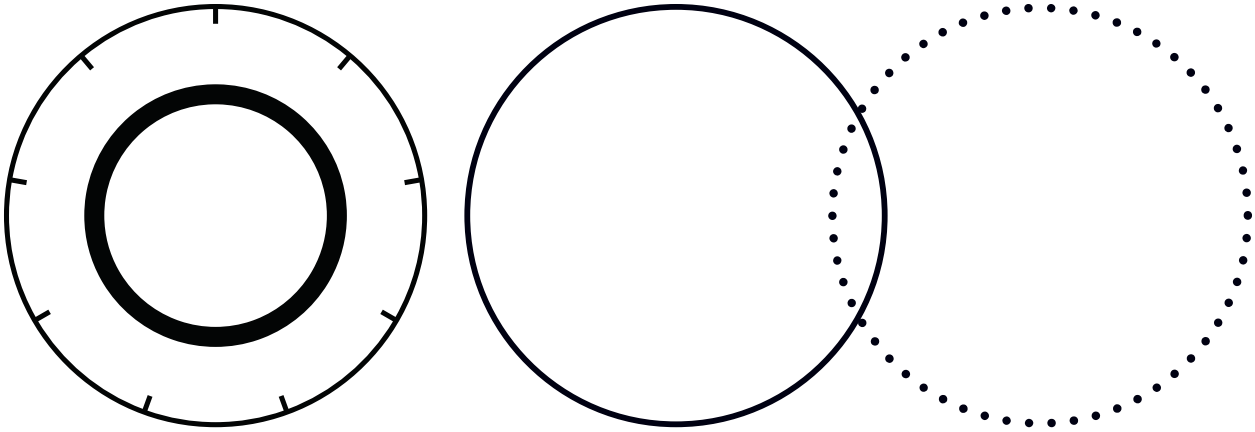
PowerMax™ USB/RS

User Manual



INNOVATIONS THAT RESONATE

COHERENT

User Manual
PowerMax-USB/RS
Sensor System

COHERENT

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1 Introduction

1.1 Signal Words and Symbols in this Manual

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

1.1.1 Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and ***NOTICE***.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER!
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING!
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

The signal word '***NOTICE***' is used when there is the risk of property damage:

NOTICE
Indicates information considered important, but not hazard- related.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

1.1.2 Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of additional information.

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the danger of potential hot surfaces.

This symbol is intended to alert the operator to the danger of crushing injury.

This symbol is intended to alert the operator to the danger of a lifting hazard.

1.2 Preface

This manual contains user information for the PowerMax USB/RS Sensor System.

NOTICE
Read the associated documentation carefully before operating a laser with the sensor for the first time. Failure to follow necessary instructions and safety precautions can result in serious injury or death.

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

1.3 Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

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

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

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

2 Safety

2.1 Introduction

Carefully review the following safety information to prevent personal injury or damage to this product or any equipment connected to it. There are no user-serviceable parts in Coherent PowerMax meterless power sensors. For service information, refer to 'Obtain Service' (p. 70).

2.2 Laser and Optical Safety

Laser light, because of its optical qualities, poses safety hazards not associated with light from conventional light sources. The safe use of lasers requires all operators, and everyone near a laser, to be aware of the dangers involved. Users must be familiar with the instrument and the properties of coherent, intense beams of light.

At all times, make sure that all personnel who operate, maintain or service the laser are protected from accidental or unnecessary exposure to laser radiation exceeding the accessible emission limits defined in the laser safety standards

WARNING!
LASER RADIATION - AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION CLASS 4 LASER PRODUCT!

The greatest concern when using a laser is eye safety. In addition to the main beam, there are often many smaller beams present at various angles near the laser system. These beams are formed by specular reflections of the main beam at polished surfaces such as lenses or beamsplitters. While weaker than the main beam, such beams may still be sufficiently intense to cause eye damage.

For safety information specific to the use of lasers, read and obey all respective documentation provided by the manufacturer of the laser system being used.

CAUTION!
Laser safety eyewear protects the user from accidental exposure to laser radiation by blocking light at the laser wavelengths.

However, laser safety eyewear may also prevent the operator from seeing the beam or the beam spot. Exercise extreme caution even while wearing safety glasses.

2.3 Electrical Safety

The PowerMax USB/RS Sensor System does not have dangerous voltages.

NOTICE
Do not disassemble the enclosure. There are no user-serviceable parts inside.

All units should be operated as assembled. The warranty is canceled if the enclosure is disassembled. See ’Calibration, Warranty and Service’ (p. 67) for assistance.

WARNING!
Do not operate the system if its panels are removed or any of the interior circuitry is exposed.

WARNING!
Do not operate the system in wet or damp conditions, or in an explosive atmosphere.

NOTICE

Do not operate the system if there are suspected failures. Refer damaged units to qualified Coherent service personnel.

2.4 Safety Information for LM-200 Sensor

This section gives safety information specifically for the PowerMax LM-200 sensors.

Devices must be IEC/EN 62368 or IEC 60950 tested and approved before they are connected to the USB or RS-232 ports

2.4.1 LM-200 Safety Label and Information

The electrical safety label is found on the side of the module. It gives maximum power use, amperage and polarity information. Refer to Figure 2-1.

Figure 2-1. LM-200 Sensor Electrical Safety Label

The heat hazard warning label is found on the other side of the LM200 module. Refer to Figure 2-1.

Figure 2-2. LM-200 Sensor Heat Hazard Warning Label

2.5 ESD Protection

The most common ESD damage occurs when handling the device during installation or use.

CAUTION!
Electrostatic charges as high as 4000 volts easily collect on the human body and equipment and can discharge without detection.

Although the electronics features have input protection, permanent damage can occur on devices subjected to high-energy electrostatic discharges. You must take correct ESD precautions to prevent damage or performance degradation.

The most common ESD damage occurs when handling a device during installation or use. Take the necessary measures to protect the system from ESD.

Dry air and carpet also create a higher potential for ESD. Remember to take precautions or shielding not only for operations, but for demonstrations or trade show exhibitions.

When mobile equipment (a cart or table) is used as an ESD-protected workstation, connect it to ESD ground that meets ANSI/ESD S4.2 required limits for an ESD-protected workstation (<1 x 10^9 ohms).

3 Compliance

3.1 Compliance to Standards Relevant to CE and UKCA Marks

The PowerMax USB/RS Power Meters are tested and marked as independent products in the European Community (CE) and the United Kingdom (UKCA). For specific details regarding what applicable compliance directives and standards the products have been tested to, refer to the EU Declaration of Conformity and/or the UKCA Declaration of Conformity which are available upon request from Coherent, per contact information on p. ii of this manual.

Compliance to applicable standards for a particular laser tool incorporating PowerMax USB/RS User Manual must be demonstrated by the manufacturer of the complete system. The primary issue for the system integrator is to design covers, shielding, grounding, routing of electrical cable assemblies, and control elements with the proper safety features so that during subsequent testing the system meets the appropriate standards.

3.2 Electromagnetic Compatibility

Compliance of this laser with the Electromagnetic Compatibility (EMC) requirements is certified by the CE mark and the UKCA mark.

Each application and installation is unique, and in some cases, the user may experience Electromagnetic Interference (EMI) noise being emitted from various electronic components. This laser may use high-frequency RF. While adequate countermeasures have been taken to suppress this emission to meet the requirements stated on the Declaration of Conformity, the user may wish to employ additional measures to suppress the EMI to reduce the emissions further. Standard methods of reducing the EMI are:

1. Use of shielded control cables grounded on both ends
2. Addition of appropriate ferrite beads to cables connected to the beam source.

3.3 Environmental Compliance

This section describes compliance with various environmental regulatory directives to identify hazardous substances.

3.3.1 EU REACH

Coherent products are classified as 'articles' according to EU REACH definition, as follows:

Article means an object which, during production, is given a special shape, surface or design that determines its function to a greater degree than its chemical composition. (REACH, Article 3(3))

Articles as defined by REACH regulations are exempt from registration as long as they are not intended to release a chemical substance.

Coherent product(s) conform to all applicable requirements of the EU-REACH Regulation, (1907/2006). Declarations of Compliance are available upon request.

In addition, to the best of our knowledge, Coherent products do not contain any Substances of Very High Concern (SVHC) above the legally mandated thresholds included in the REACH SVHC list, which is updated every six months. The current SVHC list is available on-line at https://echa.europa.eu/candidate-list-table.

3.3.2 RoHS Compliance

Coherent product(s) conform to all applicable requirements of the EU-RoHS Directive (2011/65/EU) and subsequent Amendment Directives including Directive (EU) 2015/863. Compliance Declarations are available upon request.

3.3.3 China RoHS Compliance

Coherent product(s) conform to all applicable requirements of Restriction of Hazardous Substances Regulation SJ/T 11364-2014 commonly referred to as China RoHS.

Hazardous substances (if applicable) in the PowerMax USB/RS User Manual are listed in the material declaration table included with the equipment, REACH Compliance.

Coherent product(s) conform to all applicable requirements of the EU-REACH Regulation, (1907/2006). Compliance Declarations are available upon request.

Any hazardous substances in Coherent products (if applicable) are shown on the product label.

The China RoHS label is as follows for the PowerMax USB/RS sensor:

部件名称 Part Name	有害物质 Hazardous Substances						
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)	
印刷电路板组装 PCB Assembly	X	O	O	O	O	O	
硬件 Hardware	X	O	O	O	O	O	
电缆装配 Cable Assembly	X	O	O	O	O	O	
本表格依据SJ/T 11364的规定编制							
O: 表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。 X: 表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。							

The China RoHS Regulation also requires that the date of manufacture be identified. This information is provided on the *Certificate of Calibration* shipped with each product.

3.3.4 Waste Electrical and Electronic Equipment (WEEE, 2012)

The European Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU) is represented by a crossed-out waste container label (Figure 3-1). WEEE management also covers EU Directive 2006/66/EC-EU Battery Directive and Directive 94/62/EC on Packaging and Packaging Waste. Do not dispose of these products or packaging as unsorted municipal waste.

Figure 3-1. Waste Electrical and Electronic Equipment Label

Coherent joins approved compliance organizations to meet its collection and recycling obligations. For further information, please contact:

Email: info@rene-europe.com

Phone: +49 (0) 8266-869806

Website: www.rene-europe.com

3.4 Declaration of Conformity

Declaration of Conformity certificates are available upon request.

4 Description

4.1 Introduction

Coherent PowerMax-USB and PowerMax-RS sensors are the world's first laser power sensors that use state of the art microelectronics miniaturization techniques and integrate an entire instrument within a USB 2.0 or RS-232 cable connector. Specifically, PowerMax-USB and PowerMax-RS sensors have all the signal processing and power measurement electronics normally in a LabMax meter and connect directly to a PC with plug-and-play functionality. Ideally adapted for low- and high-volume embedded sensor applications, Coherent's new family of sensors removes the need for a separate meter box, thus delivering a significant savings in cost and space, but with no decrease whatsoever in performance.

This measurement platform can also be used to measure the energy in a long laser pulse—normally greater than 1 millisecond in pulse width—by integrating the output of a thermopile sensor.

A software application (PowerMax PC or Coherent Meter Connection) supplies a virtual instrument interface for sensors that enable the operator to take laser power readings, log data, and compute measurement statistics. Users can also write their own software with host interface commands that control all aspects of power meter operation.

For the first time, separate electronics are no longer required between the sensor and a PC. For those customers who can use a PC for monitoring laser power, these sensors make available significant cost savings, space savings, and no decrease in performance.

WARNING!
To avoid potential hazard due to back reflection when PowerMax sensors are used with lasers, protective measures must be used before each use. These measures must be used and include protective shielding and protective equipment.

4.2 Product Overview

4.2.1 Product Features

- *PowerMax-USB* provides direct USB 2.0 connection to a PC. Power is supplied through a USB connection.

- *PowerMax-RS* provides RS-232 connectivity. Power input is supplied by a +5VDC input (power supply is available as an optional accessory).

- Instrumentation platform is compatible with thermopile and optical sensors and can be adapted to most power sensors that Coherent manufactures.

- Displays beam position with position-sensing quadrant thermopiles (for example LM-model sensors like the LM-10).

- High resolution 24-bit A/D converter supports four digits of resolution and measurement accuracy equivalent to that found in Coherent's LabMax meters.

- Sensors include spectral compensation for accurate use at wavelengths that are different from the calibration wavelength. Each sensor receives an unique spectral compensation curve specific to the responsivity of its specific element, as well as transmission characterization of any related optics.

- Thermopile sensors include a speed-up algorithm that speeds up the normal response of the thermopile detector without overshoot.

- LED status indicators inside USB and RS-232 connectors give health-and-status information.

- Thermopile sensors offer long-pulse joules capability.

4.2.2 Software Features

Plug-and-play application software, Coherent Meter Connection, is supplied standard and includes the following features:

- Trending

- Statistics (mean, minimum, maximum, and standard deviation) and log batch to file.

- Tuning

- Display beam position on position-sensing thermopiles and log results to file

- Histogram view

- Operate several sensors at the same time

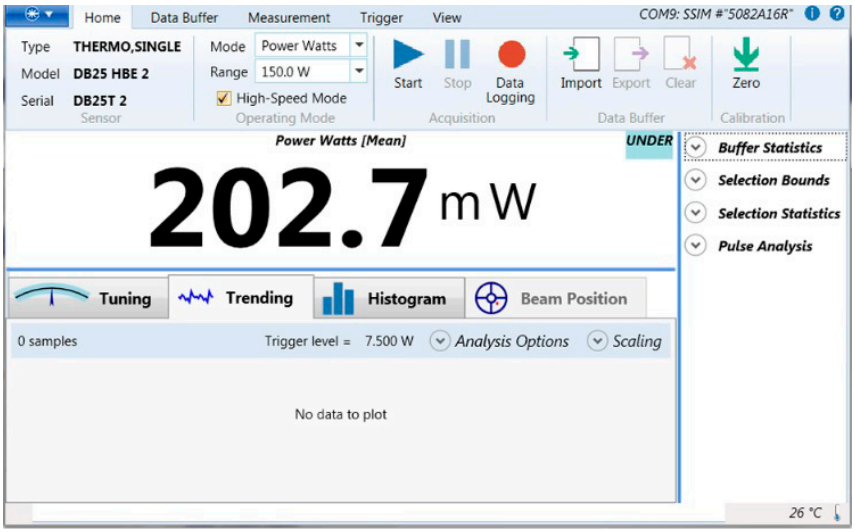


Figure 4-1. Software Interface (Coherent Meter Connection)

- Perform synchronized ratiometry (A/B analysis) (with PowerMax PC software). Trend and log results to file.
- For LaserPAD or SSIM customers, the host command set includes drop-in compatibility.
- For system integrators and for implementations that include customer-written software, the sensors include a complete command set that is easy to access:
- Utilize a Windows USB driver and supports simple ASCII host commands for remote interfacing using both PowerMax-USB and PowerMax-RS sensors.
- Use customer-written software, the remote interfacing host command set permits sensors to be remotely controlled.
- National Instruments™ LabVIEW™ driver is supplied for easy LabVIEW integration.

4.3 Technical Description

4.3.1 Thermopile Technology

Thermopile sensors are a great all-purpose technology suitable for many lasers. They are used for measuring CW laser power, average power in pulsed lasers, and are frequently used to integrate the energy of long pulses. Thermopile sensors absorb incident laser radiation and convert it into heat. This heat ultimately flows to a heatsink that is held at ambient temperature by either convection-cooling or water-cooling. The temperature difference between the absorber and the heatsink is changed into an electrical signal by a thermocouple junction.

Thermopiles operate across a wide range of input powers, and unlike a photodiode-based sensor they will not saturate. The spectral range is dependent on the coating applied to absorb the laser power. The coating used on many thermopiles is broadband in nature and is relatively flat from the ultraviolet through the infrared.

These sensors have normal response times on the order of several seconds for a low power sensor and up to one minute for a kilowatt sensor. The exponential nature of the natural thermopile output permits one to electronically increase the voltage to its final value ahead of the actual sensor signal using a software algorithm.

This capability is typically called a ’speed-up’ algorithm. When combined with the PowerMax-USB and PowerMax-RS circuitry, a speed-up algorithm can be applied to provide a much faster response—on the order of seconds or less for most thermopile sensors. This feature can be turned on and off in the software.

Coherent has two main types of thermopile sensors:

- The *LM Model* line uses a unique thermopile disk in which the thermocouples are divided into four quadrants, letting the sensors provide beam position information in addition to power measurement.

- The *PM Model* line incorporates traditional thermopile disks that supply power measurement without beam position information.

PowerMax-USB and PowerMax-RS sensors can use both types of thermopile sensors.

Figure 4-2. Coherent Thermopiles

4.3.1.1 Long-Pulse Energy Measurement With a Thermopile

Thermopile sensors are most commonly for average power measurements on pulsed and CW lasers. A unique function of thermopile sensors is the ability to integrate the power of a single “long” laser pulse (*long pulse* refers to pulses roughly 1 millisecond up to several seconds in pulse length).

The instrumentation analyzes the output of the thermopile and applies the integration through the use of an algorithm that results in a Joules reading.

This lets the thermopile measure the energy of single pulses between 1 millisecond and 10 seconds in length, and with energies from millijoules to hundreds of Joules. The measurement accuracy of this mode is typically better than ± 3% when performed with PowerMax-USB and PowerMax-RS sensors.

This capability is very useful for what are commonly called long-pulse medical or industrial type lasers. Common applications for this type of measurement are in the medical field—especially skin resurfacing and hair removal—and in material processing applications, for example laser welding. These laser systems frequently use high-energy lasers that have large beam sizes and relatively long pulses.

This type of measurement requires careful selection of the applicable power sensor, based upon the laser pulse being measured. A good 'rule of thumb' for using a thermopile for this type of measurement is to compare the maximum pulse energy you need to measure (in Joules) with the maximum power rating of a sensor (in Watts).

Frequently a sensor such as the PM150-50C is best for these measurements. It features a large 50 mm aperture size, can handle pulse energies up to 150J, and can be used air-cooled for single pulse energy measurements. A PM150-50C normally needs to be water-cooled for continuous power measurements. The PS19Q sensors, on the other hand, permit long-pulse measurements down into the mJ level.

For an up-to-date list of all compatible sensors and their specifications, go to: www.Coherent.com/LMC.

4.3.2 Semiconductor Technology

Semiconductor photodiode-based sensors convert incident photons into current that can be measured by our instrumentation. We normally refer to these devices as *optical sensors* or *quantum sensors*. The photodiodes used in these types of sensors offer high sensitivity and low noise, enabling them to detect very low light levels. The UV/VIS optical sensor in the PowerMax-USB line is designed to measure power of CW sources, as well as the average power of pulsed sources, as long as the repetition rate is above 100 pps. Photodiodes also have a fast response time, making this senor convenient for tuning and peaking lasers.

These types of sensors have several orders of magnitude higher sensitivity than thermopile sensors and are quite stable. They do, however, suffer from photocurrent saturation. The UV/VIS sensor incorporated into the PowerMax-USB product line includes an attenuating filter that allows the sensor to be used into the hundreds of milliwatt level without saturation. This ND filter, and the light shield threaded onto the front of the sensor, also help to block stray light, thereby resulting in a lower noise floor.

Coherent incorporates spectral compensation in the PowerMax-USB and PowerMax-RS UV/VIS sensor to give accurate measurements across the 325 to 1065 nm spectrum. Because the spectral response of the ND filter and photodiode varies significantly across this wavelength range, always check the maximum measurable power at the wavelength of use to make sure the sensor is not being saturated. Figure 4-3, below, indicates the maximum and minimum measurable power levels by wavelength.

The curve in Figure 4-3shows a plot of the maximum measurable power, which is the saturation level of the photodiode. It also shows the minimum recommended power level, by wavelength for the PowerMax-RS UV/VIS sensor.

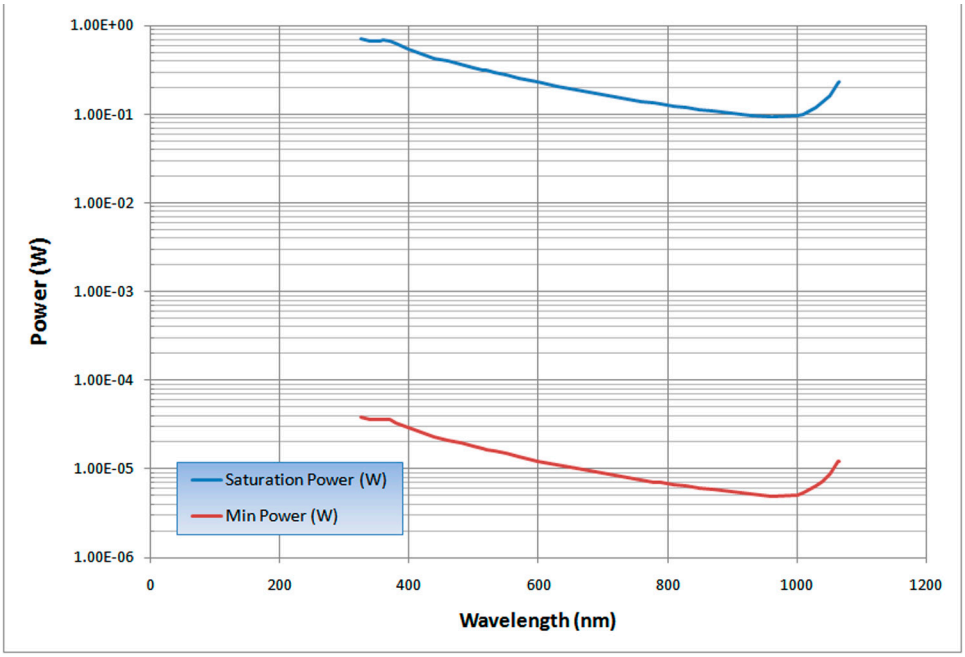


Figure 4-3. Saturation & Minimum Power - PowerMax-USB UV/VIS Quantum Sensor

UV/VIS Temperature Linearity: Like all silicon photodiodes, the UV/VIS Quantum sensor has temperature sensitivity in the infrared region. At 1064 nm, for example, it has a 0.5%/ºC thermal coefficient. Because of the electronics inside the sensor, measurement error up to 2% is present at 1064 nm after a 10-minute warm-up time. Additional error can be present if the ambient measurement environment is different from the calibration wavelength shown on the calibration certificate.

In practice, wavelengths shorter than 1000 nm have insignificant effects caused by temperature.

The following figure references the thermal coefficient at the wavelength of use.

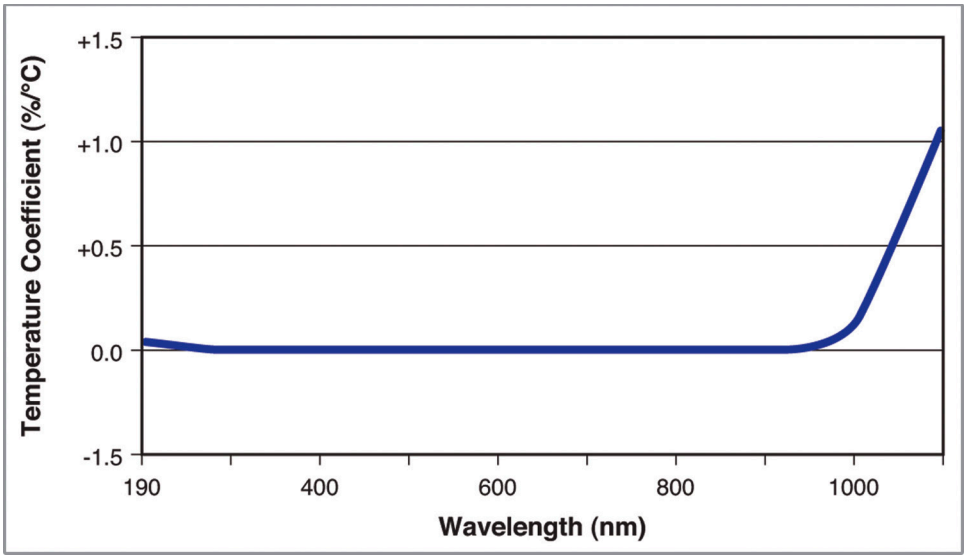


Figure 4-4. Photo Sensitivity Temperature Characteristics

4.3.3 LM-200 Maximum Laser Power Handling

The LM-200 Power Sensor can measure laser power up to 100W continuously with the fan on. For power levels between 100W and 200W, the fan must be on and the measurement time must not exceed five minutes. After measurements above 100W, please wait for five minutes to let the sensor cool down before another measurement is taken.

Without the fan, the LM-200 can measure up to 50W continuously. For power levels between 50W and 100W without the fan, the measurement time must not exceed ten minutes. After measurements above 50W without the fan, please wait for five minutes to let the sensor cool down before another measurement is taken.

4.3.4 Equipment Ratings

The power sensors are usable under the following conditions:

- Internal use only
- 0m to 2000m altitude
- 5 deg C to 40 deg C, and 41 deg F to 105 deg F temperatures
- 80% relative maximum humidity
- Main voltage fluctuation not more than +/- 10%

- Transient over-voltages category II
- Pollution level 2

4.4 Apply Wavelength Compensations

Overall measurement accuracy is a combination of:

- Calibration uncertainty. Note: For an up-to-date list of all compatible sensors and their specifications, go to : www.Coherent.com/LMC.
- Wavelength compensation accuracy—refer to Table 4-1, “Wavelength Compensation Accuracy,” on page 22.

The combined accuracy is based upon practices outlined in the *National Institute of Standards Guidelines for Evaluating and Expressing Uncertainty*. The combined accuracy of the measurement is calculated by using the law of propagation of uncertainty using the ‘root-sum-of-square’ (square root of the sum of squares), sometimes described as ‘summing in quadrature’ where:

Measurement Accuracy = $\sqrt{U^2 + W^2}$

where:

U = Percent Calibration Uncertainty
W = Wavelength Accuracy

Example:

PowerMax-USB LM-10 used at 1064 nm

U = 2%
W = 1.5%

Measurement Accuracy = $\sqrt{2^2 + 1.5^2} = \sqrt{4 + 2.3} = 2.5\,\%$

Coherent uses three primary coatings to capture the incident radiation on our thermal sensors. The specifications for each sensor list which coating is used.

