.
  - Press **OK** to return to the measurement screen with the new selection.
  - Press **Cancel** to ignore any changes and continue in Power measurement mode.

- **Display:** Press this key to change the graphical display.
  - Press the Up/Down arrow (↕) to set the display mode to Bargraph or Needle.
  - Press OK to return to the measurement screen with the new selection.
  - Press Cancel to ignore any changes and continue with the Bargraph display.

- **Setup:** Press this key to change the Energy measurement parameters. This will be described in Section 6.3.3 Energy Setup Screen.

- **Right Arrow** (→)**:** Press this for additional Needle screen functions.

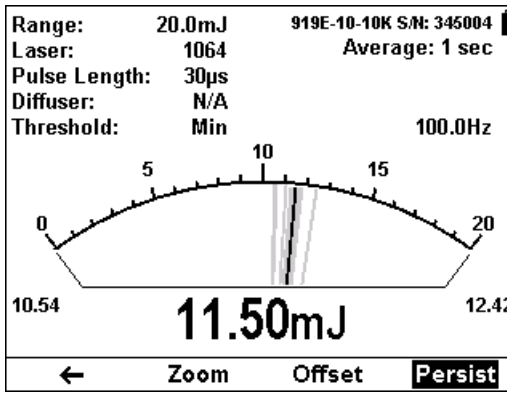


Figure 6.4 Needle display with second set of Softkeys and Persistence active

- **Left Arrow (←):** Press this for previous set of Needle functions.

- **Zoom:** Press this key to focus the Needle on the present reading. The Needle arc will show 20% of the full scale centered on the present reading. Thus, if the full scale of the Needle is 20 Joules, and your reading is 15 Joules, pressing **Zoom** will make the Needle scale range between approximately 13 and 17 Joules. Small fluctuations in energy are more easily seen in this mode. **Zoom** will be reverse highlighted to show that it is active. Press the **Zoom** key again to return to the unexpanded Bargraph display.

- **Offset:** Offset can be used to facilitate comparison between readings. For example, the first laser pulse is 1 Joule. To subtract this from future readings, press the **Offset** key. If the next pulse is actually 3 Joules, 2 Joules will be displayed on the screen, thereby indicating the difference between the two laser pulses.

  When active, the **Offset** key is reverse highlighted and the offset that is being subtracted is shown in the upper right part of the screen. To deactivate, press Offset again.

6.3.3. Energy Setup Screen

The 843-R meter can be set to various chosen settings while operating. These configuration settings are automatically saved for the next time the meter is turned on with this sensor.

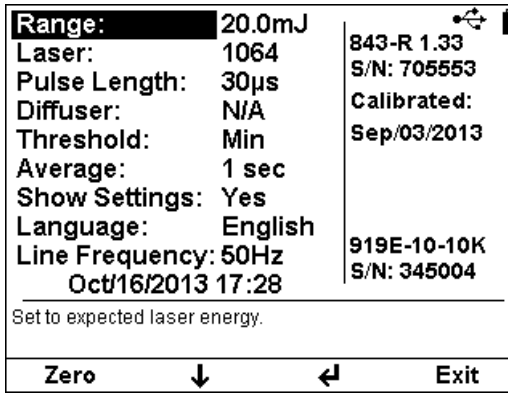


Figure 6.5 Setup Screen

6.3.3.1. Energy Range

Energy measurement with a Pyroelectric sensor is always made in a set manual range. The correct range to select is the lowest one that is larger than the largest expected measurement.

To Set the Energy Range

1. Press the Down arrow (↓) until Range is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the available ranges until you reach the one that is correct for your measurement needs.
3. Press the **OK** key to keep the new setting.

6.3.3.2. Laser

Metallic type absorbers (continous spectral curve):

The absorption of the detector coating varies somewhat with 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.

In order to simplify changing from one laser wavelength to another, the user can program up to 6 different wavelengths to be available from the screen menu. Please use the following procedure to set the pyroelectric or photodiode energy sensor to your laser wavelengths.

1 Press the Down arrow (↓) until Laser is highlighted and press the Enter arrow (↵).
2 Using the Down arrow (↓), scroll through the available lasers until you reach the appropriate laser wavelength.
3 If your wavelength is listed, use the Down arrow (↓) to scroll through the wavelengths until reached and press the **OK** key.
4 If the wavelength you want is not among the wavelengths in the six wavelengths listed press the **Modify** key.
5 Use the Right (→) and Down (↓) arrows to adjust the wavelength as desired. Then press the OK key.

6.3.3.3. Laser Pulse Width

Most Newport pyroelectric sensors can be configured to measure the energy of laser pulses of shorter or longer lengths. In order to operate properly, the 843-R must be set to a maximum pulse width setting longer than the actual laser pulse width. Therefore the pulse width should be set to the shortest pulse width longer than the actual laser pulse width.

Warning:

If the pulse width is incorrectly set to a pulse width shorter than the actual pulse width of the laser, the reading will be erroneously low. If it is set to a setting longer than necessary, the reading will be correct but noisier.

To set up for pulse width, please do the following:

1. Press the Down arrow (↓) until Pulse Length is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the available pulse lengths until you reach the shortest one that is longer than the expected laser pulse width.
3. Press the **OK** key.

6.3.3.4. Diffuser Sensors

Some pyroelectric sensors are equipped with a removable diffuser. Using this diffuser enables the sensor to measure higher energy pulses.

To choose the diffuser setting:

1. Press the Down arrow (↓) until Diffuser is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), toggle between OUT and IN to reach the appropriate Diffuser setting.
3. If you choose wish to work with Diffuser IN, be sure to attach the Diffuser to the detector sensor.
4. If you choose wish to work with Diffuser OUT, be sure to detach the Diffuser from the detector sensor.
5. Press the **OK** key to keep the new setting.

Note:

The laser dependent calibration factors are different for the two Diffuser states. Therefore, after setting the Diffuser state, make sure that the Laser and Pulse Length settings are correct as well.

6.3.3.5. Minimum Energy Threshold

Pyroelectric sensors are sensitive to noise and vibration as well as the heat from the laser pulses. They can falsely trigger on such disturbances, especially on the lowest ranges. The 919E series of sensors has a user settable

threshold to suppress such false triggering. The default threshold setting is set to 3% of full scale. However, it can be set to smaller or larger values. If you are measuring very low energies, for highest accuracy, it is recommended to set the threshold to the minimum value, as long as this does not result in false triggering. For noisy environments with false triggering, it is recommended to set the threshold to the lowest value that eliminates the false readings. You can change the threshold as follows:

To Set the Minimum Threshold Level:

1. Press the Down arrow (↓) until Threshold is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the list of threshold levels until you reach the one that is correct for your measurement needs.
3. Press the **OK** key to keep the new setting.

6.3.3.6. Average

How Averaging Works

When a laser output is fluctuating or unstable, it is useful to measure a number of pulses and display the average value of the energy over a certain period. The 843-R gives you this exclusive feature, allowing averaging over periods varying from ½ second to 30 seconds.

Pyroelectric sensors is capable of measuring pulses up to very high repetition rates, some on the order of kilohertz or higher. The 843-R meter actually captures each pulse up to 500Hz and will sample pulses at up to 25,000 pulses depending on the sensor. However, the display can only display at rates up to 10Hz. At higher rates, if the user has chosen "NONE", the 843-R will display individual pulses sampled at a rate of 5Hz. If the user has chosen to average over a time period, the instrument will display the average of readings over the period from the time the screen was entered up to the present. For instance, if the

average period is 30 seconds, at 15 seconds, the average is over 15 seconds, at 30 seconds it is over 30 seconds, at 5 minutes, it is over the period from 4.5 to 5 minutes (30 seconds back from the present etc.).

To Set the Average Period:

1. Press the Down arrow (↓) until Average is highlighted and press the Enter arrow (↵).
2. Using the Down arrow (↓), scroll through the list of average periods until you reach the one that is correct for your measurement needs. Set the average period to NONE to disable averaging.
3. Press the **OK** key to keep the new setting.

6.3.3.7. Other Settings

Show or Hide Settings

1. Press the Down arrow (↓) until Show Settings is highlighted and press the Enter arrow (↵).
2. Set to Yes to display sensor settings in the measurement screens. Set to No to hide the sensor settings and show a larger graph.
3. Press the **OK** key to keep the new setting.

Language Selection

The 843-R display can be configured to one of several languages. In order to select the display language:

1. Press the Down arrow (↓) until Language is highlighted and press the Enter arrow (↵).
2. Set to English, Japanese, Russian, or Chinese.
3. Press the **OK** key to keep the new setting.