Typical wavelength ranges and response curves for these coatings are shown in Figure 4-5, below. Each sensor has a spectral curve created from reflectance measurements taken with spectrometers. The reflectance data are converted into a wavelength compensation look-up table that is loaded into the sensor. This data is accessed by selecting a wavelength of operation in the software.

Table 4-1 shows the spectral compensation accuracy for each type of sensor.

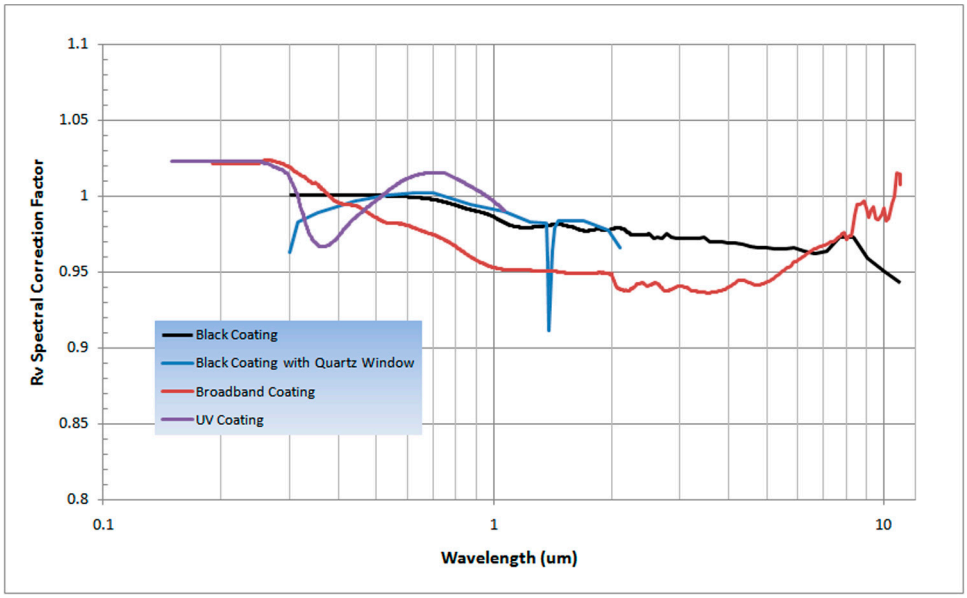


Figure 4-5. RV Spectral Correction for Thermal Sensors (Normalized to Calibration Wavelength)

Table 4-1. Wavelength Compensation Accuracy

Sensor	Wavelength Compensation Accuracy[a]	Calibration Wave-length (nm)
All PM- and LM-model thermopiles	± 1.5%	10600
PS model	± 1.5%	514
UV/VIS optical model	± 4% (325 to 900 nm) ± 5% (900 to 1065 nm)	514

a. Refers to wavelengths different from the calibration wavelength.

4.5 LED Status Indicators

Blue LED lights are contained within the PowerMax-USB and Power-Max-RS connectors to supply health-and-status information.

4.5.1 PowerMax-USB LED Lights

Table 4-2. PowerMax-USB LED Light Conditions

LED Light Condition	Status
No light visible	If the PowerMax-USB sensor is connected to the PC but there are no visible lights, the sensor is not powering up correctly. Test the sensor on another USB port and if that does not solve the problem, contact Coherent for service—refer to Table 8-1 (p. 71) for contact information.
Lights flashing slowly (0.5 Hz)	Sensor is in operation; however, the driver has not been properly loaded. First, make sure power is being properly applied to the USB port. If that does not solve the problem, remove the sensor from the USB port and reinstall the software from the CD that shipped with the product (or download the latest software from our website: www.Coherent.com).
Lights slowing ramping up and down in intensity	Sensor is in operation and the driver has been correctly loaded.
Lights flashing fast (10 Hz)	The sensor is taking power measurements and sending data over the host port.

4.5.2 PowerMax-RS LED Lights

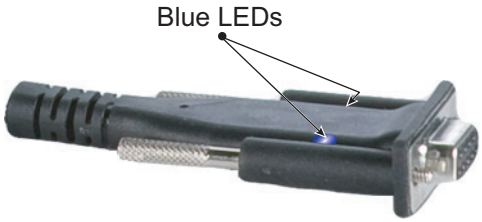


Figure 4-6. LED Lights — PowerMax-RS

Table 4-3. PowerMax-RS LED Light Conditions

LED Light Condition	Status
No light visible	If + 5VDC has been applied to the PowerMax-USB sensor but there are no visible lights in the connector, the sensor is not powering up properly. Contact Coherent for service—refer to Table 8-1, “Coherent Service Centers,” on page 71 for contact information.
Lights slowing ramping up and down in intensity	Power has been applied to the sensor and it is in operation.
Lights flashing fast (10 Hz)	The sensor is taking power measurements and sending data over the host port.

5 Installation and Operation

This section gives information about how to start the software installation, to provide power to the sensors, to take a power measurement and to understand and use the software.

5.1 Install the Software

Install the Coherent Meter Connection Software. For requirements and instructions, refer to the Coherent Meter Connection User Manual (P/N 1343658 Rev AC).

The software for download and the software user manual are available at:

www.coherent.com/resources

5.2 Provide Power to PowerMax-RS Sensors

The PowerMax-RS sensor is powered by a provided +5 VDC, 1.5A (100-240V input) power supply input (Model GT-46181-1812-T3, Coherent P/N 1105427).

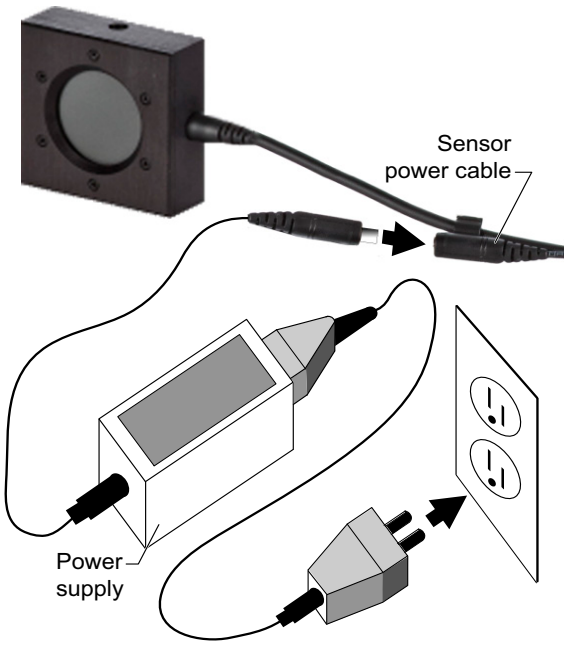


Figure 5-1. Power Supply for the PowerMax-RS Sensor

Also, an LPS power supply with 100-240V AC 50-60Hz 0.5A and 12V DC IEC62368-tested power supply can be used.

5.3 Provide Power to LM-200 Power Sensor

To attach power the sensor, do the following:

1. Attach the power supply barrel connector into the input port on the side of the sensor. Refer to Figure 5-2.
2. Attach the power cord to the power supply.

   Use only the correct 5V power supply.
3. Then, attach the power cord from the power supply into the main power source.

   Power supply must be connected to power sockets with protective earth ground. The power supply connector must be accessible.

The fan comes on when power is applied.

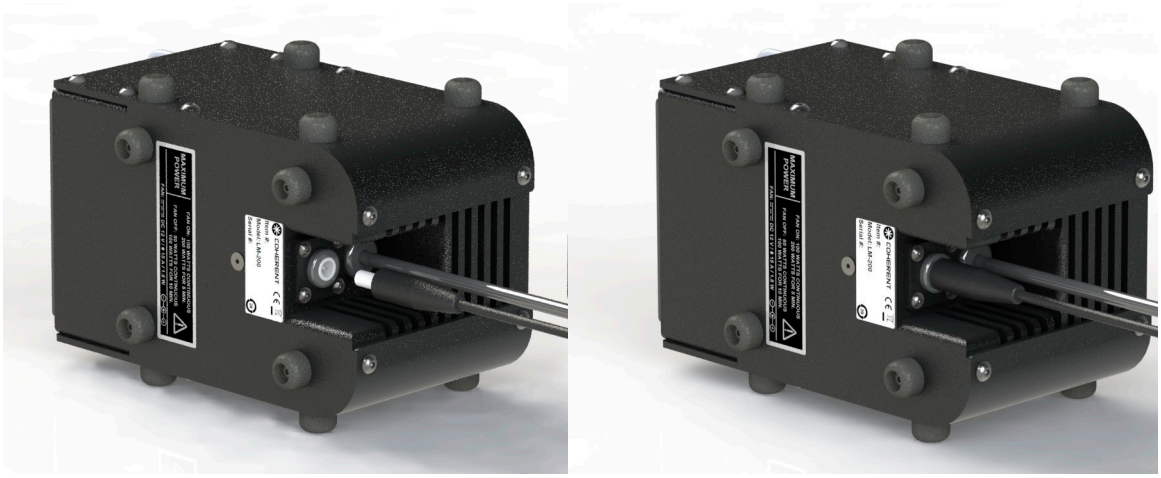


Figure 5-2. Attach Power Connector to LM-200 (not connected - left, connected - right)

CAUTION!

The sensor can become hot during operation. Do not touch or handle the sensor during or immediately after operation.

This symbol is intended to alert the operator to the danger of potential hot surfaces.

5.4 Extend Cable Length

USB sensors: The PowerMax-USB cable is 2.5 meters long. USB hubs can be used to increase the length of the cable. The USB standard permits up to five hubs—connected in series with 5-meter cables connecting the hubs—thus providing a maximum range of 27.5 meters.

There are also active 5-meter USB extension cables on the market that perform as if they were a USB hub, but for just a single USB sensor. (Feel free to contact Coherent for advice related to particular hubs we have tested in-house.)

RS sensors: The RS cable is 300 mm long. It is intended to be used with a standard off-the-shelf RS-232 extension cable to extend the length.

5.5 Take a Power Measurement

This section shows two quick-start 'mini-tutorials' that tell how to connect a PowerMax-USB or PowerMax-RS sensor to a PC and start taking measurements with the Coherent Meter Connection software.

In addition to the Coherent Meter Connection (CMC) software, a previous software application called PowerMax PC is also compatible with PowerMax-USB and PowerMax-RS sensors. This older application works well in a Windows 10 environment; it supports ratiometric operation which is not supported by Coherent Meter Connection. Coherent Meter Connection is recommended for all other applications.

For procedures with the use of PowerMax PC software, refer to 'Operation with PowerMax PC' (p. 77).

NOTICE

Procedures and figures in this section show the Coherent Meter Connection version of the software.

For instructions about communicating with the sensor directly through host commands, refer to 'Host Interface' (p. 39).

Tutorials with use of the CMC software include:

- Measure power with a PowerMax-USB thermopile sensor (p. 28).
- Measure power with a PowerMax-RS thermopile sensor (p. 29).

WARNING!
Follow all laser safety procedures. The laser must be switched OFF or shuttered before running the tutorials given in this section.

5.5.1 Measure Power With a PowerMax-USB Thermopile Sensor

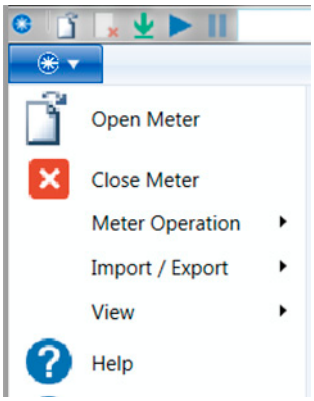
This quick-start tutorial describes how to take a power measurement with a PowerMax-USB thermopile sensor with the use of CMC software.

WARNING!
Make sure that the laser is set to OFF or shuttered before this tutorial is started.

4. Attach the PowerMax-USB sensor to the USB port on the PC.

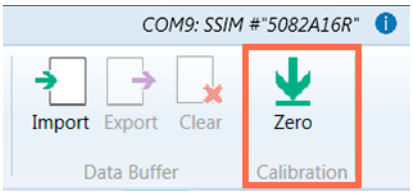
5. Make sure that the blue LEDs on the USB connector come on and slowly ramp up and down in intensity (which signifies the sensor is operating and the driver is correctly loaded).
6. Start the CMC software.

7. Click **Open Meter** in the main drop-down menu.

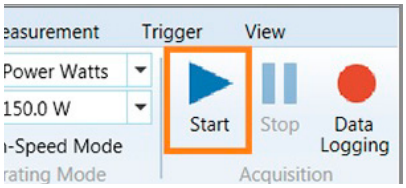


8. From the dialog box, select the COM port to which the PowerMax-RS sensor is attached. The COM port number is automatically determined by the computer. (If needed, check in Device Manager for available COM ports.)

9. Click the **Zero** button to zero out any offset in the sensor.



10. Click the **Start** button, and then set the laser to ON to start to take power measurements.

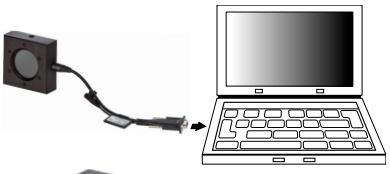


5.5.2 Measure Power With a PowerMax-RS Thermopile Sensor

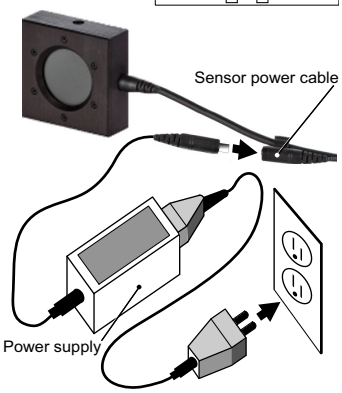
This quick-start tutorial shows how to get a power measurement with a PowerMax-RS thermopile sensor with the use of CMC software.

WARNING!
Make sure that the laser is set to OFF or shuttered before starting this tutorial.

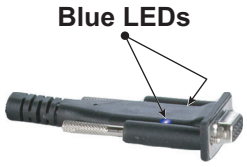
1. Attach the PowerMax-RS sensor into an available RS-232 COM port on the computer.



2. Attach the +5VDC power supply cable into the sensor power cable and the power supply into a wall electrical outlet. **NOTE**: The power supply—P/N 1105557— is available from Coherent as an optional accessory.



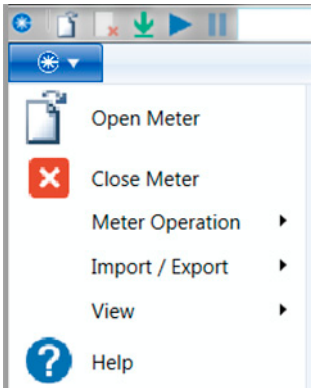
3. Make sure that the blue LEDs on the RS connector come on and slowly go up and down in intensity (which signifies the sensor is working).



4. Start the Coherent Meter Connection or PowerMax PC software.

5. Click **Open Meter** from the main drop-down menu.

6. From the dialog box, select the COM port to which the PowerMax-RS sensor is attached. The COM port number is automatically determined by the computer. (If needed, check in Device Manager for available COM ports.)

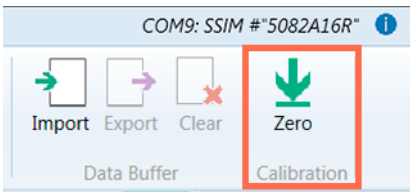


When the COM port is selected, the software scans that port and identifies the connected sensor/meter.

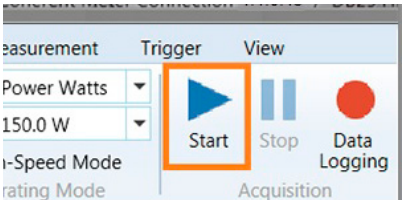
.

7. Make sure that the laser is set to OFF or shuttered until the sensor is set to zero.

8. Put the sensor into the beam path.
9. Click the **Zero** button to zero out any offset in the sensor.



10. Click the **Start** button and then set the laser to ON to start to take power measurements.



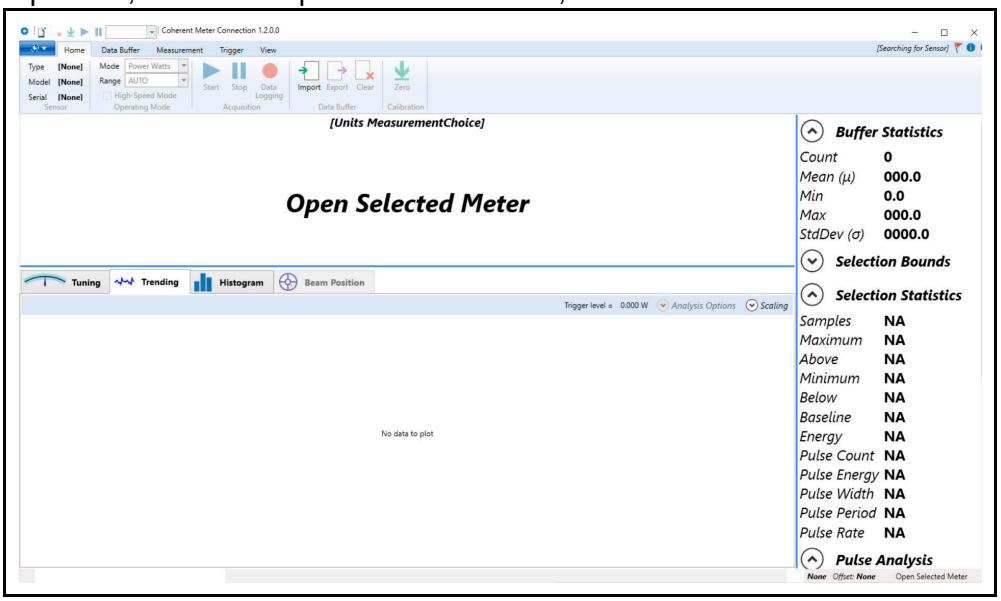
5.6 Understand and Use the CMC Software

This section describes the user interface, settings, and other key functions of the Coherent Meter Connection (CMC) software. For more details, refer to the *Coherent Meter Connection User Manual* (P/N 1343658).

For description of the legacy PowerMax PC software, refer to 'Understand and Use the PowerMax PC Software' (p. 82).

5.6.1 Home Screen

The main screen appears when the software is started. From here, users can enter parameters, select modes, change ranges, start/stop data acquisition, view the output in a chart format, and more.



Key software functions through the Home screen are discussed next.

5.6.2 Quick Start Icons

Table 5-1 shows these icons and a brief description of each. The description also lists any alternate locations in the software for the same command.

Table 5-1. Quick Start Icons

Icon	Description	Same function as…
	Access to Windows system menu	Includes standard Windows actions: Restore, Move, Size, Minimize, Maximize, and Close.
	Opens a COM port connection to the meter	Drop-down menu > Open Meter command.
	Clear the contents of the Capture Buffer	Drop-down menu > Meter Operation > Clear Buffer command. Also on the Home Tab > Clear icon.

Table 5-1. Quick Start Icons (continued)

Icon	Description	Same function as…
	Measure the sensor's zero baseline	Drop-down menu > Meter Operation > Zero Meter command. Also on the Home Tab > Zero icon.
	Start streaming measurements	Drop-down menu > Meter Operation > Start Measurements command. Also on the Home Tab > Start icon.
	Stop streaming measurements	Drop-down menu > Meter Operation > Stop Measurements command. Also on the Home Tab > Stop icon.

5.6.3 Set the Sensor to Zero

Press of the Zero button starts the Zero function and sets the current sensor input as the baseline for future measurements. *It is recommended to set the sensor to zero after first turning it on and before starting any new set of power measurements.*

When a zero procedure is in process, no other button events are queued or started until the procedure ends. The zero procedure immediately stops if the sensor is disconnected or if an error happens.

Normally, the Zero button must be clicked while the laser is set to off, or while the laser beam is blocked. If a finite power level is present at the sensor, the instrumentation will try to zero it out.

The sensor can only zero a finite level of offset equivalent to approximately 10% of full scale range.

NOTICE

If set to zero is not successful—which means the power input is too large to set to zero—set to zero again in a more stable environment or select a different range.

5.6.4 Set the Wavelength

The wavelength must always be set for accurate power measurements. This can be done either in the Coherent Meter Connection application software or over the host port via a host command.

The drop-down menu at the very top of the window, in CMC, displays the available wavelengths, as shown in the example in Figure 5-3.

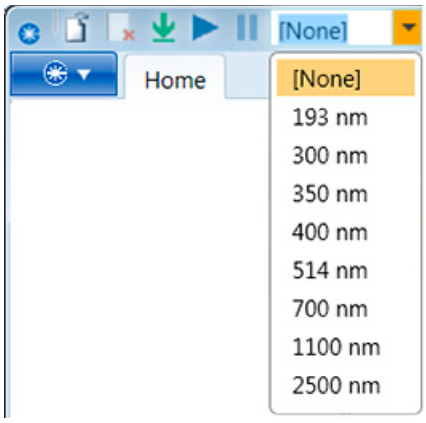
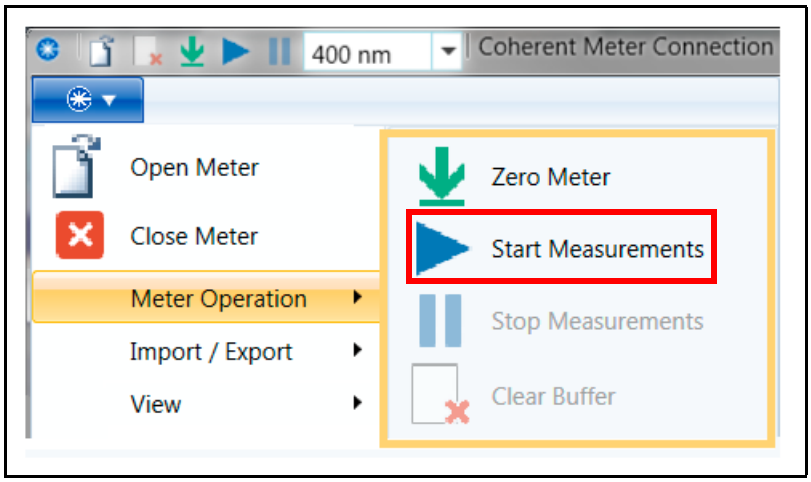


Figure 5-3. Quick Start —Laser Wavelength

5.6.5 Meter Operation and Start/Stop Data Collection

The Start and Stop Measurements functions enable/disable sample collection, including:

- The Trending chart
- Synchronized trending, if enabled
- The Histogram chart
- The Tuning chart
- All statistic and live reading indicators
- Data logging, if active



5.6.6 Software User Interface, Options and Controls

For detailed descriptions and information about the software user interface, settings, and controls, refer to the Coherent Meter Connection user manual.

Topics include the following and more:

- View Options
- Limits and Alarms
- Analysis Options
- Operating Modes
- Data Logging
- Data Buffer
- Measurement and Wavelength Settings
- Trigger Settings
- Condition Indicators
- Tuning, Trending and Histogram Panels

6 Advanced Procedures

6.1 PowerMax Communications Through a Terminal Emulator

The procedure described in this section works for both PowerMax-RS sensors and PowerMax-USB sensors.

NOTICE

***PowerMax-USB sensors only*: Before the following procedure is done, install the Coherent Meter Connection or PowerMax PC software to make sure that the USB driver is correctly installed on the computer. For information on how to add a sensor, refer to 'Measure Power With a PowerMax-USB Thermopile Sensor' (p. 28).**

1. Open the Device Manager on the computer and look for Coherent PowerMax RS or USB Sensor under the Ports (COM & LPT) heading.

   In the example below, the PowerMax-USB sensor is *COM12*.

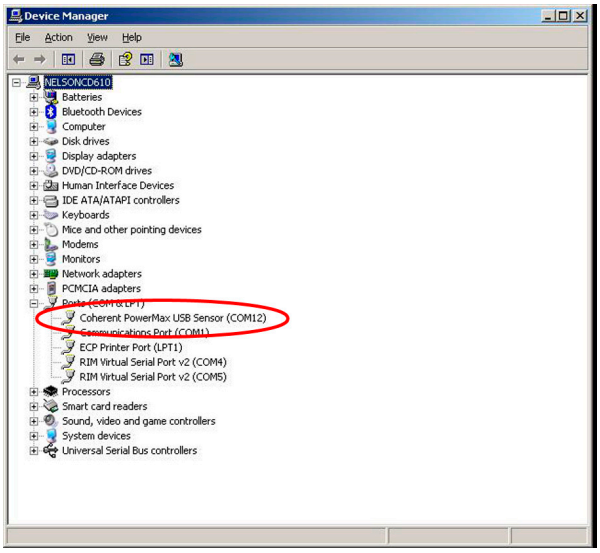


Figure 6-1. Device Manager Location

2. Open HyperTerminal (or an equivalent program) and select the port with which you want to communicate.

3. Set the following COM (communication) port settings:
   - Baud rate: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None

The following screens are set-up examples specifically for HyperTerminal:

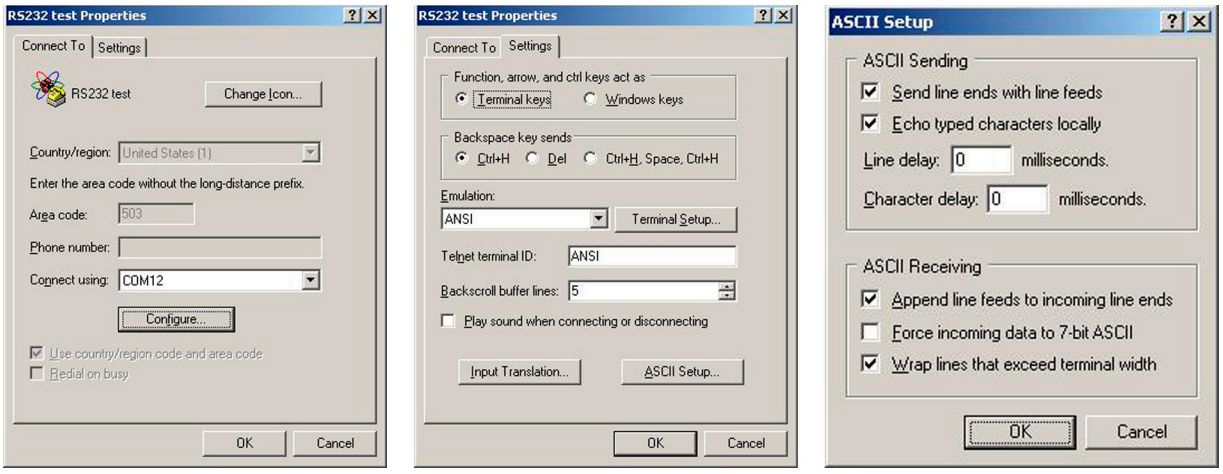


Figure 6-2. HyperTerminal Setup

HyperTerminal is now available to send and receive basic commands. The following example shows the 'PW?' query and the related response from the PowerMax-USB sensor.