Line Frequency

843-R has built-in circuitry to screen out electrical noise from the local power grid that can introduce errors to the measurements.

Set Line Frequency to your power grid's frequency to screen out the noise correctly.

1. Press the Down arrow (↓) until Line Frequency is highlighted and press the Enter arrow (↵).
2. Set to 50Hz or 60Hz, depending on the electrical power grid of the area that you are in.
3. Press the **OK** key to keep the new setting.

Clock Settings

The 843-R is equipped with a real time clock which will show the date and time. This clock will also allow the 843-R to query the sensor attached and notify you if the sensor is due for calibration.

To set Date and Time

1. Press the Down arrow (↓) until the Date and Time are highlighted and press the Enter arrow (↵).
2. Scroll through and select Month, Day, Year, Hour, and Minutes with the Right arrow (→). Change the selected item with the Down arrow (↓).
3. When finished, press the **OK** key to keep the new setting.

6.3.3.8. Additional On Screen Information

On the right hand side of the Setup screen the following information is provided to the user

- Instrument
  - Firmware Version
  - Serial Number
  - Date of Last Calibration
- Sensor
  - Name
  - Serial Number

- Date of Last Calibration (if supported by the sensor

6.3.4. Zeroing Sensor against the 843-R Meter

There is a slight variation of pyroelectric reading from meter to meter. Therefore, for the most accuracy in pyroelectric energy measurements, it is necessary to zero the pyroelectric sensor with the 843-R it will be used with. After this is done, the sensor is "conditioned" to work with the particular 843-R the zeroing was done against. It is not necessary to do this procedure again unless the 843-R is used with a different sensor. If the procedure is not done, errors of 2% or so can occur.

To zero the sensor with the 843-R**, proceed as follows:**

Make sure the sensor is in a quiet environment and not subject to pulsed radiation. Plug sensor into 843-R and turn on. Press the **Setup** key to enter the Setup screen. Press the **Zero** key to enter the Zero screen. Press the **Start** key. When "Zeroing completed successfully" appears, press the **Save** key and then press the **Exit** key. After you have done zeroing, you do not have to do it again when used with the same type of meter. If you have zeroed it against a different of meter, then a different value has been saved and when used with this 843-R again you should zero it again.

6.4. Measuring Average Power and High Energies

6.4.1. Measuring Average Power

Although the Pyroelectric sensors are designed for energy measurement, they can be used to measure average power as well using the formula…

Average Power = Average Energy X Frequency

… where the energy and frequency of the pulses have been measured by 843-R.

Note: 843-R use when measuring power is the same as when measuring energy and has been described in full in Section Measuring Energy with Pyroelectric Sensors.

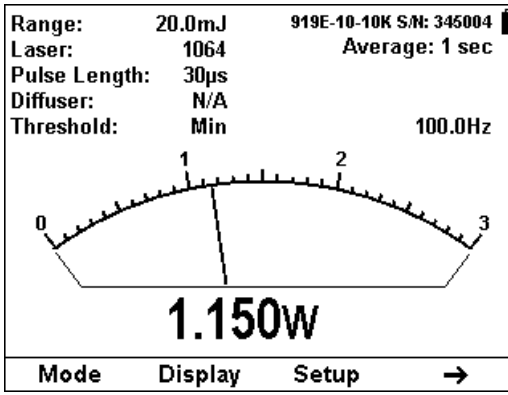


Figure 6.6 Bargraph display when measuring Power

6.4.2. Measuring Pulses of High Energy Density

Because of their construction, pyroelectric sensors are restricted in the energy density they can withstand, particularly for short pulses on the order of nanoseconds. If the energy density of your laser exceeds the rating of the pyroelectric absorber, there are several options available:

1. You can enlarge your laser beam using a negative lens until the energy density is below damage threshold. You should test this using the test slide that is supplied with the sensor.
2. You can use a beam splitter, splitting off typically 8 - 10% of the light. If you use this method, note that there may be polarization effects.
3. Newport has sensors specifically designed for high energy density pulses. Some of these sensors can measure energy densities up to several Joules/cm². Contact your Newport dealer for details.

Chapter 7. Circuit Description

The 843-R Power Meter has two circuit boards: the Analog Module with the analog signal processing circuitry, and the Processor Board with the power supplies and user interface components.