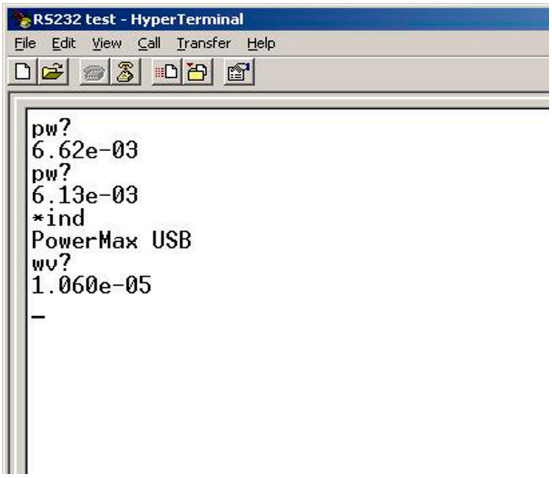


Figure 6-3. PW Query Example

7 Host Interface

In this section:

7.1 Introduction

For those customers who want to communicate with Coherent PowerMax-USB and PowerMax-RS sensors over a host interface—instead of using the Coherent Meter Connection software—we are providing a complete remote host command interface that can be used to control all aspects of sensor operation. Use this host interface environment to communicate with these sensors in an ad hoc manner using a terminal emulator, or to write custom software in a number of programming environments, including Visual Studio and LabVIEW.

The PowerMax-USB sensors utilize a standard Windows COM class driver and operate much like a serial port. After the driver is installed, the sensor will show up as a device on the computer's COM port and the host interface will accept commands and respond in ASCII format using commands that adhere to the SCPI standard.

The sensors also support a second ASCII command set used by our legacy LaserPAD/SSIM products, which allow drop-in software compatibility. For new software installations, we recommend using the newer SCPI-based command set.

For customers who prefer to capture streaming data over the host port—instead of the query method—we have implemented a special data streaming command interface. This interface requires the user to monitor

for a high/low bit—as described under 'Data Streaming Transmission Interface Gating Section' (p. 64)—and is a more advanced interface than the standard SCPI ASCII command language.

For customers who want streaming, and who want to stream in a purely ASCII format, there is a command in the legacy LaserPAD/SSIM command set that can be used—refer to 'Legacy LaserPAD/SSIM Interface Section' (p. 58).

The PowerMax-RS sensors support the same command set as the PowerMax-USB sensors. No driver is required, as they function as a serial device on an RS-232 port.

For customers who prefer to program in the National Instruments LabVIEW environment, we provide a full set of LabVIEW drivers on the installation CD that shipped with your system. In addition to a basic Getting Started VI that shows how to initiate communication with a PowerMax-USB or PowerMax-RS sensor, we also provide access to the architecture of our PowerMax PC software, which was written using our LabVIEW driver library.

7.2 Message Terminators

Messages between the sensor and the host computer are comprised entirely of ASCII string characters, and all message strings passing through the host interface are terminated to signal the end of a message string.

The one exception to messages comprised entirely of ASCII string characters is the Data Streaming Transmission Interface. After data streaming is initiated, the host sends unsolicited streaming data in non-ASCII format in which a high bit is set on all transmissions. The streaming data mode is covered under "Start Data Streaming Command" and "Stop Data Streaming Command" beginning on p. 62.

7.2.1 Messages Received by the Sensor

Messages received by the sensor must be terminated by a carriage return (decimal 13). Line feed characters (decimal 10) are discarded so message terminator flexibility can be attained. A command or query is considered incomplete without the terminator. The maximum length of any message received by the sensor is 200 bytes.

7.2.2 Messages Sent by the Sensor

All legacy SSIM messages sent by the sensor—defined under ’Legacy LaserPAD/SSIM Interface Section’ (p. 58)—are terminated by a carriage return.

All other messages sent by the sensor—defined under ’SCPI Interface Section’ (p. 44) and ’Data Streaming Transmission Interface Gating Section’ (p. 64)—are terminated by a carriage return and line feed pair.

7.3 Host Command Quick Reference

The following table gives a brief description of all host commands. For detailed information about a specific command, go to the page referenced in the right-hand column.

Table 7-1. Host Command Quick Reference (Sheet 1 of 4)

Command	Description	Page #
SCPI Interface		
SCPI Common Commands		
*RST	Resets all operational parameters to their power-on states.	7-45
*IDN?	Queries the sensor identification string.	7-45
System Options		
SYSTem:STATus?	Queries the system status.	7-46
SYSTem:INFormation:TEMPerature?	Queries the sensor temperature.	7-46
SYSTem:SYNC	Resets the system measurement sync timer.	7-46
SYSTem:SYNC?	Queries the system measurement sync timer.	7-46
SYSTem:RESTore	Restores the persistent data back to the factory settings.	7-47
SYSTem:COMMunicate:HANDshaking	Selects the state of SCPI message round trip handshaking.	7-47
SYSTem:COMMunicate:HANDshaking?	Queries the state of SCPI message round trip handshaking.	7-47

Table 7-1. Host Command Quick Reference (Sheet 2 of 4)

Error Record Reporting and Collection		
SYSTem:ERRor:COUNt?	Queries the number of error records in the error queue at the time of the query.	7-49
SYSTem:ERRor:NEXT?	Queries the next error record(s) in the error queue.	7-49
SYSTem:ERRor:ALL?	Queries all error records in the error queue at the time of the query.	7-49
SYSTem:ERRor:CLEar	Clears all error records in the error queue.	7-50
Measurement Setup and Control		
CONFigure:MEASure	Sets the sensor measurement mode.	7-50
CONFigure:MEASure?	Queries the sensor measurement mode.	7-50
CONFigure:SPEedup	Sets the speedup state.	7-50
CONFigure:SPEedup?	Queries the speedup state.	7-50
CONFigure:WAVElength	Sets the current wavelength.	7-50
CONFigure:WAVElength?	Queries the current wavelength.	7-50
CONFigure:GAIN:COMPensation	Enables or disables gain compensation.	7-51
CONFigure:GAIN:COMPensation?	Queries the state of gain compensation.	7-51
CONFigure:GAIN:FACTor	Sets the gain compensation factor.	7-51
CONFigure:GAIN:FACTor?	Queries the gain compensation factor.	7-51
CONFigure:ZERO	Sets the current measurement as the zero baseline measurement.	7-51
CONFigure:AMODe	Selects the measurement accuracy mode.	7-52
TRIGger:PTJ:LEVel	Selects the pulsed thermopile Joules mode trigger sensitivity level.	7-52
TRIGger:PTJ:LEVel?	Queries the pulsed thermopile Joules mode trigger sensitivity level.	7-52
Command	Description	Page #
Measurement Data Record Item Select and Format		
CONFigure:ITEMselect	Selects the transmit data items	7-52
Measurement Data Record Reading		

Table 7-1. Host Command Quick Reference (Sheet 3 of 4)

READ?	Queries the last recorded measurement at the time of the query.	7-54
Sensor Information		
SYSTem:INFormation:SNUMber?	Queries the serial number.	7-56
SYSTem:INFormation:PNUMber?	Queries the part number.	7-56
SYSTem:INFormation:MODel?	Queries the model name.	7-57
SYSTem:INFormation:CDATe?	Queries the calibration date.	7-57
SYSTem:INFormation:MDATe?	Queries the manufacturing date.	7-57
SYSTem:INFormation:TYPE?	Queries the sensor type and connection configuration.	7-57
SYSTem:INFormation:DIAMeter?	Queries the aperture diameter.	7-57
SYSTem:INFormation:WAVE-length?	Queries the default wavelength.	7-58
Legacy LaserPAD/SSIM Interface		
h	Queries the list of LaserPAD/SSIM commands.	7-58
*rst	Resets all operational parameters to their power-on states.	7-59
*ind	Queries the hardware description.	7-59
v?	Queries the firmware version.	7-59
vp?	Queries the data stream protocol version.	7-59
msn?	Queries the serial number.	7-59
mcal?	Queries the calibration date.	7-60
mfg	Queries the manufacturing date.	7-60
df?	Queries the sensor family.	7-60
app	Queries the aperture diameter.	7-60
rmi	Queries the minimum range.	7-60
rmx	Queries the maximum range.	7-61
spd?	Queries the speedup state.	7-61
spd	Toggles the speedup state.	7-61
wl?	Queries the default wavelength.	7-61

Table 7-1. Host Command Quick Reference (Sheet 4 of 4)

wv?	Queries the current wavelength.	7-61
wv	Sets the current wavelength.	7-62
pw?	Queries the current power reading.	7-62
pos	Queries the current beam position.	7-62
tmp	Queries the current thermistor ADC value.	7-62
dst	Enables LaserPAD/SSIM interface data streaming.	7-62
dsp	Disables LaserPAD/SSIM interface data streaming.	7-63
Data Streaming Transmission Interface Gating		
INITiate	Enables data streaming interface transmission.	7-64
ABORt	Disables data streaming interface transmission.	7-64

7.4 SCPI Interface Section

7.4.1 Syntax and Notation Conventions

Unless otherwise specified, all SCPI commands and queries follow the syntax and notation conventions specified by the SCPI Standard. For more information, refer to the SCPI Standard—found on the IVI Foundation website.

All commands must end with a carriage return character. A carriage return character instructs the meter that the full command has been received.

The base-10 numeric data format specification is used heavily in this document. Unless otherwise specified, numeric data items are represented as:

- Integer values
- Non-scientific notation floating point values
- Scientific notation floating point values (upper / lower case E)

For example, the following data values are functionally equivalent:

- 31256
- 31256.0

- 3.1256E4
- 31.256E3
- +3.1256E+4.

Unless otherwise specified, non-numeric data items (typically referred to as strings) are not quoted.

Enumerated values must exactly match, using the long form/short form comparison rules defined under the SCPI Standard.

7.4.2 Commands and Queries

7.4.2.1 SCPI Common Commands

The SCPI Standard specifies a standard set of common commands. All common commands and queries start with an asterisk.

7.4.2.1.1 Reset Command - *RST

Resets all operational parameters to their power-on states. Reset does not affect factory settings. Also see ’Reset Command - *RST’ (p. 45).

Command: *RST

Query: none

7.4.2.1.2 Identification Query - *IDN?

Queries the sensor identification string, such as model name, firmware version, and firmware date.

Query: *IDN?
Reply: “Coherent, Corp – PowerMax” + <type> + “–” + <version> + “–” + <firmware date> *Note: The quotes are not transmitted*.

Example reply: Coherent, Corp – PowerMax-USB – V1.3 – Jul 10 2009

7.4.2.2 System Options

The system commands and queries access functionality that is exclusive of sensor measurement functions. These commands can be sent at any time without affecting a measurement in progress.

7.4.2.2.1 System Status

Queries the system status. Status is returned in a string containing one ASCII character for each status condition that is asserted. If the status condition character is present, the condition is asserted. If the status condition character is absent, the condition is not asserted. The following table describes the status condition character mapping.

Table 7-2. Status Condition Character Definitions

Status Character	Status Condition
T	Damage temperature is exceeded
0 (zero)	No status condition is asserted

Command: none

Query: SYSTem:STATus?
Reply: <status>

Example: If the sensor damage temperature is exceeded, the system status query will return:

“T” note*: The quotes are not transmitted*.

7.4.2.2.2 Sensor Temperature

Queries the sensor temperature.

Command: none

Query: SYSTem:INFormation:TEMPerature?
Reply: <sensor temperature in degrees Celsius in integer format>

The literal string “NA” (quotes not included) is returned if the sensor does not have a temperature measurement capability.

7.4.2.2.3 System Sync

Resets the system measurement sync timer. This query gets the system measurement sync timer value. The system measurement sync timer is a free-running timer that increments by one for every 1 millisecond of

elapsed time. It is necessary to synchronize the measurement sync timers of all sensors that are used for applications requiring synchronization. The maximum value of this timer is 4294967295 milliseconds; however, to counteract clock creep, the system sync command should be sent at intervals not to exceed 10 minutes.

Command: SYSTem:SYNC

Query: SYSTem:SYNC?
Reply: <current timer value>

7.4.2.2.4 System Restore

Restores the persistent data back to the factory settings, which erases user-defined settings.

Command: SYSTem:RESTore

Query: none

7.4.2.2.5 Message Handshaking

Selects the state of SCPI message round trip handshaking.

Command: SYSTem:COMMunicate:HANDshaking {ON|OFF}
Reply: OK if ON is selected; otherwise, no reply is sent

Default is OFF.

Query: SYSTem:COMMunicate:HANDshaking?
Reply: ON|OFF

If handshaking is ON:

- Empty commands (that is, commands with only whitespace characters) reply with “OK\r\n”
- Valid commands with valid data reply with “OK\r\n”
- Valid queries with valid data reply as explicitly defined elsewhere in this section, followed by “OK\r\n”
- Valid commands or queries which result in an error reply with “ERR<n>\r\n”, where <n> is the error code number—see ’Error Record Reporting and Collection’ (p. 48).
- Unrecognized commands or queries reply with “ERR100\r\n”
- Error queuing occurs, as explicitly defined elsewhere in this document

If handshaking is OFF:

- All command and query response will behave as explicitly defined elsewhere in this section

7.4.2.3 Error Record Reporting and Collection

Programming and system errors occasionally occur while testing or debugging remote programs, and during measurement. Error strings follow the SCPI Standard for error record definition:

<error code>,<quoted error string>

The host queries for errors in two steps:

1. The host queries for the number of error records available (N).
2. The host queries N times for the error records.

Errors are stacked up to 20 deep. In the case of error overflow, the last error in the error list is an indication of error overflow. The possible error strings are shown in the following table.

Table 7-3. Error Codes and Description Strings

Error Code	Quoted Error String	Error Description
-350	“Queue overflow”	Error queue is full
-310	“System error”	Unexpected/unrecoverable hardware or software fault
0	“No error”	No error
100	“Unrecognized command/query”	The command or query is not recognized
101	“Invalid parameter”	The command or query parameter is invalid
102	“Data error”	A data error was encountered

Error -350 is raised when the error queue becomes full. Non-“Queue overflow” errors are replaced by “Queue overflow” errors when there is exactly one available storage location available in the error queue. No additional errors are added to the error queue if the error queue is full.

Error -310 is raised when the firmware detects an unexpected or unrecoverable error. This error condition includes unrecoverable hardware faults.

Error 100 is raised when the sensor receives an unrecognized command or query.

Error 101 is raised when the sensor receives a command or query with one or more invalid data parameters.

Error 102 is raised when the sensor receives a command or query for which no valid data exists.

7.4.2.3.1 Error Count Query

Queries the number of error records in the error queue at the time of the query.

Command: none

Query: SYSTem:ERRor:COUNt?
Reply: <count of error records stored in integer format>

7.4.2.3.2 Error Query

Queries the next error record(s) in the error queue. More than one error record may be queried using the optional <error record count> parameter, which must be an integer value. A single error record is returned if <error record count> is not specified. No reply is transmitted if no error records are available.

As the sensor transmits each error record:

- The error record is permanently removed from the error queue
- The queued error record count decrements by one

Command: none

Query: SYSTem:ERRor:NEXT? [<error record count>]
Default is not applicable.
Reply: <next available error record(s)>

7.4.2.3.3 All Error Query

Queries all error records in the error queue at the time of the query. No reply is transmitted if there are no error records available.

After completion of the reply transmission:

- The error queue will be empty
- The queued error record count will be zero

Command: none

Query: SYSTem:ERRor:ALL?
Reply: <all available error record(s)>

7.4.2.3.4 All Error Clear

Clears all error records in the error queue.

Command: SYSTem:ERRor:CLEar

Query: none

7.4.2.4 Measurement Setup and Control

7.4.2.4.1 Measurement Mode

Sets the sensor measurement mode to select either power (Watts) or energy (Joules) measurement mode. Note: Joules measurement mode is only possible with a thermopile type power sensor.

Command: CONFigure:MEASure {DEFault|J|W}
Default is W (Watts) mode.

Query: CONFigure:MEASure?
Reply: J|W

Error 100 is raised if the sensor is an optical sensor.

7.4.2.4.2 Speedup

Sets the speedup state. The query gets the speedup state.

Command: CONFigure:SPEedup {DEFault|ON|OFF}
Default is OFF

Query: CONFigure:SPEedup?
Reply: {ON|OFF}

Error 100 is raised if the sensor is an optical sensor.

7.4.2.4.3 Wavelength

Sets the current wavelength, which is committed to persistent storage when it is changed. If the requested wavelength is *greater* than the upper wavelength limit, the current wavelength is set to the upper wavelength limit. Likewise, if the requested wavelength is *less* than the lower wavelength limit, the current wavelength is set to the lower wavelength limit.

The minimum and maximum allowed wavelength may also be named as data arguments. The query gets the current maximum or minimum allowed wavelengths, depending on the optional query data argument.

Command: CONFigure:WAVElength {MINimum|
MAXimum|<requested wavelength in nm>}

Query: CONFigure:WAVElength? [MINimum|
MAXimum]
Reply (*if [MINimum|MAXimum] is not specified*):
<granted wavelength in nm>
Reply (*if MAXimum is specified*):
<allowed maximum wavelength in nm>
Reply (*if MINimum is specified*):
<allowed minimum wavelength in nm>

7.4.2.4.4 Gain Compensation

Enable/Disable State

Enables or disables gain compensation, which is committed to persistent storage when it is changed. If gain compensation is enabled, power readings sent over the host port will be measured power multiplied by the gain compensation factor.

Command: CONFigure:GAIN:COMPensation {DEFault|OFF|ON}
Default is OFF

Query: CONFigure:GAIN:COMPensation?
Reply: OFF|ON

Factor

Sets the gain compensation factor, which is committed to persistent storage when it is changed.

Command: CONFigure:GAIN:FACTor {DEFault|
<0.001...100000.0>}
Default is 1.0

Query: CONFigure:GAIN:FACTor?
Reply: <gain compensation factor>

7.4.2.4.5 Sensor Zero

Sets the current measurement as the zero baseline measurement. We recommend that the sensor is set to zero prior to measuring power to null out any offset in the power sensor. If a thermopile was recently touched or exposed to heat, wait for the sensor to settle back to a stable zero point before the Zero command is sent.

Command: CONFigure:ZERO

7.4.2.4.6 Accuracy Mode

Selects the measurement accuracy mode. The available modes are power-only and power-plus-position.

Command: CONFigure:AMODe {DEFault|PONly|PPPosition}
Default is PPPosition (power plus position) mode

Query: CONFigure:AMODe?
Reply: PONLY|PPPOSITION

Error 100 is raised if the sensor is a mono or optical sensor.

7.4.2.4.7 Pulsed Thermopile Joules Trigger Level

Selects the pulsed thermopile Joules mode trigger sensitivity level.

Command: TRIGger:PTJ:LEVel {DEFault|LOW|MEDium|HIGH}
Default is LOW

Query: TRIGger:PTJ:LEVel?
Reply: LOW|MEDIUM|HIGH

7.4.2.5 Measurement Data Record Item Select and Format

Data items that appear in a measurement data record are selectable. Available selections differ, based on measurement mode and sensor type.

This command selects the transmit data items transmitted in non-SIMM measurement data records—defined later in this section, and SSIM measurement data records—defined under 'LaserPAD/SSIM Streaming Data Record Format' (p. 63). The data argument is a comma-separated list of one or more tokens, shown below. At least one token must be specified. The tokens may be specified in any order.

Command: CONFigure:ITEMselect {MEAS,POS,FLAG,TST}

Query: CONFigure:ITEMselect?
Reply: one or more of MEAS|POS|FLAG|TST

Measurement data records contain one or more data items and are formatted according to the following table.

Table 7-4. Non-SIMM Measurement Data Record Formats

Sensor Type	Measurement Mode	Last Measurement Record Format
Thermopile Mono	Watts	<power>,<flags>,<timestamp>
	Joules	<energy>,<flags>,<timestamp>

Table 7-4. Non-SIMM Measurement Data Record Formats

Sensor Type	Measurement Mode	Last Measurement Record Format
Thermopile Quad	Watts	<power>,<X position>,<Y position>,<flags>,<time-stamp>
	Joules	<energy>,<flags>,<timestamp>
Optical	Watts	<power>,<flags>,<timestamp>

Each data item is selected for transmission using the ITEMselect command:

- <power>, expressed in Watts using the “%.5E” C formatting specification, is transmitted when MEAS is specified
- <energy>, expressed in Joules using the “%.5E” C formatting specification, is transmitted when MEAS is specified
- <X position> and <Y position>, expressed in mm using the “%.2E” C formatting specification, is transmitted when POS is specified
- <flags>, enumerated in Table 5 and described below, is transmitted when FLAG is specified
- <timestamp>, expressed in integer milliseconds, is transmitted when TST is specified

The <flags> data item, which communicates qualification information, is reported with each data message. Qualification information includes various error conditions. It is reported in a string containing one ASCII character for each qualification that is asserted.

- If the qualification character is present, the qualification is asserted.
- If the qualification condition character is absent, the qualification is not asserted.

Each character present has a unique meaning as described in the following table.

Table 7-5. Flags Character Definitions (Sheet 1 of 2)

Qualification Character	Qualification Meaning
R	Over-range error
N	Negative power

Table 7-5. Flags Character Definitions (Sheet 2 of 2)

Qualification Character	Qualification Meaning
S	Measurement is sped up
T	Over-temperature error
0 (zero)	No qualification exists

Selecting POS for non-quad sensors has no effect on the transmission of data records.

X and Y positions are zero if the power is less than 10% of the minimum range—refer to 'Minimum Range Query' (p. 60).

The data has over-range status if the power is greater than the maximum range—refer to 'Maximum Range Query' (p. 61).

7.4.2.6 Measurement Data Record Reading

Queries the last recorded measurement at the time of the query. No reply is transmitted if a measurement has not been recorded.

Command: none

Query: READ?
Reply: <last measurement record>

The last measurement record is composed of comma-delimited data items generated at the same instant. The data items presented, including a flags item, varies, depending on the sensor type as enumerated in the following table.

Table 7-6. Measurement Data Record Formats

Sensor Type	Measurement Mode	Last Measurement Record Format
Thermopile Mono	Watts	<power>,<flags>,<timestamp>
	Joules	<energy>,<flags>,<timestamp>
Thermopile Quad	Watts	<power>,<X position>,<Y position>,<flags>,<time-stamp>
	Joules	<energy>,<flags>,<timestamp>
Optical	Watts	<power>,<flags>,<timestamp>

<power> will be expressed in Watts using the “%.5E” C formatting specification.

<energy> will be expressed in Joules using the “%.5E” C formatting specification.

<X position> and <Y position> will be expressed in mm using the “%.2E” C formatting specification.

<timestamp> will be expressed in integer milliseconds. This timestamp is based upon the system sync function. Zero time is set when the device receives the SYSTem:SYNC command.

The <flags> data item, which communicates qualification information, is reported with each data message. Qualification information—including various error conditions—is reported in a string containing one ASCII character for each qualification that is asserted.

- If the qualification character is present, the qualification is asserted.
- If the qualification condition character is absent, the qualification is not asserted.

Each character present has a unique meaning, as described in the following table.

Table 7-7. Flags Character Definitions

Qualification Character	Qualification Meaning
R	Over-range error
N	Negative power
S	Measurement is sped up
T	Over-temperature error
0 (zero)	No qualification exists

- X and Y positions are zero if the power is less than 10% of the minimum range.
- Data has over-range status if the power is greater than the maximum range.

The READ? query returns a power reading, along with a flag and a timestamp. The power reading is in the format of *X.XXXXX*, followed by an exponent value. In the following example, two readings were taken:

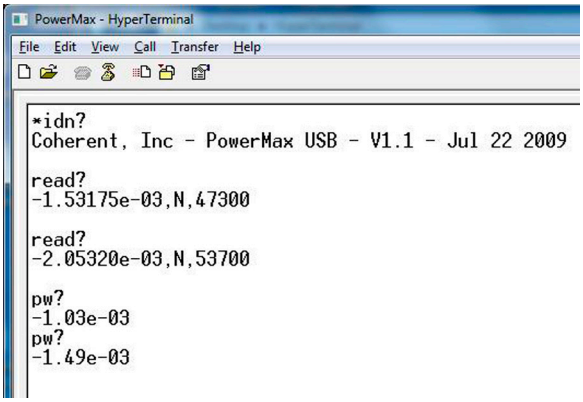


Figure 7-1. Read Query Example

- The first power reading return is *-1.53175e-03*, followed by the *N* flag (indicating a negative power reading—meaning the sensor has not yet been properly zeroed), and then the timestamp (*47300* ms).
- The second power reading return is *-2.05320e-03*, followed by the *N* flag and the timestamp (*53700* ms).

The READ? query separates the reading into several parts. If only a numeric value for a power reading is needed, use the PW? query, which is easier to use if you want a power reading and aren't worried about checking for errors or a timestamp.

For more information about the PW? query, refer to ’Current Power Reading Query’ (p. 62).

7.4.2.7 Sensor Information

The sensor can be queried for unit identification and quality control information.

7.4.2.7.1 Serial Number

The query gets the sensor serial number.

Query: SYSTem:INFormation:SNUMber?
Reply: <quoted serial number>

7.4.2.7.2 Part Number

The query gets the part number.

Query: SYSTem:INFormation:PNUMber?
Reply: <quoted part number>

7.4.2.7.3 Model Name

The query gets the model name.

Query: SYSTem:INFormation:MODel?
Reply: <quoted model name>

7.4.2.7.4 Calibration Date

The query gets the calibration date.

Query: SYSTem:INFormation:CDATe?
Reply: <quoted calibration date>

7.4.2.7.5 Manufacturing Date

The query gets the manufacturing date.

Query: SYSTem:INFormation:MDATe?
Reply: <quoted calibration date>

7.4.2.7.6 Sensor Type and Connection Configuration

The query gets the sensor type and connection configuration (thermopile mono, thermopile classical quad, thermopile enhanced quad, or optical).

Query: SYSTem:INFormation:TYPE?
Reply: <type>,<qualifier>

<type> is one of THERMO or OPT.
<qualifier> is one of SINGLE, QUAD, ENHQUAD, or NOSPEC.

7.4.2.7.7 Aperture Diameter

The query gets the aperture diameter.

Query: SYSTem:INFormation:DIAMeter?
Reply: <aperture diameter in mm>

7.4.2.7.8 Default Wavelength

The query gets the default wavelength.

Query: SYSTem:INFormation:WAVElength?
Reply: <default wavelength in nm>

7.5 Legacy LaserPAD/SSIM Interface Section

PowerMax-USB and PowerMax-RS sensors support the legacy LaserPAD/SSIM host command sets. This offers customers the capability of using PowerMax-USB And PowerMax-RS sensors as drop-in replacements for their current OEM sensors. The LaserPAD/SSIM interface supports all LaserPAD/SSIM commands, queries, and responses, except those related to PocketPC mode.

7.5.1 Commands and Queries

Note that some LaserPAD/SSIM commands also have defined replies.

7.5.1.1 Help Query

Queries the list of LaserPAD/SSIM commands.

Query: h
Reply:

“*rst - reset system
*ind - identify system
app - get aperture diameter
cal - get calibration date
df? - get family
dsp - stop data streaming
dst - start data streaming
dt? - get name
h - show this help
mfg - get manufacture date
pos - get x,y position in mm
pw? - get power in watts
rmi - get minimum range
rmx - get maximum range
sn? - get serial number
tmp - get thermistor reading
v? - get firmware version
vp? - get protocol version

wl? - get default wavelength
wv <float> - set current wavelength in meters
wv? - get current wavelength in meters
spd - toggles speedup state on/off
spd? - queries the speedup state" *Note: The quotes are not transmitted*.

7.5.1.2 Reset Command

Resets all operational parameters to their power-on states. Reset does not affect factory settings. Also refer to 'Reset Command - *RST' (p. 45).

Command: *rst
Reply: none

7.5.1.3 Hardware Description Query

Queries the hardware description.

Query: *ind
Alias query: dt?
Reply: "PowerMax" + <type> *Note: The quotes are not transmitted*.

Example reply: PowerMax USB

7.5.1.4 Firmware Version Query

Queries the firmware version.

Query: v?
Reply: <the firmware version string>

7.5.1.5 Data Stream Protocol Version Query

Queries the data stream protocol version.

Query: vp?
Reply: "v.12.10.03" *Note: The quotes are not transmitted*.

7.5.1.6 Serial Number Query

Queries the serial number.

Query: msn?
Alias query: sn?
Reply: <serial number>

7.5.1.7 Calibration Date Query

Queries the calibration date.

Query: mcal?
Alias queries: cal and cal?
Reply: <calibration date>

7.5.1.8 Manufacturing Date Query

Queries the manufacturing date.

Query: mfg
Alias query: mmfg?
Reply: <manufacturing date>

7.5.1.9 Sensor Family Query

Queries the sensor family.

Query: df?
Reply: {“thermal”|“quantum”} *Note: The quotes are not transmitted*.

7.5.1.10 Aperture Diameter Query

Queries the aperture diameter, a fixed value.

Query: app
Reply: <aperture diameter in mm>

7.5.1.11 Minimum Range Query

Queries the minimum range.

Query: rmi
Reply: <minimum allowed power measurement in watts>

7.5.1.12 Maximum Range Query

Queries the maximum range.

Query: rmx
Reply: <maximum allowed power measurement in watts>

7.5.1.13 Speedup State Query

Queries the speedup state.

Query: spd?
Reply: {“on”|“off”} *Note: The quotes are not transmitted*.

7.5.1.14 Speedup State Toggle Command

Toggles the speedup state. If the speedup state is ON, sending the command turns speedup OFF, and vice versa.

Command: spd
Reply: {“speedup threshholding is on.”|“speedup threshholding is off.”} *Note: The quotes are not transmitted*.

7.5.1.15 Default Wavelength Query

Queries the default wavelength.

Query: wl?
Reply: <default wavelength in meters>

7.5.1.16 Current Wavelength Query

Queries the current wavelength.

Query: wv?
Reply: <current wavelength in meters>

7.5.1.17 Current Wavelength Command

Sets the current wavelength, which is committed to persistent storage when it is changed. If the requested wavelength is greater than the upper wavelength limit, the requested wavelength is set to the upper wavelength limit. Likewise, if the requested wavelength is less than the lower wavelength limit, the requested wavelength is set to the lower wavelength limit.

Command: wv <requested wavelength in meters>
Reply: <granted wavelength in meters>

7.5.1.18 Current Power Reading Query

Queries the current power reading.

Query: pw?
Reply: <current power reading in watts>

7.5.1.19 Current Beam Position Query

Queries the current beam position. If the sensor is an optical sensor, the returned position X and Y values are 0.

Query: pos
Reply (*thermopile quad sensor*): <X position in mm>,<Y position in mm>
Reply (thermopile mono or optical sensor): 0,0

Note that X and Y positions are zero if the sensor is a thermopile mono or if the power is less than 10% of the minimum range—see 'Minimum Range Query' (p. 60).

7.5.1.20 Current Thermistor Counts Query

Queries the current thermistor ADC value.

Query: tmp
Reply: <thermistor integer ADC counts>

7.5.1.21 Start Data Streaming Command

Enables LaserPAD/SSIM mode interface data streaming. Streaming data records are transmitted at 10 Hz. Streaming data records continue to be transmitted until the Stop Data Streaming command (see below) is issued.

Command: dst
Reply: none

7.5.1.22 Stop Data Streaming Command

Disables LaserPAD/SSIM mode interface data streaming.

Command: dsp
Reply: none

7.5.2 LaserPAD/SSIM Streaming Data Record Format

The LaserPAD/SSIM mode streaming data record format is different for thermopile and optical sensors, as shown in the following table.

Table 7-8. Measurement Data Record Formats

Sensor Type	Last Measurement Record Format
Thermopile	*<X position in mm>,<Y position in mm>,<power in Watts>,<status code>
Optical	*<power in Watts>,<status code>

The asterisk is literal.

X and Y position are zero if the sensor is a thermopile mono or if the power is less than 10% of the minimum range—see 'Minimum Range Query' (p. 60).

The data has over-range status if the power is greater than the maximum range—see 'Maximum Range Query' (p. 61).

Each data item is selected for transmission using the ITEMselect command—see 'Measurement Data Record Item Select and Format' (p. 52):

- <power in Watts>, expressed in Watts using the "%.3e" C formatting specification, is transmitted when MEAS is specified
- <X position in mm> and <Y position in mm>, expressed in mm using the "%.2e" C formatting specification, is transmitted when POS is specified
- <status code> (described below) is transmitted when FLAG is specified

Status code:

c = Measurement data is valid

r = Measurement is over-range

t = Sensor temperature exceeds the damage temperature

7.6 Data Streaming Transmission Interface Gating Section

The data streaming transmission interface should not be confused with legacy LaserPAD/SSIM mode interface data streaming. Gating of the data streaming transmission is controlled by the INITiate and ABORt commands (described under “Initiate Command” and “Abort Command” below).

7.6.1 Streaming Measurement Data

In data streaming mode, the host has control over when measurement data is transmitted from the data streaming transmission interface.

Transmission is enabled after an INITiate command and disabled after an ABORt command.

When transmission is enabled, measurement data records are transmitted immediately as they are generated.

7.6.2 Commands and Queries

7.6.2.0.1 Initiate Command

Enables data streaming interface transmission. This command is ignored if data streaming interface transmission is already enabled.

Command: INITiate

Query: none

7.6.2.0.2 Abort Command

Disables data streaming interface transmission. This command is ignored if data streaming interface transmission is already disabled.

Command: ABORt

Query: none

Data streaming transmission messages are ASCII formatted, but not strictly so. The high bit (mask 0x80) is always set for all bytes of all data streaming transmission messages, including the terminators. This allows host software to easily differentiate between data streaming transmission messages and LaserPAD/SSIM and SCPI reply messages. The host may operate using the rule that if the high bit is set on any byte received from the sensor, it is part of a data streaming transmission message.

Data streaming transmission messages are immediately sent to the host in ASCII text form as measurements are generated (see Table 7-9, below). Each message conforms to the last measurement data record format but with the high bit set in all transmitted bytes.

Table 7-9. Data Streaming Transmission Rates

Sensor Type	Measurement Mode	Transmission Rate
Thermopile	Watts	Continuously at 10 Hz
Thermopile	Joules	When pulse energy is calculated
Optical	Watts	Continuously at 10 Hz

7.7 Operational Parameters

All operational parameters—except the current wavelength, gain compensation factor, and gain compensation state—are not persistent after a reset cycle. The following table shows all operational parameters.

Table 7-10. Operational Parameters (Sheet 1 of 2)

Parameter	Power-on State
Speedup state	Off
Measure Mode	Watts
Error count	0
LaserPAD/SSIM data streaming state	Stopped/Disabled
Data streaming transmission interface state	Stopped/Disabled

Table 7-10. Operational Parameters (Sheet 2 of 2)

Parameter	Power-on State
Sync	0
SCPI handshaking	Off
Zero	Factory setting
Pulsed thermopile Joules mode trigger sensitivity level	Low
Accuracy mode	Power-plus-position
Current wavelength (persistent)	Last granted setting
Gain compensation factor (persistent)	Last setting
Gain compensation state (persistent)	Last setting
Wavelength correction cursor	0/start
Temperature compensation cursor	0/start
Power compensation cursor	0/start

7.8 RS-232 Port Settings

The PowerMax-RS sensors communicate over an RS-232 port using the RS-232 settings shown in the following table.

Table 7-11. RS-232 Port Settings

Parameter	Setting
Baud rate	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

8 Calibration, Warranty and Service

In this section provides information on calibration, warranty, service, and product shipment instructions.

8.1 Calibration

Coherent laser power and energy meters are precision instruments, capable of delivering very accurate measurements, as well as providing many years of useful service. To maintain this high level of performance, it is important to have measurement systems serviced and re-calibrated once a year.

A large percentage of Coherent calibrations are performed within five business days, and expedited service is available, to minimize customer downtime.

8.1.1 Scope of Calibration

Calibration of a Coherent power and energy laser measurement product includes:

- Calibration to original uncertainty levels
- Minor repairs (see more information, below)
- Extended 12 month warranty, on eligible products
- Fast calibration turn around time.

Minor repairs includes fixing manufacturer's defects, hardware updates, firmware, software updates, damaged connectors, and other small repairs. Detector element replacement due to laser damage and damage caused by negligent use is not covered – for customer caused damaged an additional repair service charge is applied.

This level of service results in an overall lower cost of ownership, with many owners realizing a lifetime warranty for their products.

8.1.2 Re-certify Once a Year

Coherent laser power and energy meters are precision instruments, capable of delivering very accurate measurements as well as providing many years of useful service. To maintain this high level of performance, and to ensure compliance with your quality and ISO certification, it is important to have measurement systems serviced and re-certified once per year.

Extended use of laser power and energy meters and sensors, as well as environmental factors, can have an adverse effect on accuracy and also result in wear and/or damage to parts critical to optimum performance.

8.1.3 Coherent Calibration Facilities and Capabilities: ISO 17025 Accredited

Coherent calibration facilities contain the widest possible range of light sources from 193 nm to 10,600 nm, with powers ranging nanowatts to kilowatts.

Coherent Wilsonville, Oregon, and its satellite sites, are fully accredited to ISO/IEC 17025:2017 by ANAB - The ANSI National Accreditation Board. ANAB is a signatory of the International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC) multilateral recognition arrangements. ANAB has signed the MRAs of the InterAmerican Accreditation Cooperation (IAAC) and the Asia Pacific Accreditation Cooperation (APAC). Accreditation to ISO/IEC 17025 is the formal recognition that a calibration laboratory is technically competent to carry out specific calibrations.

A detailed discussion of the Scope of Accreditation and the Technical Requirements of ISO 17025 Accreditation can be found on the Coherent ISO 17025:2017 Accreditation web page.

In addition, Coherent team delivers the industry's best service, with a knowledgeable and responsive staff, and rapid turnaround.

8.2 Warranty

8.2.1 Limited Warranty

Coherent, Corp. (the “Company”) warrants its laser power and energy meters and sensors products (“Products”) to the original purchaser (the “Customer”) that the product is free from defects in materials and workmanship and complies with all specifications, active at the time of purchase, for a period of twelve (12) months.

Coherent, Corp. will, at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferable.

8.2.2 Warranty Limitations

The foregoing warranties shall not apply, and Coherent reserves the right to refuse warranty service, should malfunction or failure result from:

- Damage caused by improper installation, handling or use.
- Laser damage (including sensor elements damaged beyond repair).
- Failure to follow recommended maintenance procedures.
- Unauthorized product modification or repair.
- Operation outside the environmental specifications of the product.

Coherent assumes no liability for Customer-supplied material returned with Products for warranty service or recalibration.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL, OR IMPLIED. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR ANY INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS PRODUCTS.

8.3 Extended Warranty Program

Coherent, Corp. (the “Company”) offers original purchasers (the “Customer”) purchasing laser power and energy meters and sensors products (“Products”) an extended twelve (12) month warranty program, which includes all parts and labor. In order to qualify for this warranty, a Customer must return the Product to the Company for recalibration and recertification.

- The Company will re-certify the Product, provide software upgrades, and perform any needed repairs, and recalibrate the Product, for a fixed service fee (as established by the Company from time to time and in effect at the time of service).
- If the product cannot be re-certified due to damage beyond repair, parts obsolescence, or other reasons, the Customer may be informed that an Extended Warranty program is not available for the Product.

If the Product fails and is returned to the Company within one year following the date of recalibration and recertification service, the Company will, at its option, repair or replace the Product or any component found to be defective. If the Product must be replaced and the Product is no longer available for sale, Coherent reserves the right to replace with an equivalent or better Product. This warranty applies only to the original purchaser and is not transferable.

8.4 Obtain Service

In order to obtain service under this warranty, the Customer must notify the Company of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Company shall, in its sole discretion, determine whether to perform warranty service at the Customer's facility, at the Company's facility or at an authorized repair station.

If Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall:

Package the product (to protect from damage during shipping).

Ship it to the address specified by the Company, shipping prepaid. The customer shall pay the cost of shipping the Product back to the Customer in conjunction with recalibration and recertification.

The Company shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve (12) months from time of sale or during an extended 12-month warranty period.

8.5 Product Shipment Instructions

A Returned Material Authorization number (RMA) assigned by the Company must be included on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender.

Table 8-1. Coherent Service Centers

Location	Phone	Fax	E-mail
USA	1–(800)–367–7890	503-454-5777	Customer.Support@coherent.com or LSMservice@Coherent.com
Europe	Germany: +49–6071–968–0 Japan: +813–5635–8680	+49-6071-968-499	
International	+1–(408)–764–4983	503-454-5777	

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service (refer to Table 8-1, above) for a Return Material Authorization number.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number that was received from Coherent Customer Service.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. If the original packing material and carton are not available:
   a.) Locate a corrugated cardboard shipping carton with inside dimensions that are at least 6 in. (15 cm) taller, wider, and deeper than the product. The shipping carton must be constructed of cardboard with a minimum of 375 lb. (170 kg) test strength.
   b.) Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the product. Allow 3 in. (7.5 cm) on all sides, top, and bottom.
5. Make a seal on the shipping carton with shipping tape or an industrial stapler.

   Add the RMA number received from Coherent Customer Service to the shipping label on the outside of the box.

   Ship the product to one of the following repair and calibration facilities:

   USA

   Coherent Laser Measurement and Control Service Center
   Attn: (your RMA number)
   27650 SW 95th Avenue
   Wilsonville, OR 97070

Europe

Coherent Shared Services B.V.
Dieselstr. 5 b
D-64807 Dieburg
Germany

Asia

Coherent, Inc. Japan
Atsugi Technical Center
Toda 1042-4
Atsugi, Kanagawa Prefecture
243-0023, Japan

Appendix A: Specifications

For an up-to-date list of all compatible sensors and their specifications, visit our website: www.Coherent.com/LMC.

Appendix B: Troubleshooting and Error Messages

B.1 The PC application crashes or is forced to quit.

If the application crashes or is forced to quit, PowerMax sensors connected to the computer may not properly release from remote mode.

***To clear the error**:* Disconnect and then reconnect the USB cable on each of the affected sensors.

B.2 An error message displays when the last sensor is removed.

The PC application displays a communications error if all PowerMax sensors are removed from the computer while the application is running. This error message operates as a reminder that there are no sensors available for data collection.

***To clear the error**:* Select **OK** in the error window(s). Reconnect the sensor to the computer and then click the **Select Sensor** button to continue.

B.3 An error message displays when a sensor is removed while acquiring data.

The PC application displays error windows if a sensor is removed while that sensor is streaming data. Data collection must be stopped before removing a sensor that is being used to collect data.

To clear the error**:* Click **OK** in the error window(s). Reconnect the sensor to the computer and then click the Select Sensor button to continue; or, select **File** > ***Exit, to exit the software.

B.4 Failed communications error.

The application displays an error if a communications failure occurs while reading sensor parameters.

***To clear the error**:* Click the **OK** button.

Appendix C: Operation with PowerMax PC

In this section mini tutorials are given for setup of PowerMax RS and PowerMax USB sensors. It also shows how to take a basic power measurement and provides an explanation of the PowerMax PC software functions. Topics include:

- 'Take a Power Measurement' (p. 77)
- 'Understand and Use the PowerMax PC Software' (p. 82)

C.1 Install the Software

Install the PowerMax PC software (for complete installation instructions, refer to the 'Software Installation' section of the *PowerMax-USB/RS Software Installation and Quick Start Guide*—P/N 1169931——that shipped with a system).

C.2 Take a Power Measurement

This section shows two 'mini-tutorials' that tell how to connect a PowerMax-USB or PowerMax-RS sensor to a PC and start taking measurements with the PowerMax PC software.

For instructions about communicating with the sensor directly through host commands, refer to 'Host Interface' (p. 39).

Tutorials include:

- Measure power with a PowerMax-USB thermopile sensor (p. 78).
- Measure power with a PowerMax-RS thermopile sensor (p. 79).

WARNING!
Follow all laser safety procedures. The laser must be switched OFF or shuttered before running the tutorials given in this section.

C.2.1 Measure Power With a PowerMax-USB Thermopile Sensor

This quickstart tutorial describes how to take a power measurement with a PowerMax-USB thermopile sensor and PowerMax PC software.

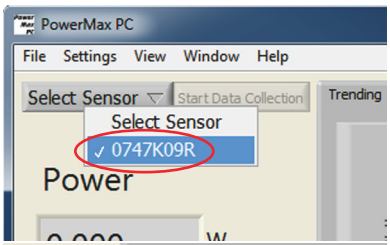
WARNING!
Confirm the laser is set to OFF or shuttered before starting this tutorial.

1. Attach the PowerMax-USB sensor to the PC.

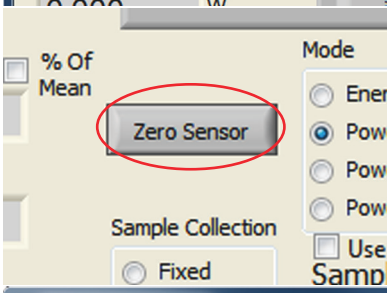
2. Make sure that the blue LEDs on the USB connector are come on and slowly ramping up and down in intensity (which signifies the sensor is operating and the driver is correctly loaded).

3. Start the PowerMax PC software.

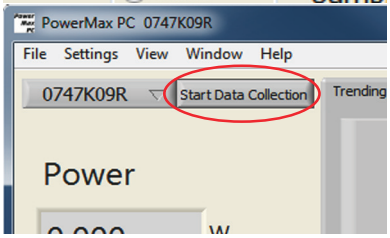
4. Select the sensor serial number from the **Select Sensor** drop-down menu. In the example at right, the selected sensor serial number is *0747K09R*.



5. Press the **Zero Sensor** button to zero out any offset in the sensor.



6. Press the **Start Data Collection** button and then set the laser to ON to start taking power measurements.



C.2.2 Measure Power With a PowerMax-RS Thermopile Sensor

Note the following:

This quickstart tutorial shows how to get a power measurement with a PowerMax-RS thermopile sensor and the use of PowerMax PC software.

Note that the PowerMax-RS sensor is powered by a +5 VDC power supply input.Refer to Figure C-1.

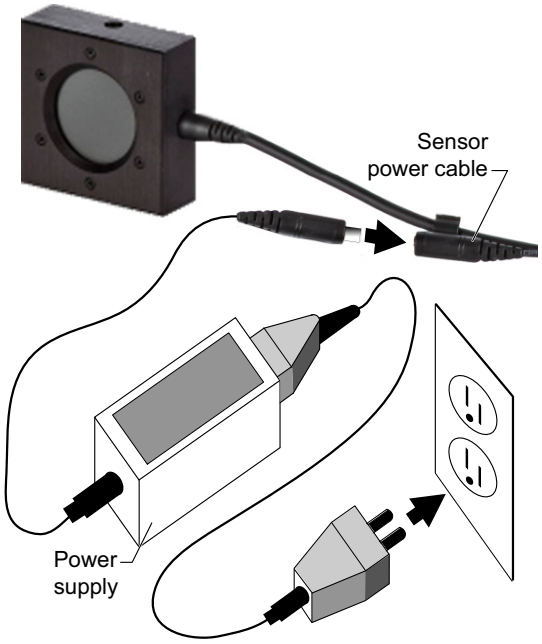
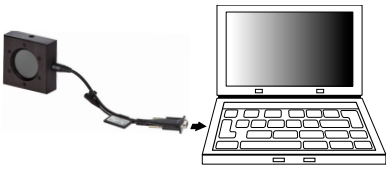


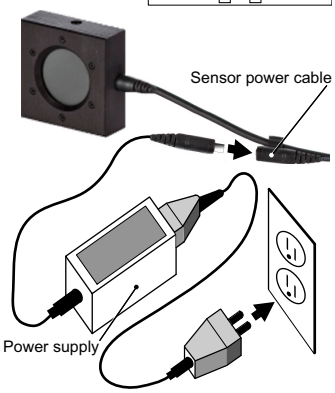
Figure C-1. Power Supply for the PowerMax-RS Sensor

WARNING!
Make sure that the laser is set to OFF or shuttered before starting this tutorial.

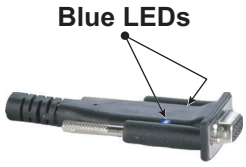
1. Plug the PowerMax-RS sensor into an available RS-232 COM port on the computer.



2. Attach the +5VDC power supply cable into the sensor power cable and the power supply into a wall electrical outlet. **NOTE**: The power supply—P/N 1105557— is available from Coherent as an optional accessory.

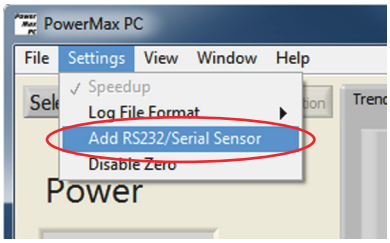


3. Make sure that the blue LEDs on the RS connector come on and slowly go up and down in intensity (which signifies the sensor is working).

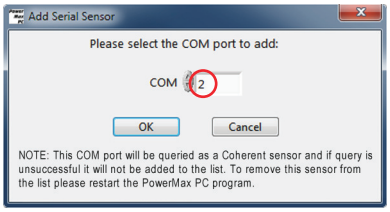


4. Start the PowerMax PC software.

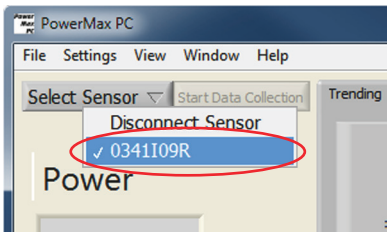
5. Click **Add RS-232/Serial Sensor** from the Settings drop-down menu.



6. From the Add Serial Sensor screen, select the COM port to which the PowerMax-RS sensor is attached. The COM port number is automatically determined by the computer. (If needed, check in Device Manager for available COM ports.) In this example, the selected COM port is 2.



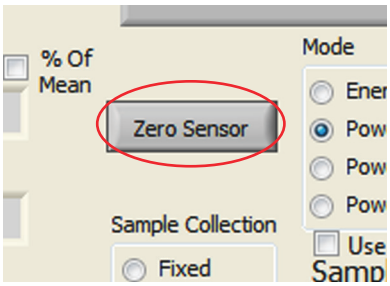
When the COM port is selected, the PowerMax PC software scans that port and identifies the connected sensor.



As long as the sensor is correctly connected and power is supplied up, the serial number of the sensor is available for selection from the drop-down menu in the software. In this example, the connected sensor is *0341I09R*.

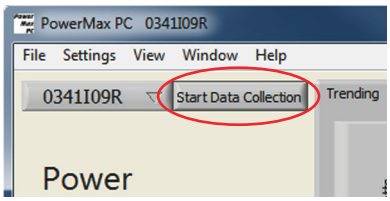
7. Put the sensor into the beam path, *making sure the laser is sett OFF or shuttered until the sensor is set* to zero.

8. Click the **Zero Sensor** button to zero out any offset in the sensor.



9. Click the **Start Data Collection** button

10. Set the Laser to ON to start to take power measurements.

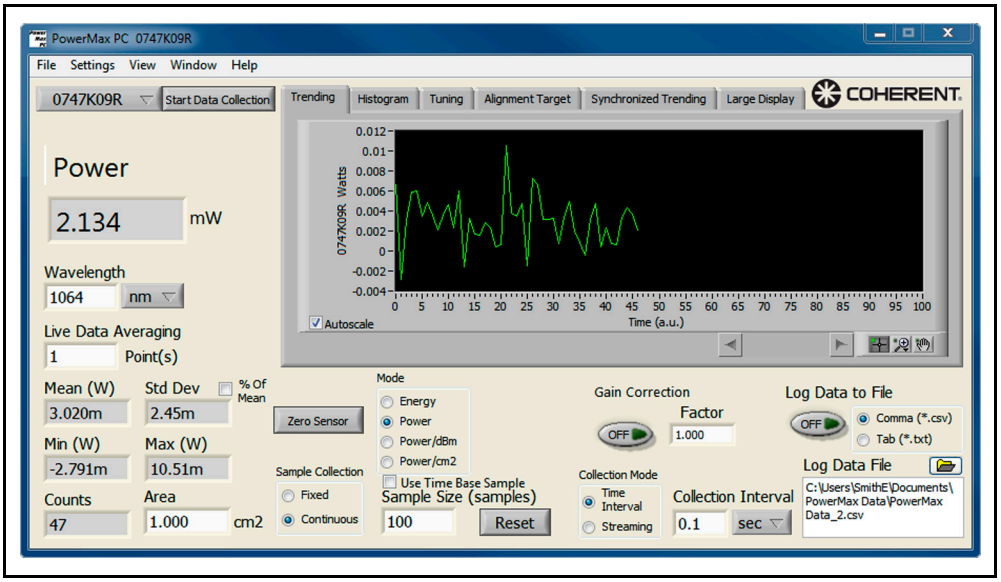


C.3 Understand and Use the PowerMax PC Software

C.3.1 Overview

C.3.1.1 Front Panel

The Front panel is the first screen that appears when the software is started. From here, enter parameters, select modes, change ranges, start/stop data acquisition, and view the output in a chart format.