7.1 Analog Module

7.1.1. Analog Circuit:

The signal from the detector sensor enters the analog circuit and passes through EMI protection components to a differential trans-impedance preamplifier. From there it is further amplified by a programmable gain voltage amplifier and passes to an Analog-to-Digital (A/D) converter. All calibration data for the analog circuit is stored in a memory chip on the main board. There are no mechanical adjustable components (trimmers etc.) in the 843-R. The Analog Module's on board digital processor receives data from the A/D converter and translates it into a measurement of current in Amps. When used with thermopile sensors, the data is then processed by a sophisticated digital filter that speeds up the effective response time of the sensor and rejects noise.

7.1.2. Fast Analog Input:

In addition to the above basic analog circuit, the 843-R contains a second fast analog input. This supports certain Newport sensors that read energy pulses at higher rates than can be supported by the basic analog circuit, but provides less overall accuracy than the above circuit. The fast analog input consists of an EMI filtered voltage input that is passed to a first stage of mild voltage attenuation. This is then passed to a fast A/D converter. Calibration data is stored on the same memory chip mentioned above. The Analog Module's on board digital processor receives data from the fast A/D converter and

translates it into a measurement that can be processed as necessary.

7.1.3. Analog Output:

The analog output is driven through an impedance of 100 ohms and provided as a means of integrating the 843-R meter with other instruments (such as an oscilloscope)

7.2 Processor Board:

The Processor Board is built around a Freescale i.MX283 ARM9 application processor. The digital circuit includes an upgradeable FLASH chip that can be programmed in-situ by the 843-R support software. The Processor Board is responsible for reading the keypad and driving the LCD display, displaying measurement information received from the Analog Module. For the 843-R-USB it is also responsible for the USB communication with the PC.

7.2.1. Power Supply:

The power supply provides the internal DC supply voltages for both the Processor Board and the Analog Module. It also contains the battery charging circuit and the AC supply for the backlight. The power supply circuits consist of high efficiency switch-mode designs.

7.2.2. EMI Protection:

The digital processor circuit and the whole 843-R instrument are protected by EMI protection component on all signals that pass in and out of the box. In addition, EMI protection is added internally to prevent disturbances to the normal functioning of the instrument. The instrument meets the requirements of the European Community with respect to electromagnetic compatibility and has the “CE” mark.

Chapter 8. 843-R Power Meter Specifications

8.1 System/Meter Specifications

Input Specifications Thermal, Photodiode	
Input Ranges	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)
Input Specifications Pyroelectric Sensors	
Input Range	0 - 6V full scale
A to D Sampling rate	500 Hz
A to D resolution	12 bits no sign (0.025% resolution)
Electrical accuracy	±0.25% new; ±0.5% after 1 year
Electrical input noise	2mV
General Specifications	
Detector Compatibility	919P series, 918D series, 818DB series, 919E series
PC Interface (843-R-USB only)	USB
Analog output	1v full-scale; 0.03% resolution. 100 ohms impedance
Analog output accuracy	±0.2% (of reading) ±0.3% of full scale volts
Dimensions	114W x 41D x 212H
Mass	470g
Display	320x240 pixel TFT LCD; Active area 70x52mm approx.
Display digit height	15mm
LCD lighting	LED's. 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
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

8.2 Sensor Specifications

Sensor	Max Power (WATTS)	Max Avg. Power Density at Max Power	Absorber Type
918D-SL/IR/UV-OD3R	2W	30W/cm²	PD
918D-UV-OD3R	0.2W	30W/cm²	PD
818-SL/IR/UV-DB	2W	30W/cm²	PD
818-UV-DB	0.2W	30W/cm²	PD
819C-UV-2-CAL	0.1W		Int Sph PD
819C-UV-5.3-CAL	0.5W		Int Sph PD
819C-SL-2-CAL2	2W		Int Sph PD
819C-SL-5.3-CAL2	4W		Int Sph PD
819C-IG-2-CAL	1.5W		Int Sph PD
819C-IG-5.3-CAL	4.5W		Int Sph PD