Each function accessed through the Front panel is discussed, starting next.

C.3.1.2 Keyboard Shortcuts

The following table shows available shortcuts for several standard functions:

Table C-1. Keyboard Shortcuts

Function	Shortcut
Exit program	**<Ctrl>+<Q>**
Open new Front panel	**<Ctrl>+<N>**
Print window	**<Ctrl>+<P>**

Table C-1. Keyboard Shortcuts

Function	Shortcut
Show context help	<**Ctrl**>+<**H**>
View full application	<**Ctrl**>+<**F**>
View saved data file	<**Ctrl**>+<**V**>

C.4 Common Functions

C.4.1 Select Sensor

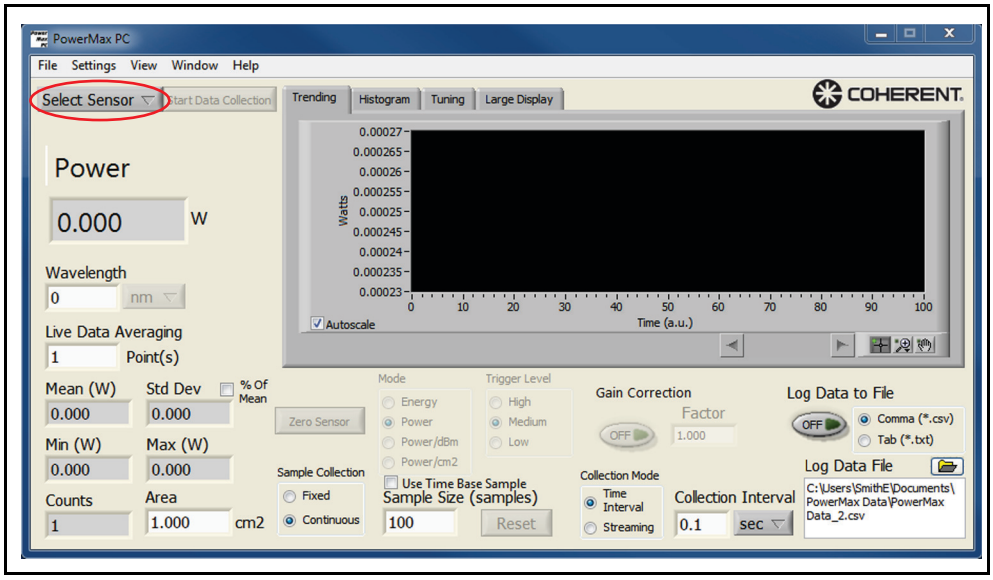
Shows all the connected PowerMax sensors that can be selected for use by the current Front panel.

The serial numbers of all attached PowerMax sensors are shown in the drop-down menu, with the visible serial number indicating which sensor is the current data source.

C.4.1.1 Notes:

- After attaching a sensor, it can take several seconds for the serial number to appear on the list.
- Sensors connected to a computer but already controlled by a Front panel will appear grayed out (not selectable) in the Select Sensor drop-down list. If a sensor is de-selected in a Front panel, the Select Sensor drop-down list automatically updates and that sensor will then be available for selection.

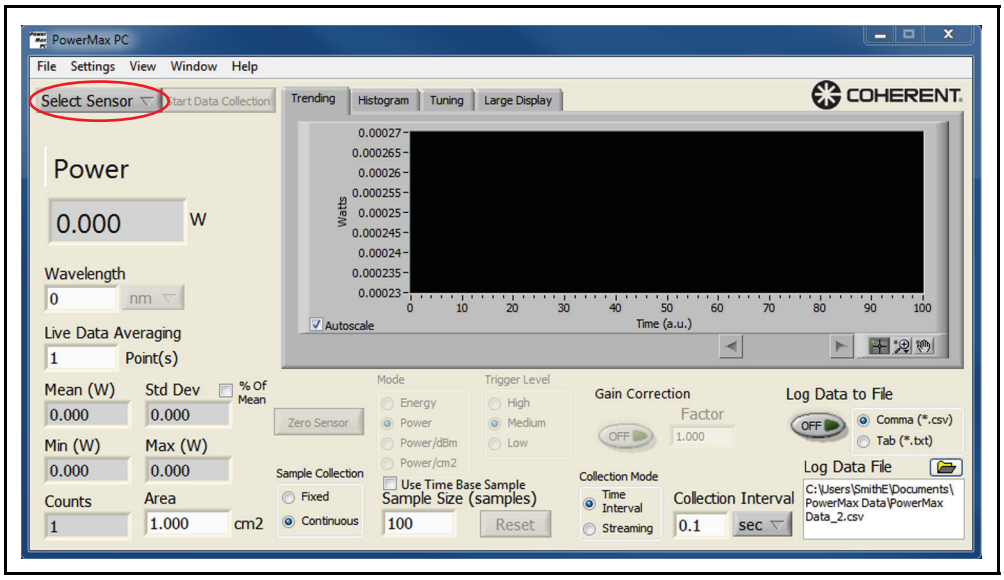
- By default, RS-232 ports do not automatically appear on this drop-down menu. For information about selecting a RS-232 port, refer to 'Add RS-232/Serial Sensor' (p. 116).



C.4.2 Start/Stop Data Collection

Enables/disables sample collection, including:

- The Trending chart
- Synchronized trending, if enabled
- The Histogram chart
- The Tuning chart
- The Live Reading indicator
- All statistic indicators
- Data logging, if active



C.4.3 Zero the Sensor

Press of the Zero button starts the Zero function and sets the current sensor input as the baseline for future measurements. *It is recommended that to set the sensor to zero after first turning it on and before starting any new set of power measurements.*

When a zero procedure is in process, no other button events are queued or started until the procedure ends. The zero procedure immediately stops if the sensor is disconnected or if an error happens.

Normally, the Zero button must be pressed while the laser is turned off, or while the laser beam is blocked. If a finite power level is present at the sensor, the instrumentation will try to null it out.

The sensor can only zero a finite level of offset equivalent to approximately 10% of full scale range.

NOTICE

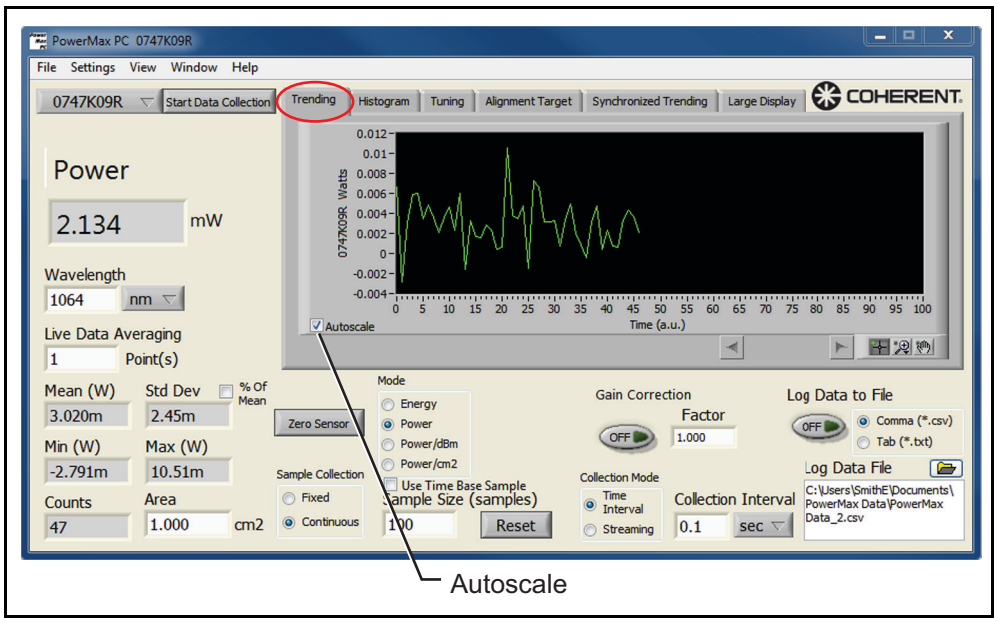
If set to zero is not successful—which means the power input is too large to null—set to zero again in a more stable environment or select a different range.

C.4.4 Set the Wavelength

The wavelength must always be set for accurate power measurements. This can be done either in the PowerMax PC application software or over the host port via a host command.

C.4.5 Trending Chart

Displays the data received from the PowerMax sensor.



The axis scale points—(x) and (y)—can be directly edited by clicking on them and entering the desired value. Example: Clicking on the first x-axis point and setting it to 0 (zero) displays the data from beginning to present.

C.4.5.1 Autoscale

- *Checked*: Y-axis Autoscale is active.
- *Unchecked*: The graph displays the y-axis in fixed scale.

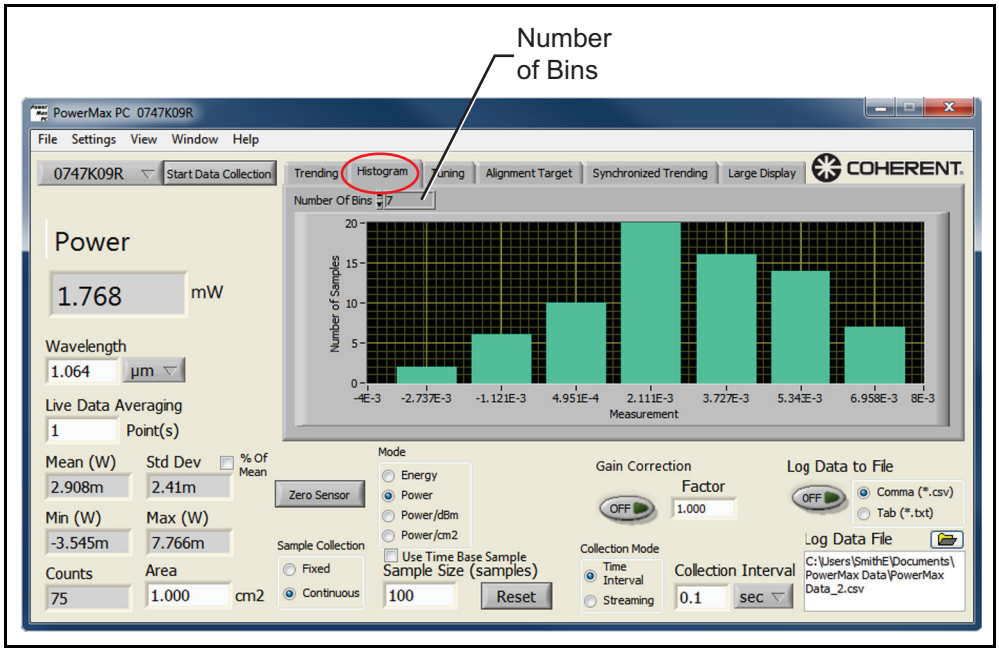
C.4.6 Histogram Chart

Displays a histogram of measurement values in the sample buffer.

The sample buffer is controlled by the Sample Size. For example, with a sample size of 100, up to 100 samples are used in the histogram. When more than 100 samples have been collected, only the 100 most recent samples are displayed.

C.4.6.1 Number of Bins

Sets the number of bins along the x-axis used to plot the histogram data.



C.4.7 Tuning Chart

Displays two values on the Tuning meter:

- **Green** pointer = current measurement value (also displayed as a value in the Current Value window at the bottom left of the Tuning chart)
- **Red** pointer = maximum measured value (also displayed as a value in the Maximum window at the bottom right of the Tuning chart)

C.4.8 Tuning Scale

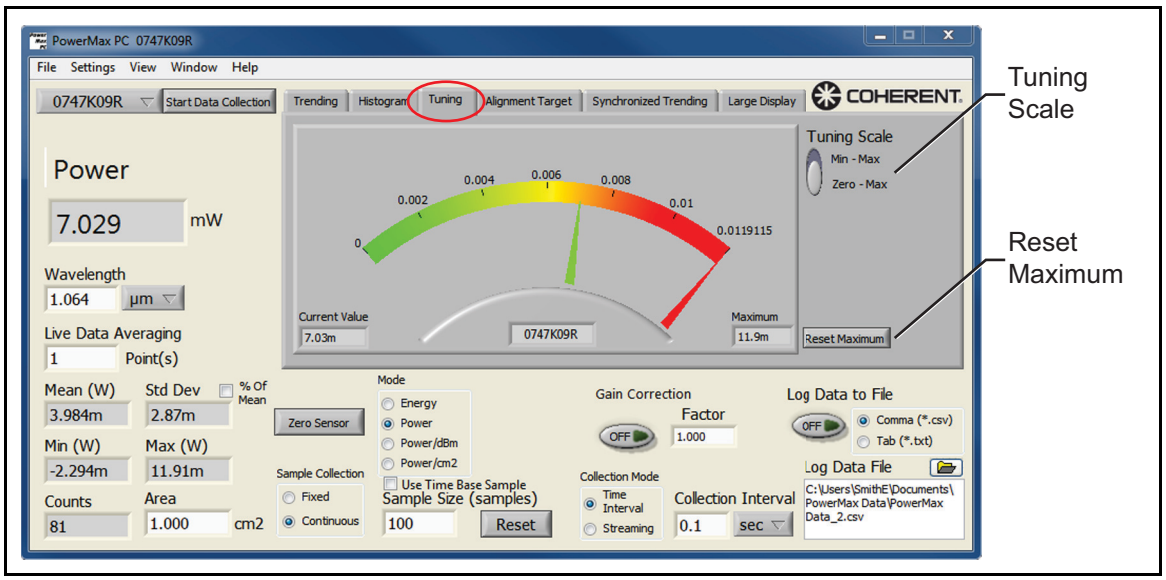
Use this button to select the scaling range of the Tuning meter.

- *Min - Max*: Sets the low end of the scale range to the minimum value in the current data set and the high end of the scale range to the highest value measured since the last reset.

- *Zero - Max*: Sets the low end of the scale to zero and the high end of the scale to the highest value measured since the last reset.

C.4.8.1 Reset Maximum Button

Click to reset the maximum value.



C.4.9 Alignment Target Chart

(*Position-sensing thermopile sensors only*)

The target represents the bull's-eye view of the laser beam position of the selected sensor. Position values are scaled and the outer ring refers to the aperture radius.

The dot on the target represents the position of the beam on the surface of the sensor. As the beam nears the edge of the aperture, the dot will display near the edge of the bull's-eye. This feature is useful when setting up the sensor for a measurement, especially with non-visible laser beams.

NOTICE

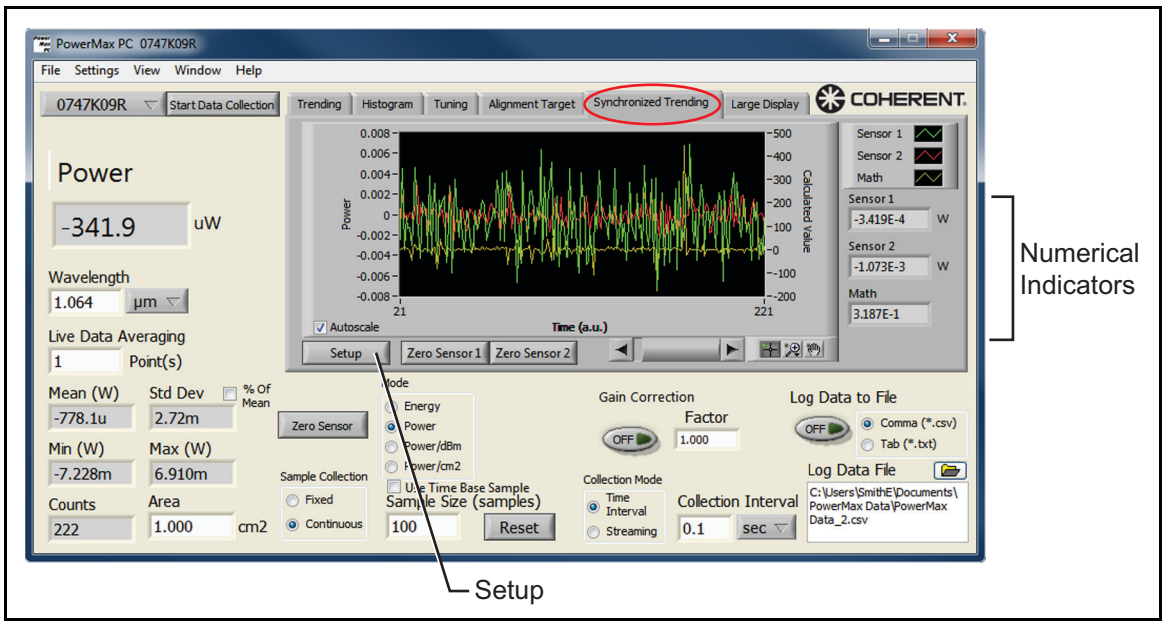
The Alignment Target tab only appears if a thermopile quad sensor is selected as the current data source.

C.4.10 Synchronized Trending Chart

When multiple sensors are available, this tab provides synchronized plotting of two sensors on the same chart. This screen also provides the option of performing math—such as ratiometry (A/B)—with use of two sensors.

NOTICE

The Synchronized Trending tab only appears if two PowerMax-USB sensors are available for control by the application. If two sensors are connected—and <u>two</u> windows open—the Synchronized Trending tab will not be visible until one of the two windows is closed.

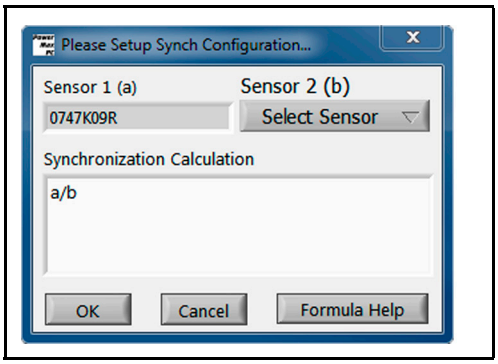


C.4.10.1 Numerical Indicators

These numerical indicators display the latest readout of both sensors (in *Watts*, *Joules*, or *dBm*, depending on measurement mode), as well as the optional synchronized calculated math value, if synchronized data collection is enabled.

C.4.10.2 Set-Up Button

Clicking the Setup button displays the following screen:



Options on this screen include:

- Selecting/de-selecting the second sensor to be used for synchronized data collection
- Changing the *Synchronization Calculation* equation.

C.4.10.3 Sensor 1 (a)

Shows the serial number of the primary PowerMax sensor in use by the current Front panel.

C.4.10.4 Sensor 2 (b)

The drop-down menu that appears when the Select Sensor button is clicked shows all the connected PowerMax sensors that can be selected for synchronized trending use by the current Front panel.

- (*USB sensors*) The serial numbers of all available attached PowerMax USB sensors are shown in the drop-down menu.
- (*RS sensors*) RS-232 sensors will not appear in the drop-down menu because RS-232 sensors do not support synchronized data collection.

C.4.10.5 Notes

- After attaching a sensor, it can take several seconds for the serial number to appear on the list.

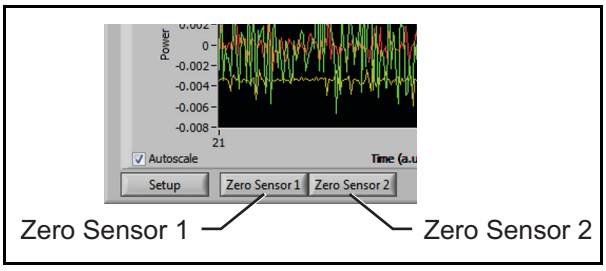
- Sensors connected to a computer but already controlled by a Front panel will not appear in the Sensor 2 (b) drop-down list. If a sensor is de-selected in a Front panel, the Sensor 2 (b) drop-down list automatically updates and that sensor will then be available for selection.

C.4.10.6 Synchronization Calculation

Displays the current formula used for math calculation on synchronized data. To change the formula, type the new formula into the *Synchronization Calculation* field—use the letter 'a' to reference Sensor 1 and letter 'b' to reference Sensor 2. An error dialog appears if an invalid formula is entered.

C.4.10.7 Zero Sensor 1 Button

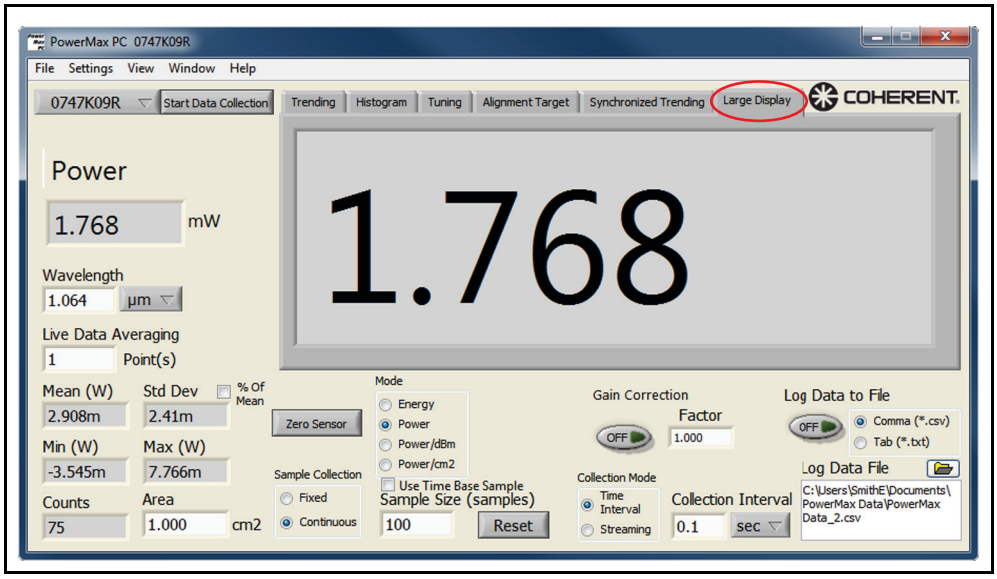
Click the **Zero Sensor 1** button to zero the main sensor. Clicking on this button has the same effect as clicking on the main Zero Sensor button.



C.4.10.8 Zero Sensor 2 Button

Click the **Zero Sensor 2** button to set the second, synchronized sensor to zero.

C.4.11 Large Display Chart

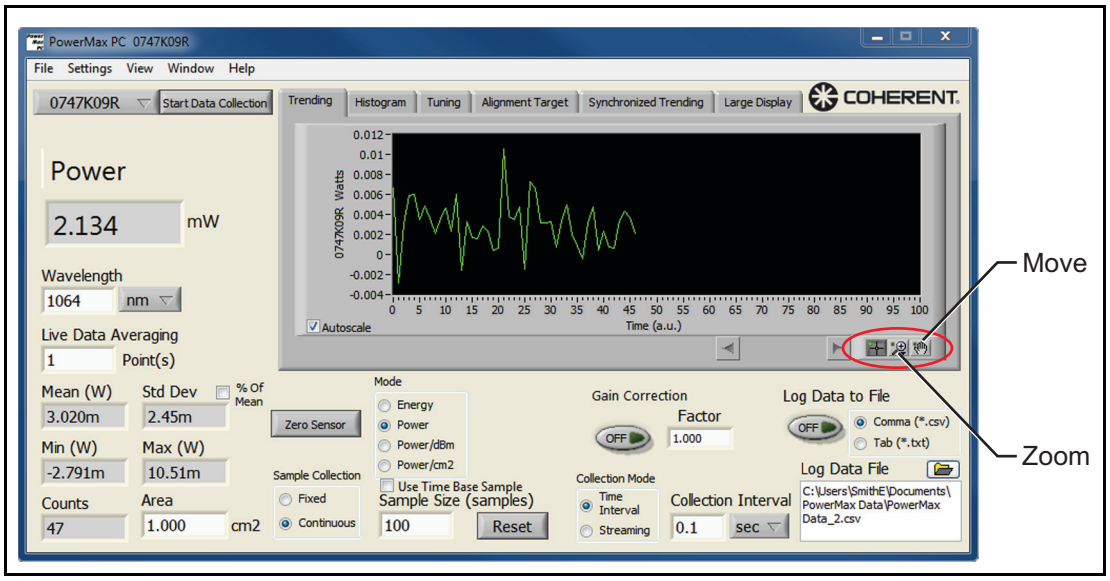


NOTICE

For information about displaying the Large Display Chart in a separate window that can be repositioned, refer to 'Show Large Format Display' (p. 120).

C.4.11.1 Graph Palette

Lets a user to zoom or move the plot displayed in the Trending chart.



C.4.11.1.1 Zoom Button

Click the **Zoom** button and then click an option button from the drop-down list to do any of the following actions:

	Drag the mouse to define the rectangular plot area that will be displayed in the chart.
	Drag the mouse to define the horizontal plot area that will be displayed in the chart.
	Drag the mouse to define the vertical plot area that will be displayed in the chart.
	Click this button to display all data points that have been collected.
	Click this button and then click anywhere on the chart to zoom in.
	Click this button and then click anywhere on the chart to zoom out.

C.4.11.1.2 Move Button

Click the **Move** button and then drag the mouse on the screen to move the plot in any direction.

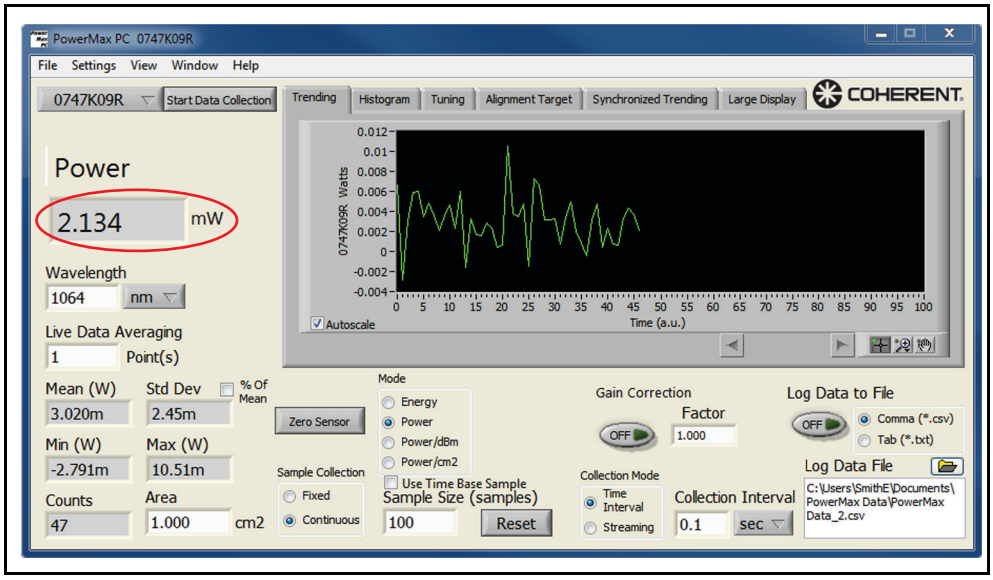
C.4.11.1.3 (undefined) Button

This button is not used at this time.

C.4.12 Data Collection Screen Elements

C.4.12.1 Live Reading

Displays the current sensor reading, if Live Data Averaging is set to 1 point. If Live Data Averaging is set to *n* points, the Reading indicator displays the average of the last *n* points.

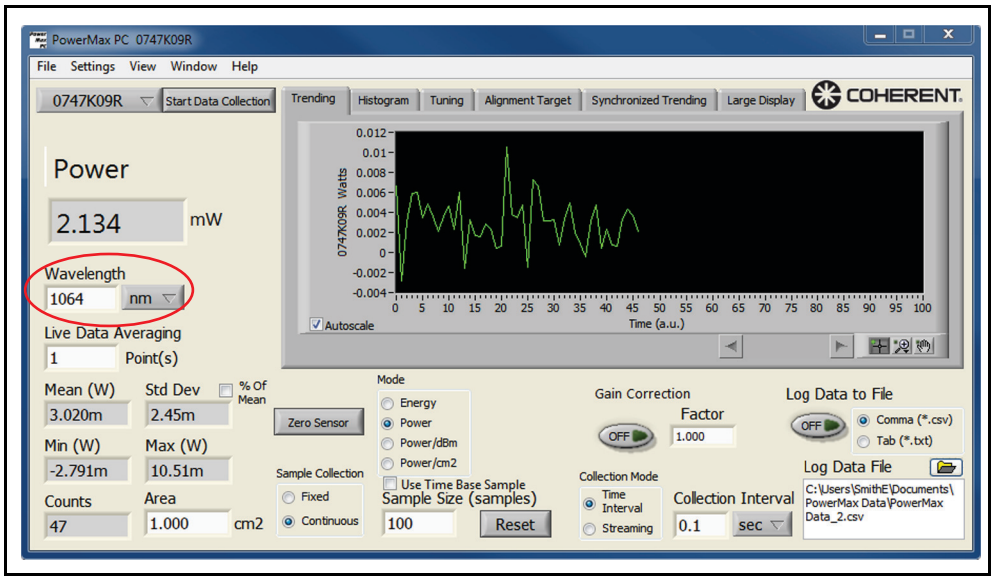


C.4.12.2 Wavelength

The Wavelength field is used to configure the sensor to automatically account for spectral responsivity differences between the laser wavelength and the calibration wavelength. Use this field to enter the needed laser wavelength.

- Units can be changed by clicking the units drop-down menu (next to the wavelength) and selecting *nm* or *µm*.

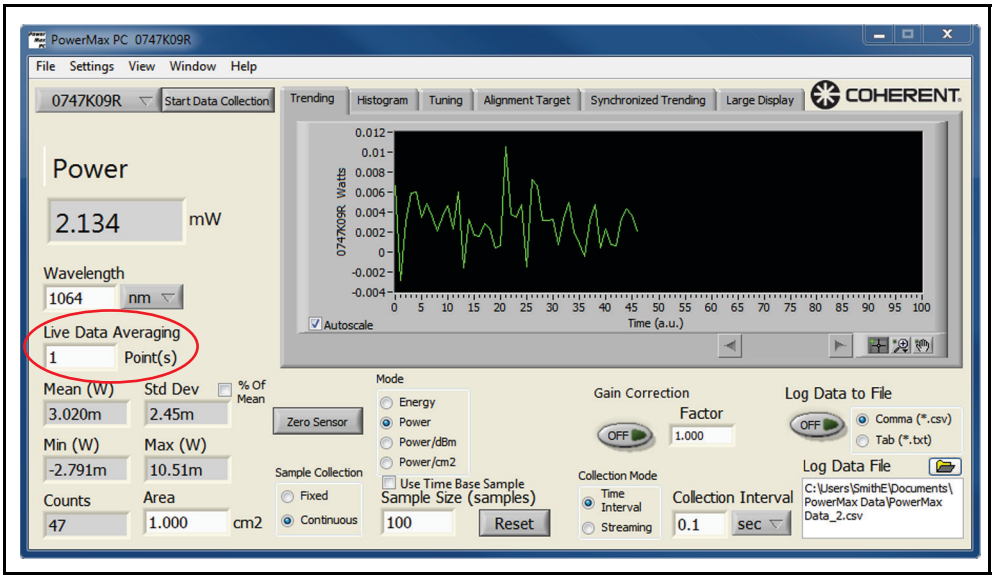
- If a wavelength outside the permitted range is requested, the nearest minimum value or maximum value will be entered and displayed.



C.4.12.3 Live Data Averaging

Enables averaging of the last *n* data points for the power/energy and plot displays. This is computed as a moving average.

n can be set from 0-to-60 seconds and 2-to-1000 pulses, depending upon the mode of operation.

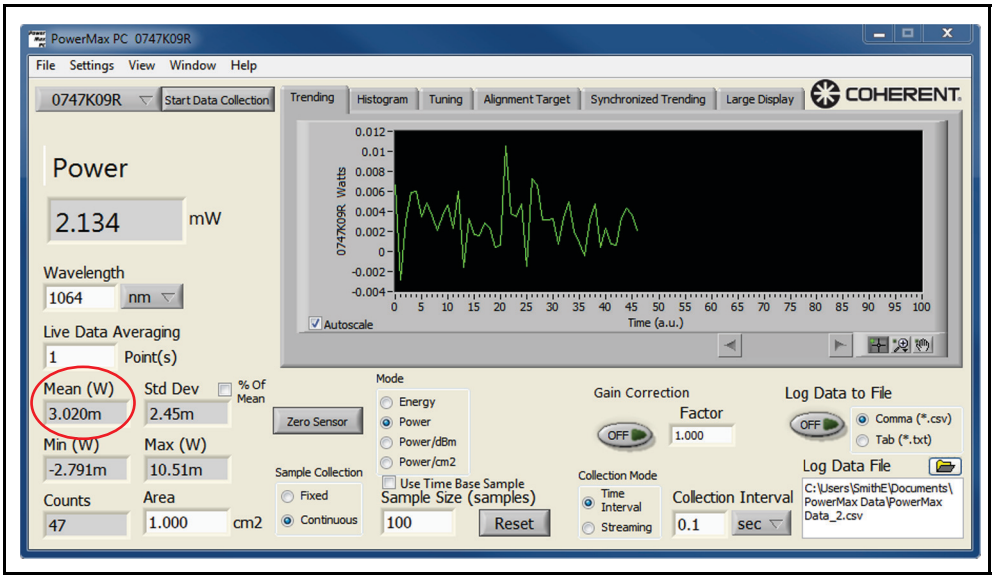


C.4.12.3.1 Notes

- Live data averaging is always in points, with 10 points per second in Power mode, and arbitrary points per second in Pulsed Joules mode.
- With optical sensors, live data averaging is *always* in Power mode with 10 points per second.

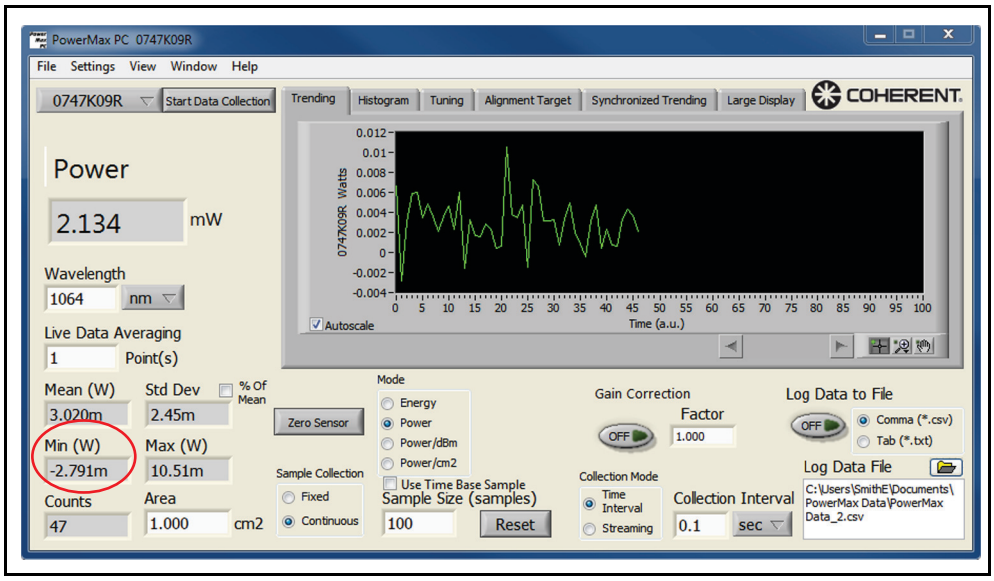
C.4.12.4 Mean

Displays the mean of the last *n* Sample Size samples. The value updates as new samples are acquired. A sample size of *100* will display the stats on two samples, then three, and continue to the n^{th} sample. If the software is in *Continuous* mode, the statistics will continue to update, using the last *n* samples. In *Fixed* mode, the statistics will hold after the n^{th} sample.



C.4.12.5 Minimum (Min)

Displays the minimum value in the last *n* Sample Size samples. The value updates as new samples are acquired. Example: A sample size of *100* will display the stats on two samples, then three samples, and continue to the n^{th} sample. If the software is in *Continuous* mode, the statistics will continue to update, using the last *n* samples. In *Fixed* mode, the statistics will hold after the n^{th} sample. Refer to the figure below.

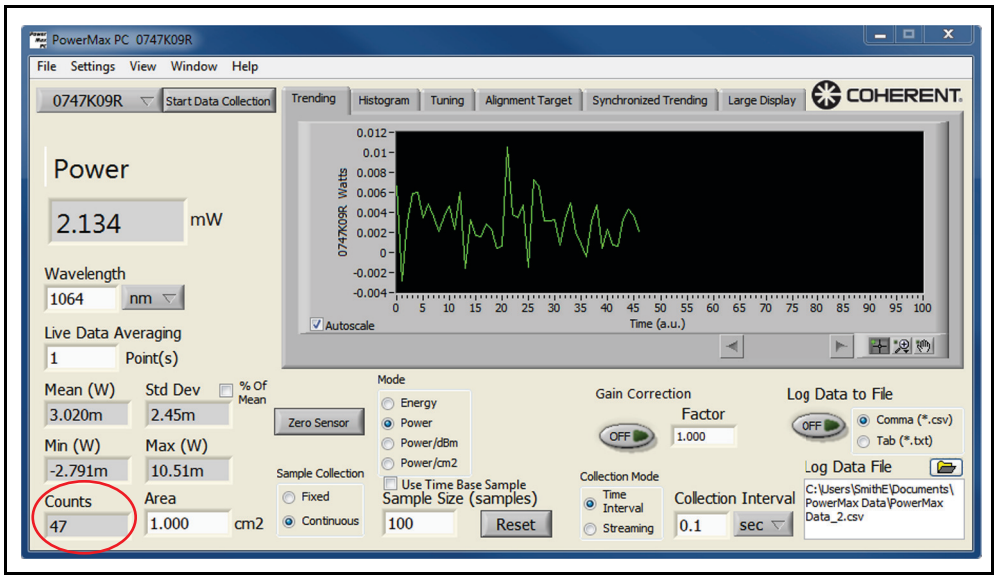


C.4.12.6 Counts

Displays the number of measurements taken in the current data set. Press the **Reset** button to reset the counter.

- In *Fixed Sample Collection* mode, the *Counts* field increments until the batch has the number of samples entered in the Sample Size field. At this point, the statistics and the Trending chart will stop updating.

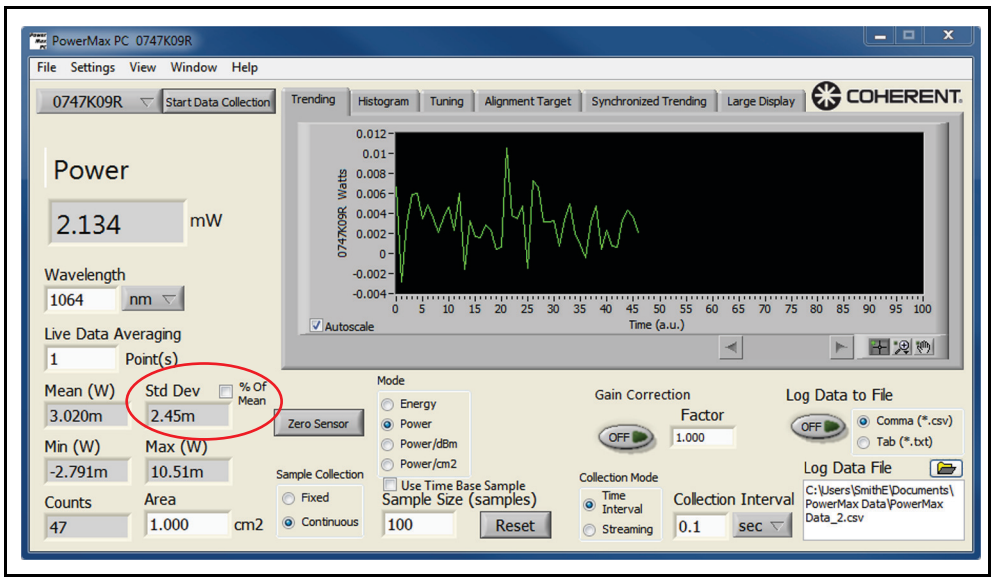
- In *Continuous Sample Collection* mode, the *Counts* field continues incrementing indefinitely as more samples are collected in the batch and plotted in the Trending chart. Even though the *Counts* field continues to increment, the statistics parameters themselves are calculated from the last *n* number of samples, and the Trending chart displays the last *n* number of samples, where *n* is the number of samples entered in the Sample Size field.



C.4.12.7 Standard Deviation (Std Dev)

Displays the Standard Deviation of the last *n* Sample Size samples. The value updates as new samples are acquired. *Example*: A sample size of *100* will display the stats on two samples, then three samples, and continue to the n^{th} sample.

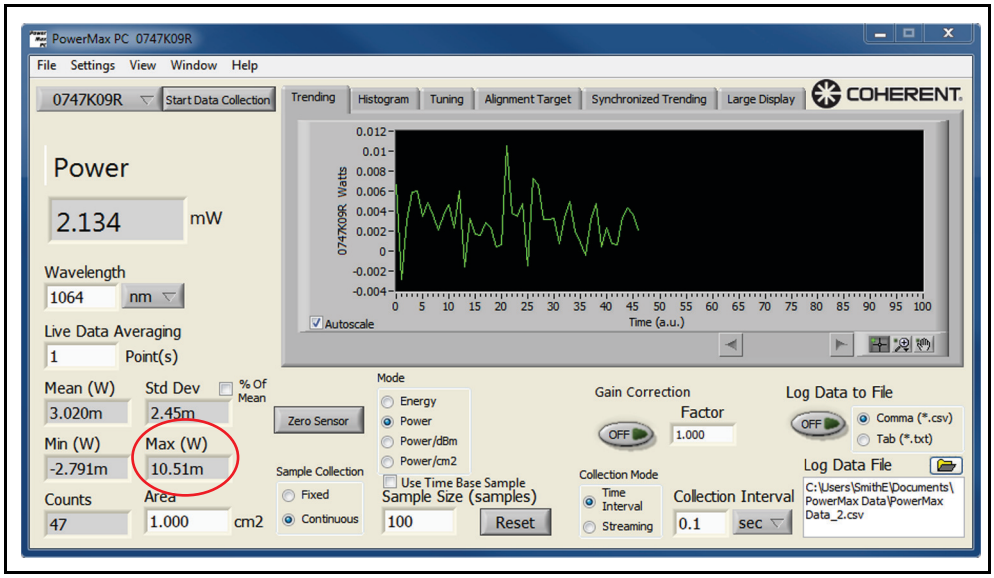
- If the software is in *Continuous* mode, the statistics will continue to update, using the last *n* samples.
- In *Fixed* mode, the statistics will hold after the n^{th} sample.



C.4.12.8 Maximum (Max)

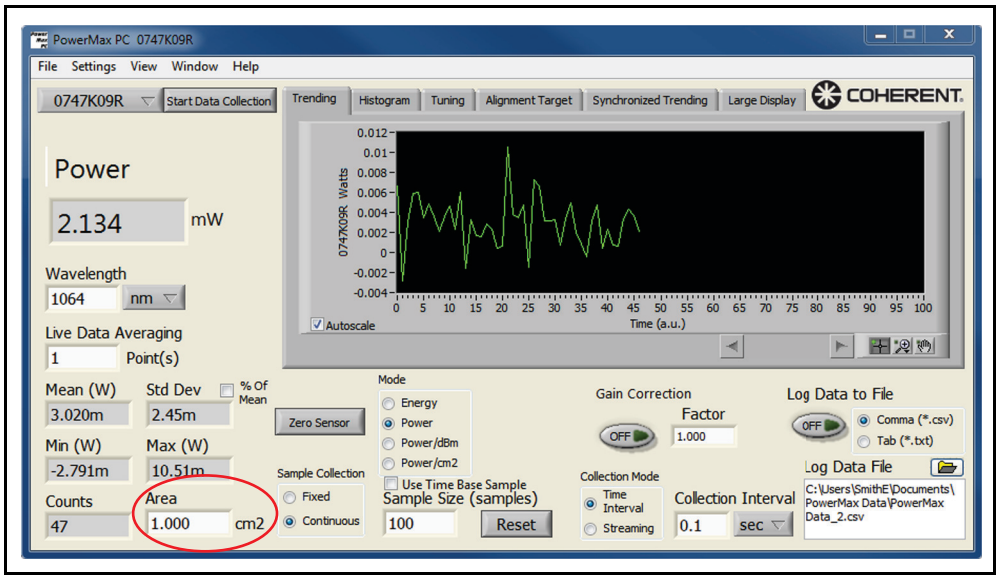
Displays the maximum value in the last *n* Sample Size samples. The value updates as new samples are acquired. Example: A sample size of *100* will display the stats on two samples, then three samples, and continue to the n^{th} sample.

- If the software is in *Continuous* mode, the statistics will continue to update, using the last *n* samples.
- In *Fixed* mode, the statistics will hold after the n^{th} sample.



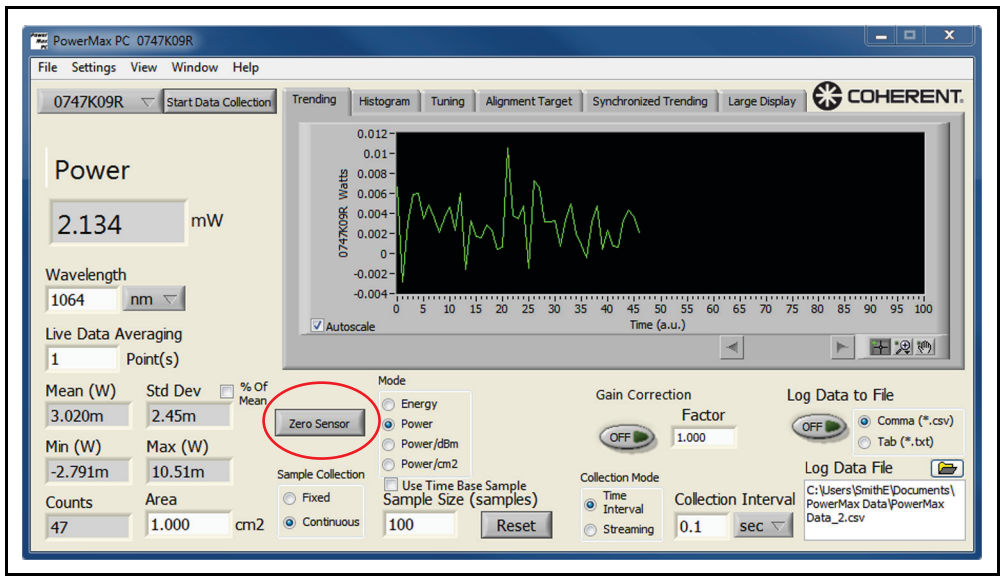
C.4.12.9 Area

The area entered in this field is used to calculate power density in Watts per square centimeter (W/cm^2). The power density reading is displayed in the Live Reading area when Mode is set to $Power/cm^2$.



C.4.12.10 Zero Sensor

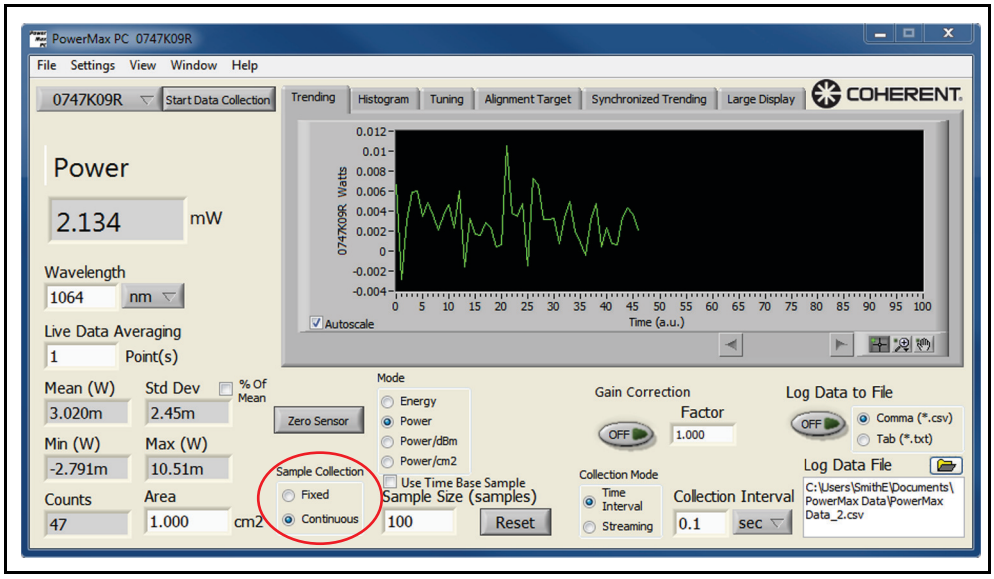
Zeroes the PowerMax sensor.



C.4.12.11 Sample Collection

Selects the logging/plotting mode:

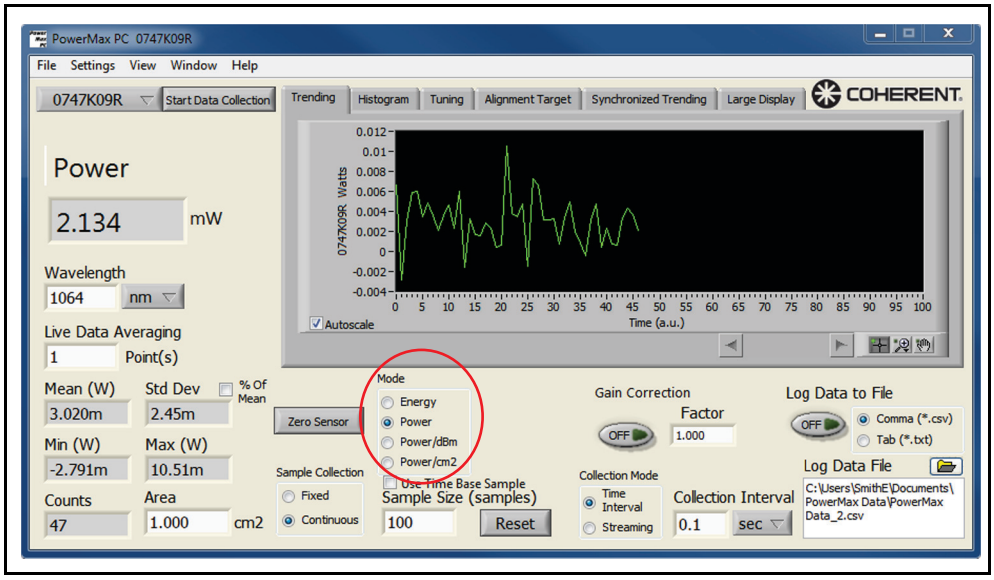
- *Fixed* takes and plots the number of data points shown in the Sample Size and holds the results after the n^{th} sample.
- *Continuous* takes continuous data and plots the number of data points shown in the Sample Size in the chart window. The newest data continuously scrolls in the window.
- The default sample rate for all PowerMax-USB and PowerMax-RS sensors is 10 samples per second. To use a different sample rate, change the Collection Interval.