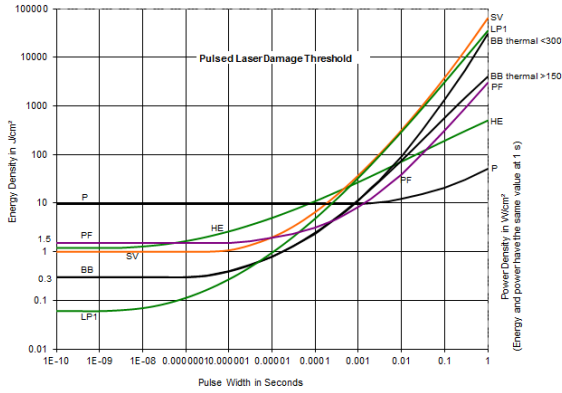
819D-UV-2-CAL	0.1W		Int Sph PD
819D-UV-5.3-CAL	0.5W		Int Sph PD
819D-SL-2-CAL2	2W		Int Sph PD
819D-SL-5.3-CAL2	10W		Int Sph PD
819D-IG-2-CAL	2.5W		Int Sph PD
819D-IG-5.3-CAL	9W		Int Sph PD
919P-003-10	3W	1000W/cm²	BB
919P-010-16	10W	28KW/cm²	BB
919P-020-12	4(20)W	23KW/cm²	BB
919P-030-18	30W	20KW/cm²	BB
919P-050-18HP	50W	0.5KW/cm²	PF-DIF
919P-050-26	50(150)W	12KW/cm²	BB
919P-040-50	35(150)W	12KW/cm²	BB
919P-150-26	150W	12KW/cm²	BB
919P-250-35	250W	10KW/cm²	BB
919P-500-65	500W	7KW/cm²	BB
919P-5KW-50	5000W	3KW/cm²	BB
919E-20U-10-20K	50mW	50W/cm²	PD
919E-200U-8-25K	2W	30W/cm²	PE-ES
919E-0.1-12-25K	2W	50W/cm²	PE
919E-0.1-12-250	3W	50W/cm²	PE-BF
919E-10-24-10K	25W	20W/cm²	PE
919E-10-20-250	30W	120W/cm²	PE-BF-DIF
919E-10-35-10K	40W	100W/cm²	PE-DIF
919E-10-35-250	40W	200W/cm²	PE-BF-DIF
919E-30-46-10K	60W	500W/cm²	PE-DIF-ER

Table 5. Max Power Specifications of Sensors

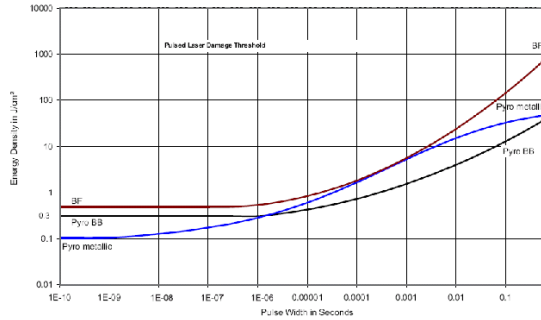
PD – Photodiode
Int Sph – Integrating Sphere
PF – Volume absorber for short pulses and high average powers
PE – Pyroelectric metallic or black absorber
BB – Broadband surface absorber, high power density
BF – Very high damage threshold, long pulses
ES – Extra Slim

Absorber Type	Max Energy Density J/cm² Pulse Length		
	10ns	1µs	300µs
BB	0.3	0.5	3
PF	1.5	1.5	5
PE Metallic	0.1	0.5	4
PE-DIF	1	2	20

Table 6: Maximum Energy Densities for Various Absorbers (Single pulse).



Pulsed Laser Damage Threshold for Thermopile Sensors



Pulsed Laser Damage Threshold for Pyroelectric Sensors

8.3 Warranty

Newport Corporation warrants that this product will be free from defects in material and workmanship and will comply with Newport's published specifications at the time of sale for a period of one year from date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's option.

To exercise this warranty, write or call your local Newport office or representative, or contact Newport

headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the product, freight prepaid, to the indicated service facility. Repairs will be made and the instrument returned freight prepaid. Repaired products are warranted for the remainder of the original warranty period or 90 days, whichever first occurs.

8.4 Limitation of Warranty

The above warranties do not apply to products which have been repaired or modified without Newport's written approval, or products subjected to unusual physical, thermal or electrical stress, improper installation, misuse, abuse, accident or negligence in use, storage, transportation or handling. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE. NEWPORT CORPORATION SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM THE PURCHASE OR USE OF ITS PRODUCTS.

8.5 Technical Support Contacts

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