C.4.12.12 Mode

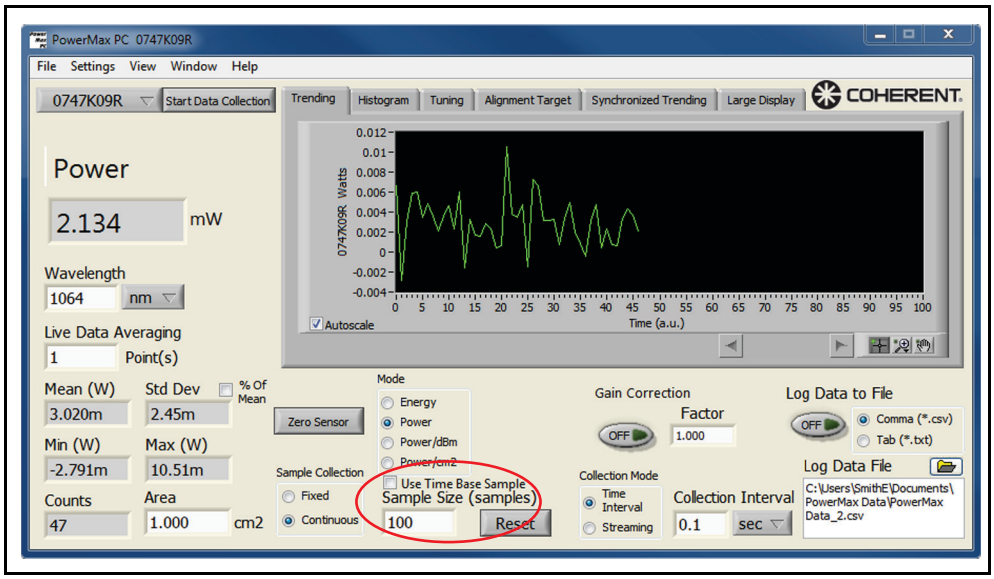
Selects the measurement mode: *Energy* (J), *Power* (W), *Power/dBm*, or *Power/cm2*.

- *Energy* refers to a special *"*long-pulse joules*"* mode with a thermopile sensor in which the energy in a single long-pulse greater than 1 msec can be integrated by the thermopile sensor to calculate and display the energy in the pulse.



C.4.12.13 Sample Size

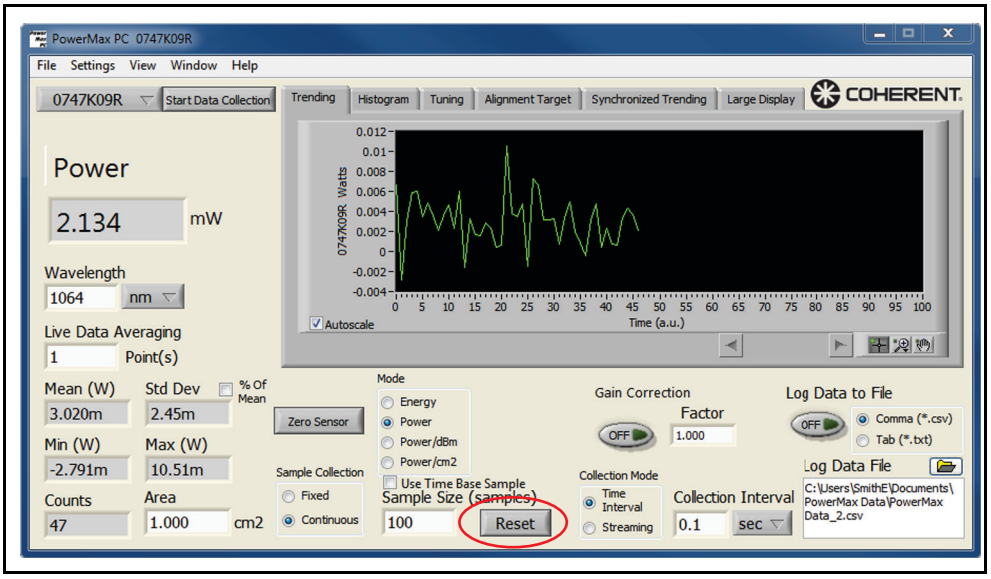
Selects the sample size to collect when in *Fixed* mode, and the sample size to use for statistics when in either *Fixed* or *Continuous* mode. Select *Use Time Base Sample* to change the sample size units to seconds.



C.4.12.14 Reset

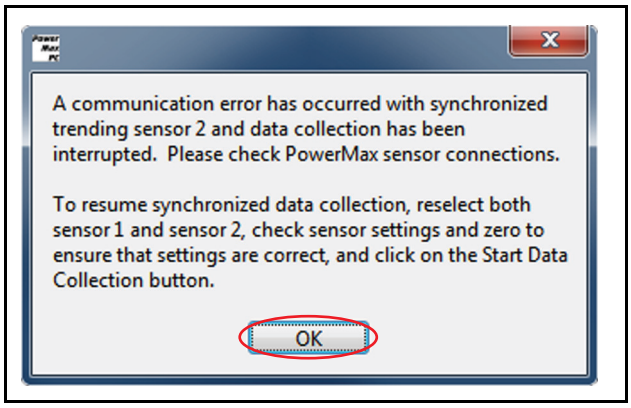
Clicking the Reset button:

- Resets the data set used for statistics (*Mean*, *Min*, *Max*, and *Std Dev*).
- Resets Counts to 1.
- Clears Trending and other charts.



C.4.12.15 Reset Error

A separate error dialog window appears when a user action creates an error. This window will list the possible cause of the error, as well as other information. Here is an example:



NOTICE

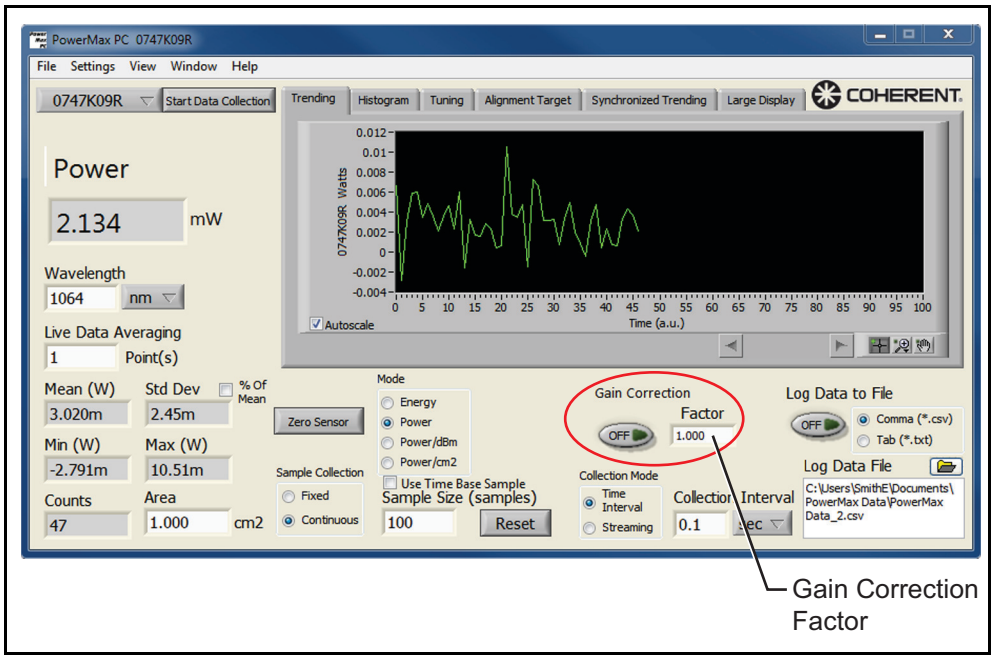
The OK button must be clicked in the error dialog window before new commands are accepted.

C.4.12.16 Gain Correction

Enables/disables Gain Correction.

- Default value: *Off*
- Range: *On* (True), *Off* (False)

- When Gain Correction is enabled, measurements taken by the sensor will be multiplied by the Gain Correction Factor, described below.



C.4.12.16.1 Gain Correction Factor

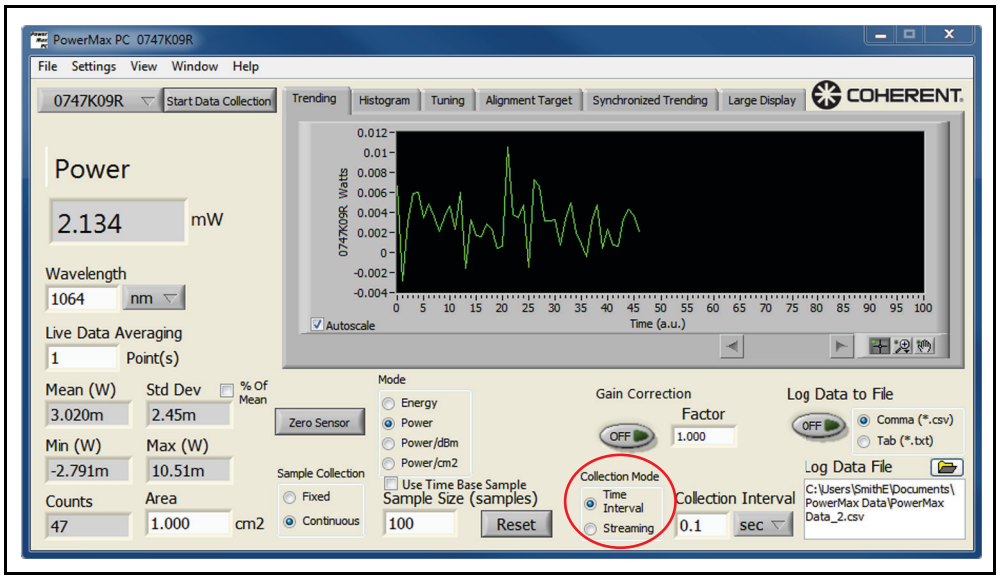
Sets the gain correction factor stored in the PowerMax sensor.

- Default Value: *1.0*
- Range: *0.001* to *100000.0*

The Gain Correction Factor control indicates the current gain correction factor stored in the PowerMax sensor. To change this setting, enter the desired factor into the Gain Correction Factor dialog box. This factor is not applied unless Gain Correction is enabled.

C.4.12.17 Collection Mode

Selects between *Time Interval* (data acquisition on a fixed-time interval) and *Streaming* (continuous data acquisition).

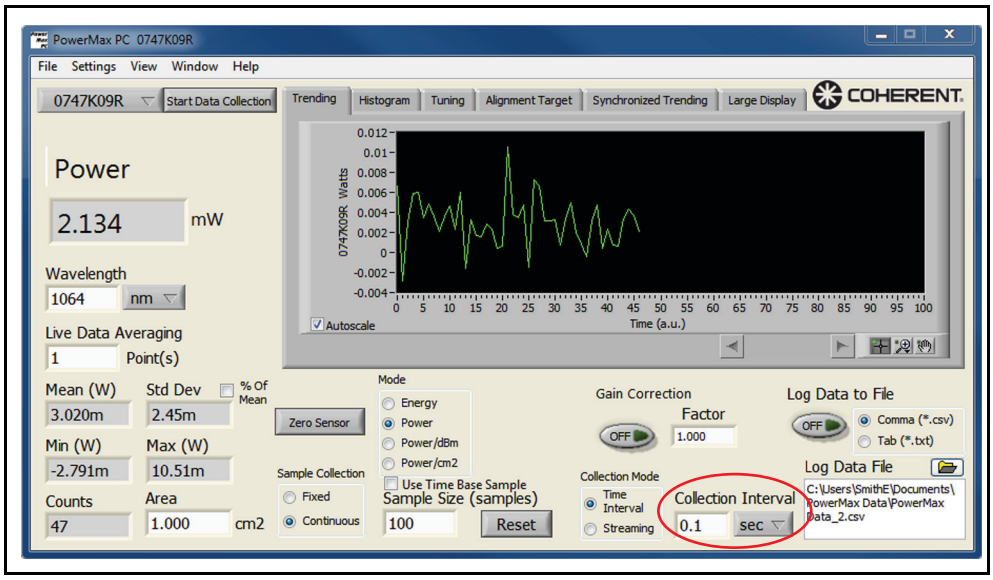


NOTICE

Changing between *Time Interval* and *Streaming* collection modes during data collection automatically clears the data plot display and the statistics batch. Clearing the plot display and statistics batch is done to prevent mixing of data sets with two different time bases. When set to *Streaming*, the collection interval is automatically set to 0.1 seconds.

C.4.12.18 Collection Interval

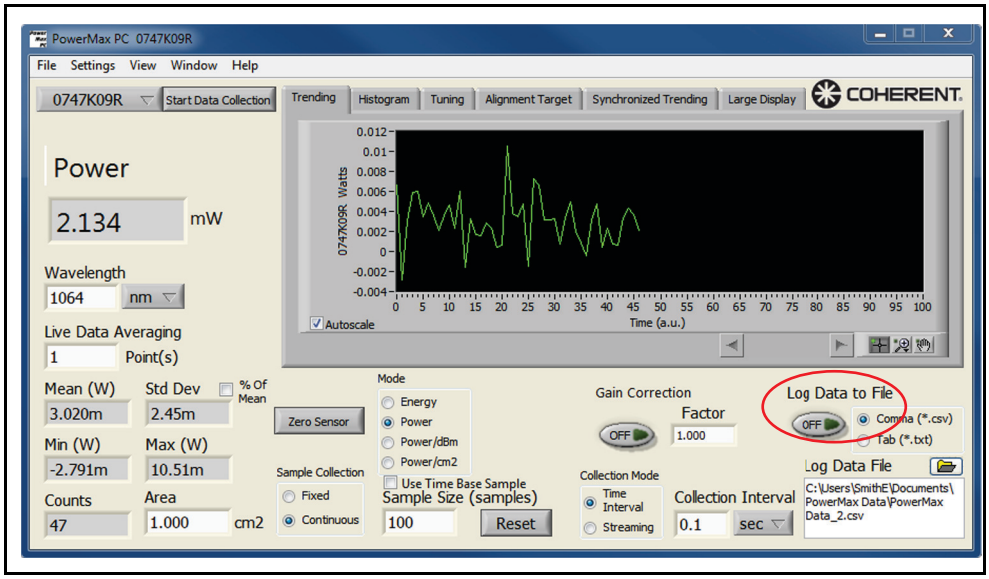
Sets the collection interval (seconds, minutes, or hours) when Collection Mode is set to *Time Interval*. This control is grayed-out when Collection Mode is set to *Streaming*.



C.4.12.19 Log Data to File

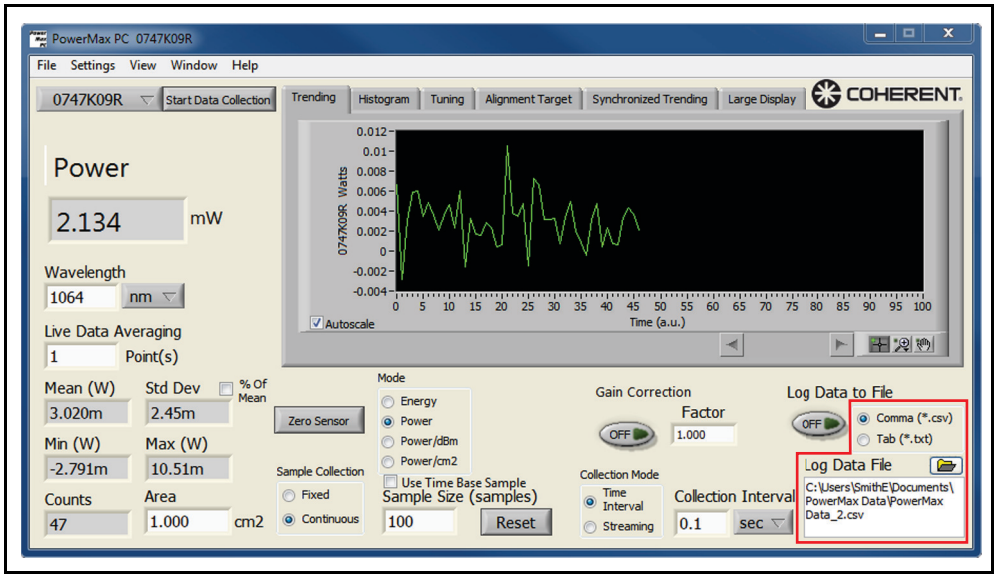
Enables/disables saving currently-acquired data to the Log Data file:

- If the Collection mode is *Time Interval*, data is logged to the Log Data file at the interval specified under Collection Interval.
- If the Collection mode is *Streaming*, all data is logged to the Log Data file.



C.4.12.20 Log Data File

Shows the file currently used to log data. The file is saved in either 'csv' (**Comma**-**S**eparated **V**alues) format—which can be automatically opened in Excel by double-clicking on the file name—or 'txt' format (a standard text file). To view a previously-saved data file, select *View Saved Data File* from the File menu.

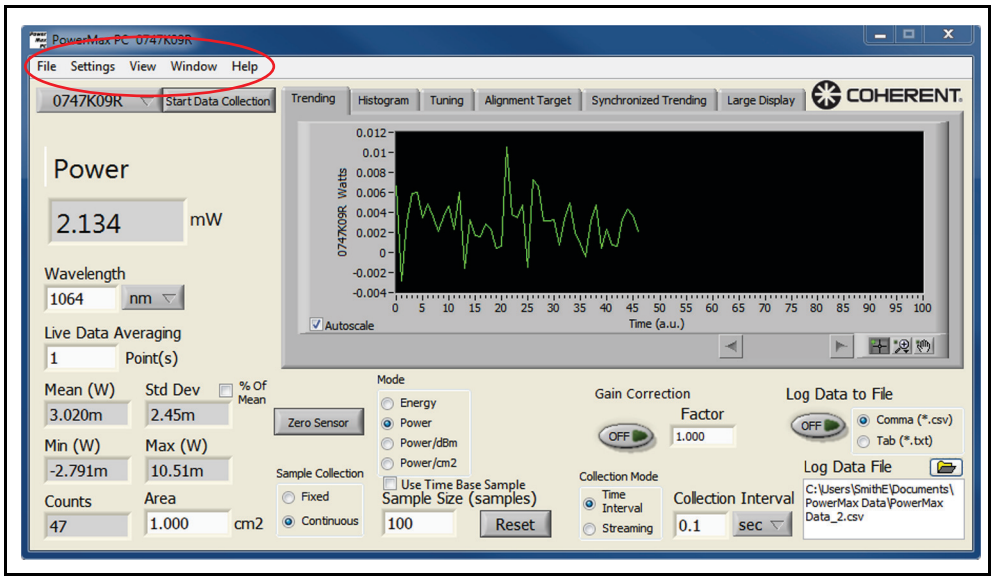


NOTICE

Each time the Log Data to File button is toggled, the number added to the file name is automatically incremented to prevent accidentally overwriting of data.

C.4.13 Menus

Five drop-down menus appear on the PowerMax PC Front panel, described in this section: File, Settings, View, Window, and Help.

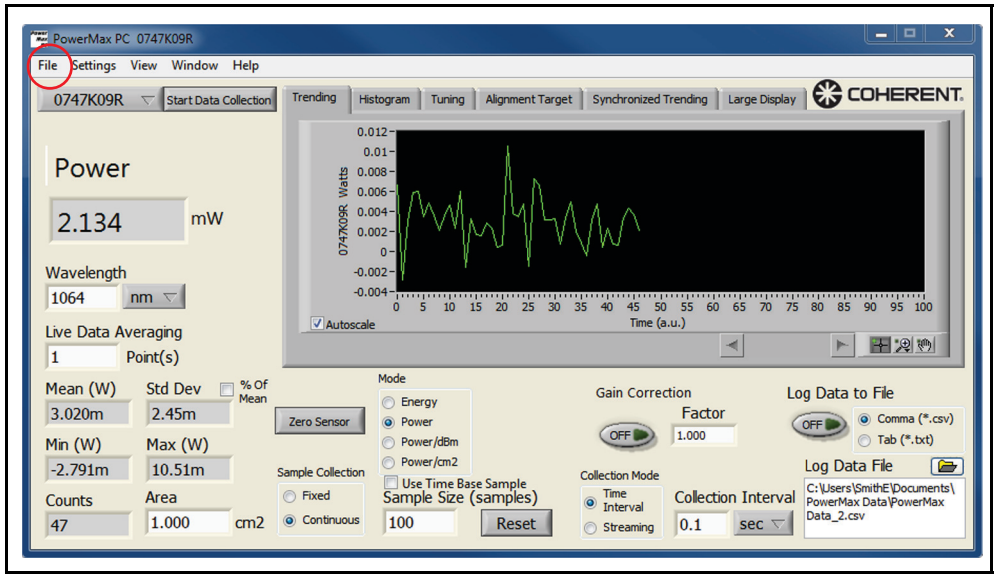


C.4.14 File Menu

Options available under the File menu:

- View a previously-saved data file (*shortcut:* <***Ctrl***>+<***V***>): 'View Saved Data File' (p. 110)
- Open a new Front panel (*shortcut:* <***Ctrl***>+<***N***>): 'Open New Front Panel' (p. 112)
- Print the current window (*shortcut:* <***Ctrl***>+<***P***>): 'Print Window' (p. 113)
- Print the current graph or chart: 'Print Graph/Chart' (p. 113)

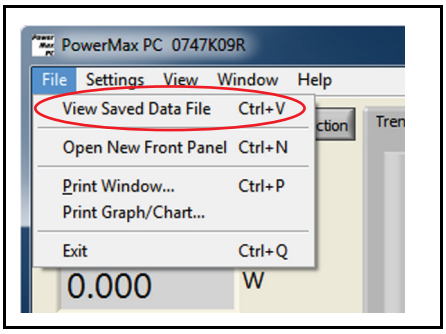
- Exit the program (*shortcut:* <***Ctrl***>+<***Q***>): 'Exit' (p. 113)



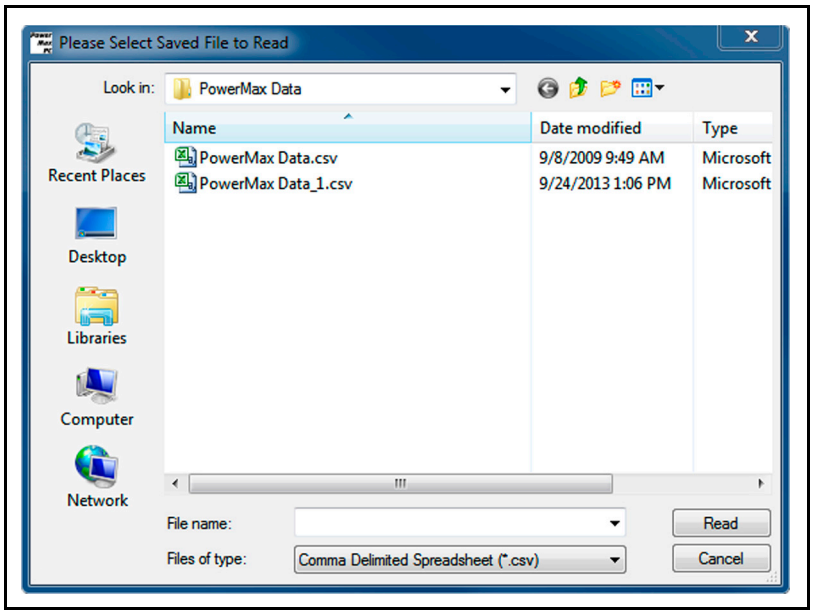
C.4.14.1 View Saved Data File

To view information previously saved in a data file:

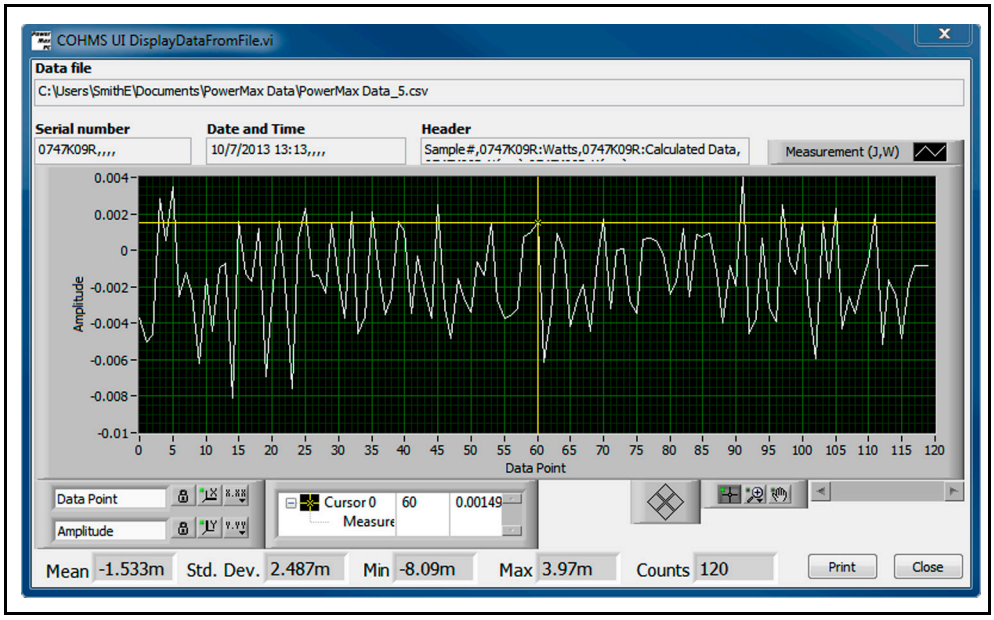
1. Click *View Saved Data File* (*shortcut:* <***Ctrl***>+<***V***>) from the File drop-down menu:



A menu similar to the following displays:



2. Select the name of the file to view, and then click *Read* to display a chart that has all the saved data. Here is an example chart:



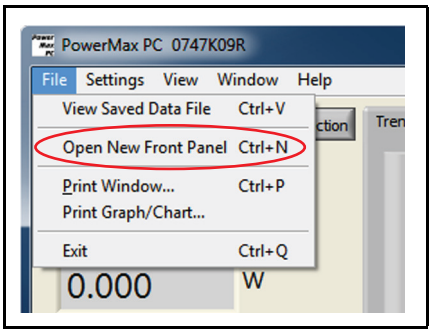
C.4.14.2 Open New Front Panel

The purpose of opening a new Front panel is to control, monitor, and simultaneously log data—from multiple sensors—to separate files. This is good for burn-in stations, where it is necessary to collect data from several lasers at the same time by running several PowerMax sensors on one PC.

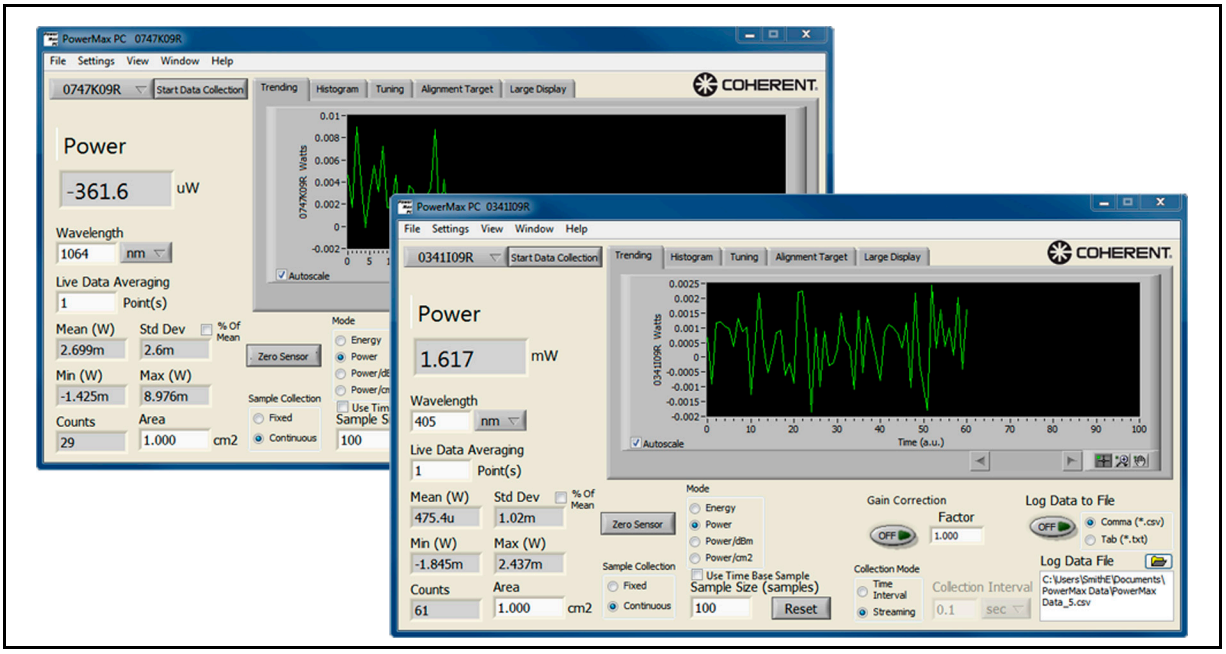
NOTICE

A sensor cannot be active in more than one Front panel at a time.

To open a new panel, click *Open New Front Panel* (shortcut: <***Ctrl***>+<***N***>) from the File drop-down menu:

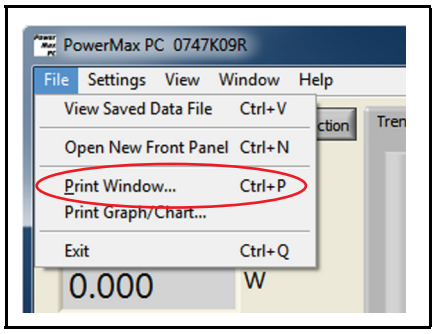


Here is an example of data from two sensors, each displayed within its own Front panel:



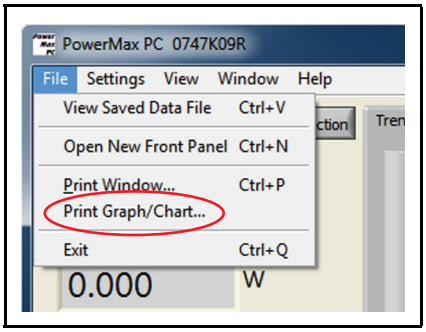
C.4.14.3 Print Window

Selecting *Print Window* (shortcut: <***Ctrl***>+<***P***>) from the File drop-down menu prints the entire active window—including graphs and charts—exactly as it appears on the screen.



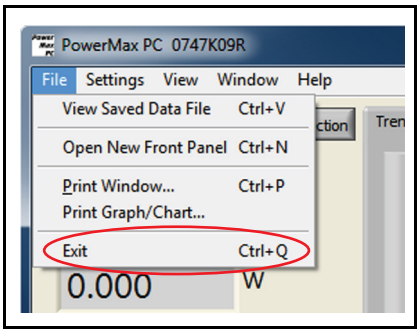
C.4.14.4 Print Graph/Chart

Like the Print Window option, selecting *Print Graph/Chart* on the File drop-down menu prints the entire active window. This option, however, uses *inverted* colors to print graphs and charts.



C.4.14.5 Exit

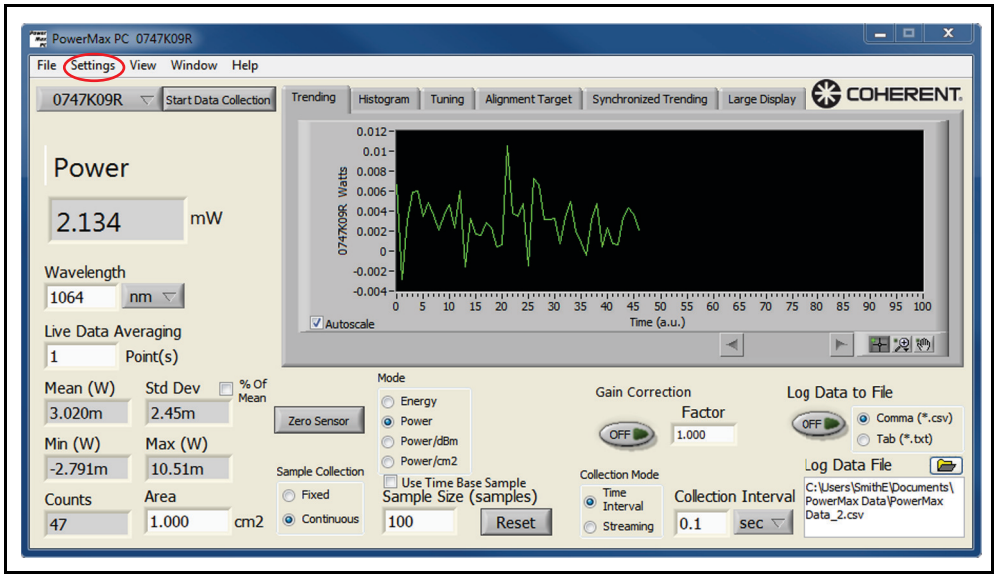
Selection of the *Exit* option (shortcut: <***Ctrl***>+<***Q***>) on the File drop-down menu closes the PowerMax PC program.



C.4.15 Settings Menu

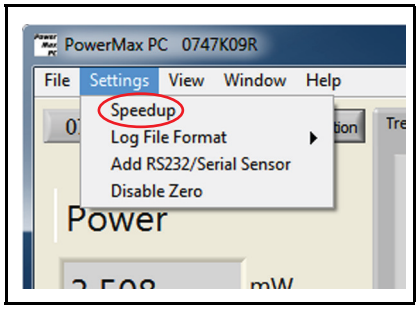
Options available under the Settings menu:

- Set Speedup to On or Off: 'Speedup' (p. 115)
- Select the log file format. Refer to 'Log Data File' (p. 108) and 'Log Data to File' (p. 107) for general information about saving data.
- Add a RS-232/serial sensor: 'Add RS-232/Serial Sensor' (p. 116)
- Disable zero: 'Disable Zero' (p. 117)



C.4.15.1 Speedup

Selecting or de-selecting *Speedup* on the Settings drop-down menu controls the host data.

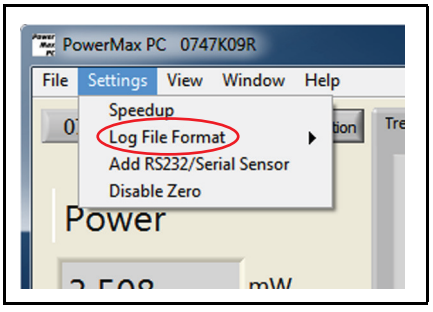


Because of the natural thermal response of thermopile sensors, they have a relatively slow response speed. To make faster measurements with these sensors, use a speedup algorithm while taking power measurements. The *Speedup* option lets the user set this algorithm on or off for different functions. The trade off to using *Speedup* is some loss of accuracy.

C.4.15.2 Log File Format

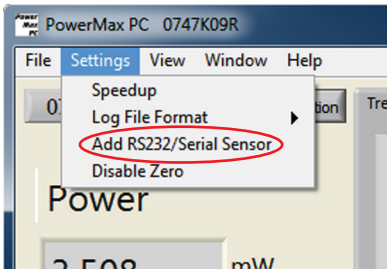
Select *Log File Format* from the Settings drop-down menu permits to add or remove the following options from the log file:

- Sensor data
- Calculated (ratio) data
- Position-Sensing Thermopiles: X Position, Y Position
- (*thermopile quad sensors only*) X and Y positions

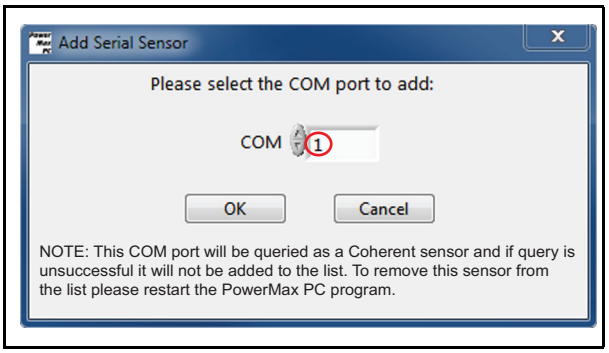


C.4.15.3 Add RS-232/Serial Sensor

Click *Add RS-232/Serial Sensor* from the Settings drop-down menu.



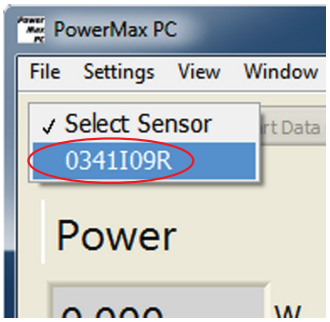
From the Add Serial screen, select the COM port to which the PowerMax-RS sensor is attached.



The COM port number is automatically determined by the computer. (If needed, check in Device Manager for available COM ports.) In this example, the selected COM port is *1*.

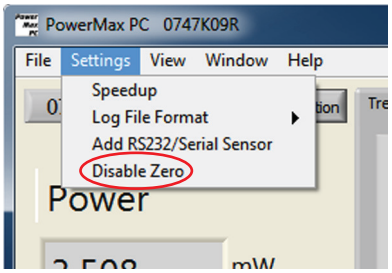
When the COM port is selected, the PowerMax PC software scans that port and identifies the connected sensor.

As long as the sensor is correctly connected and powered up, the serial number of the sensor is available for selection from the drop-down menu in the software. In this example, the connected sensor is *0341I09R*.



C.4.15.4 Disable Zero

The *Disable Zero* function disables the Zero Sensor button in the Front panel. This function prevents accidentally zeroing the sensor during a long-term test.

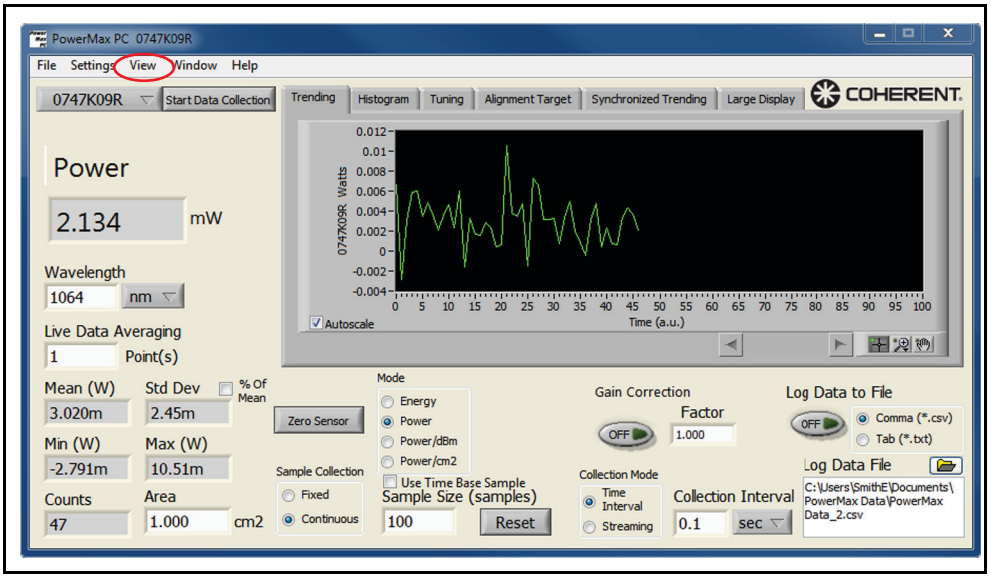


C.4.16 View Menu

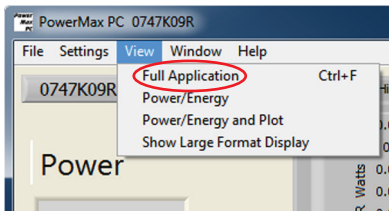
Use this menu to select which part of the display is visible. Options available under the View menu:

- Display the full application view: 'Full Application' (p. 118)
- Display the power/energy view only: 'Power/Energy' (p. 119)
- Display the power/energy and plot view only: 'Power/Energy and Plot' (p. 119)
- Show the large format display: 'Show Large Format Display' (p. 120)

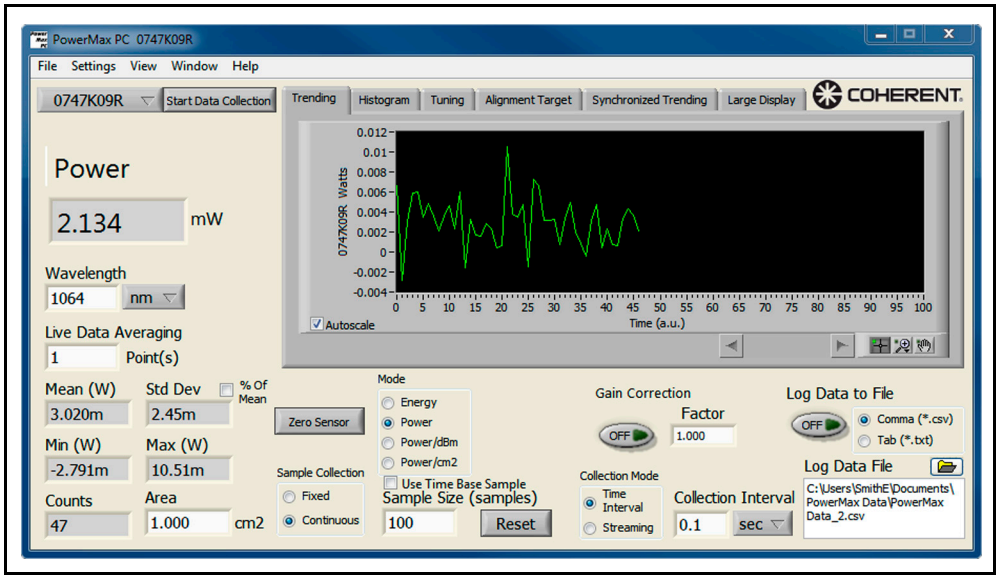
To display the full application view, use the shortcut <***Ctrl***>+<***F***>.



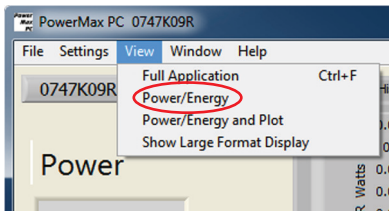
C.4.16.1 Full Application



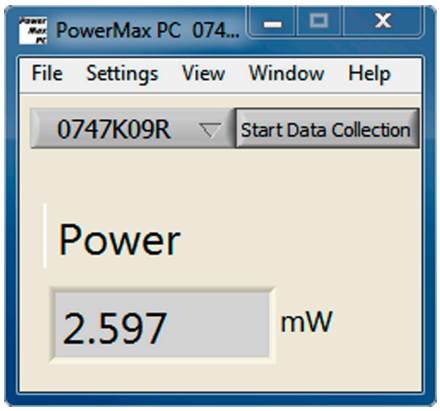
Example of a *Full Application* (*shortcut:* <***Ctrl***>+<***F***>) view:



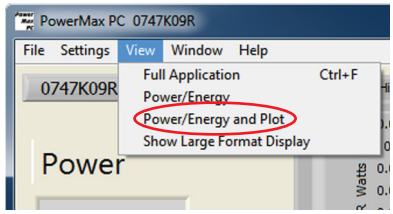
C.4.16.2 Power/Energy



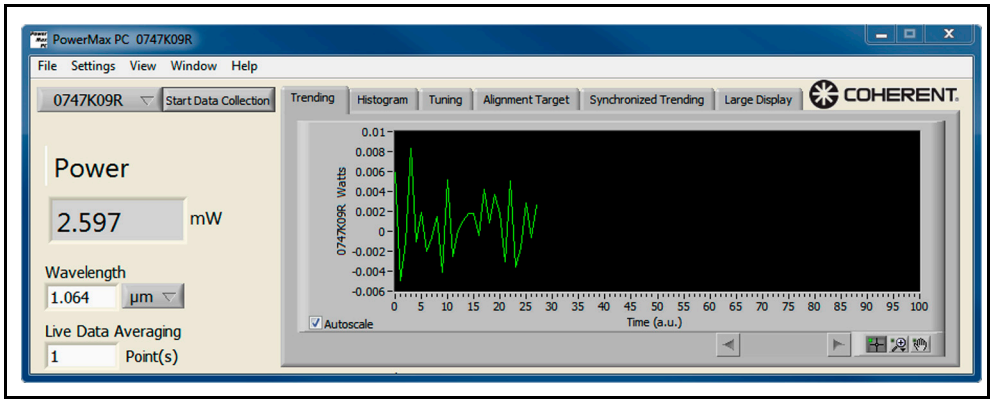
Example of a *Power/Energy* data view:



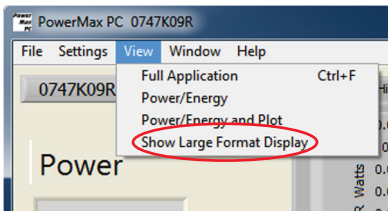
C.4.16.3 Power/Energy and Plot



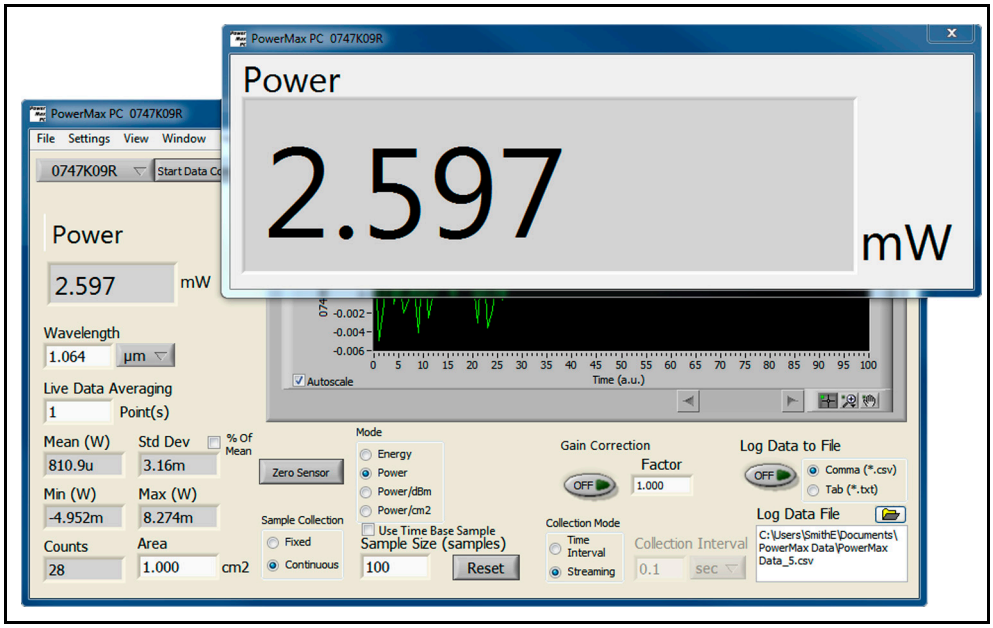
Example of a *Power/Energy and Plot* view:



C.4.16.4 Show Large Format Display

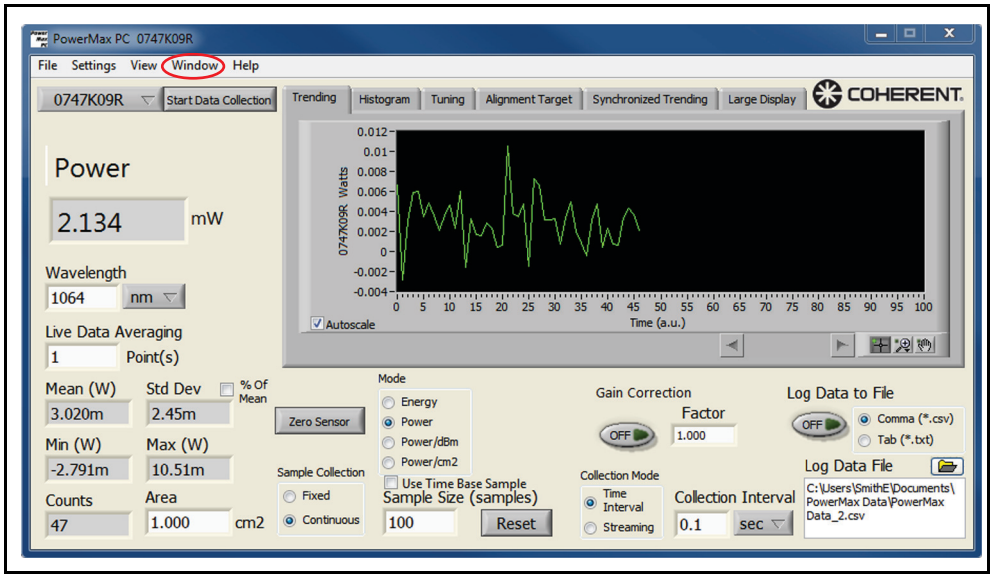


Example of a Show Large Format Display view:



C.4.17 Window Menu

When more than one window is open—that is, when there is more than one sensor connected to the computer and each sensor has its own Front panel open—this menu item lets users determine the relative position of the open Front panels on the monitor screen.

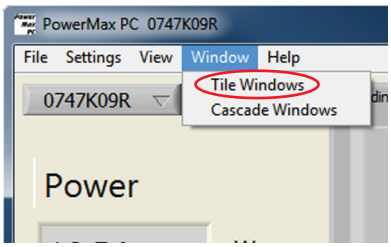


Options available under the Window menu are:

- Tile the windows (this page)
- Cascade the windows (p. 122)

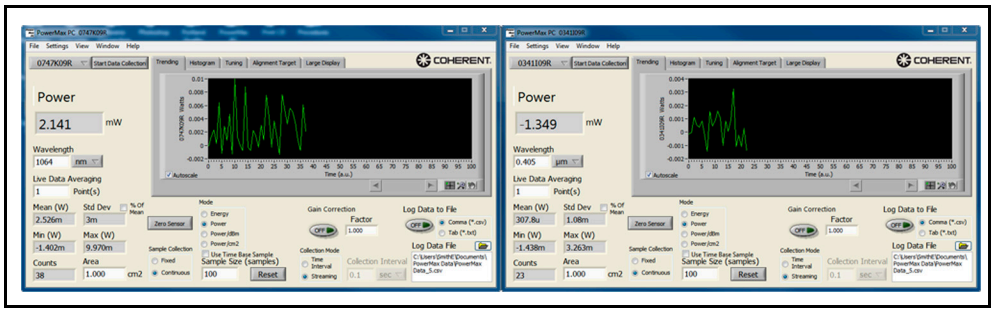
Tile Windows:

Displays open Front panels edge-to-edge.



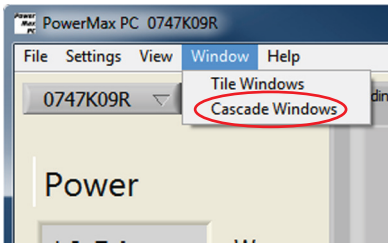
If five or more Front panels are open, only the first four panels tile—the remaining open panels stay in their current location.

Example of two Front panels in a tiled view:

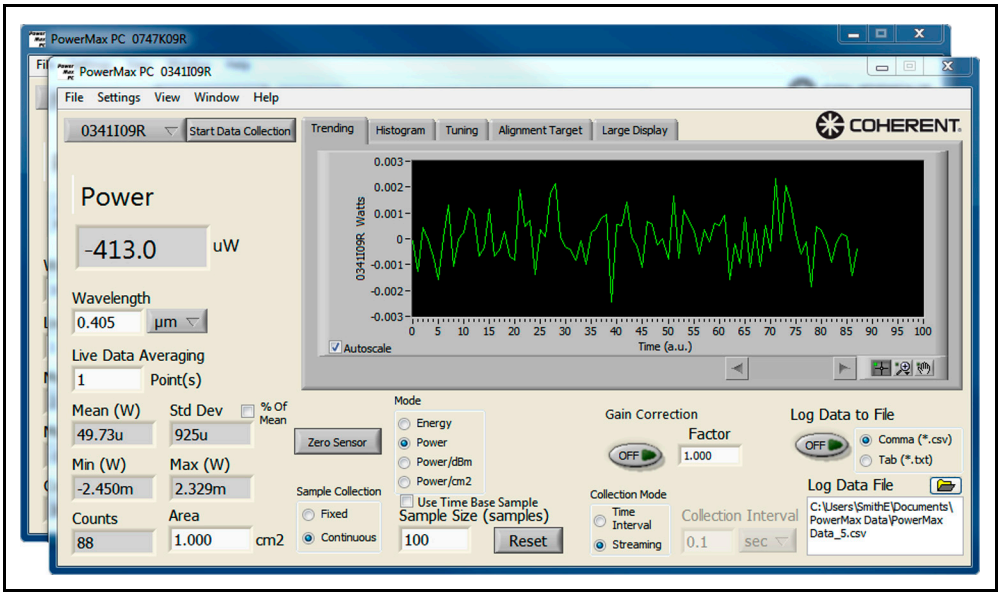


Cascade Windows:

Displays all open Front panels, stacked and cascading from the upper left to the lower right of the screen.



Example of two Front panels displayed in a Cascaded view:

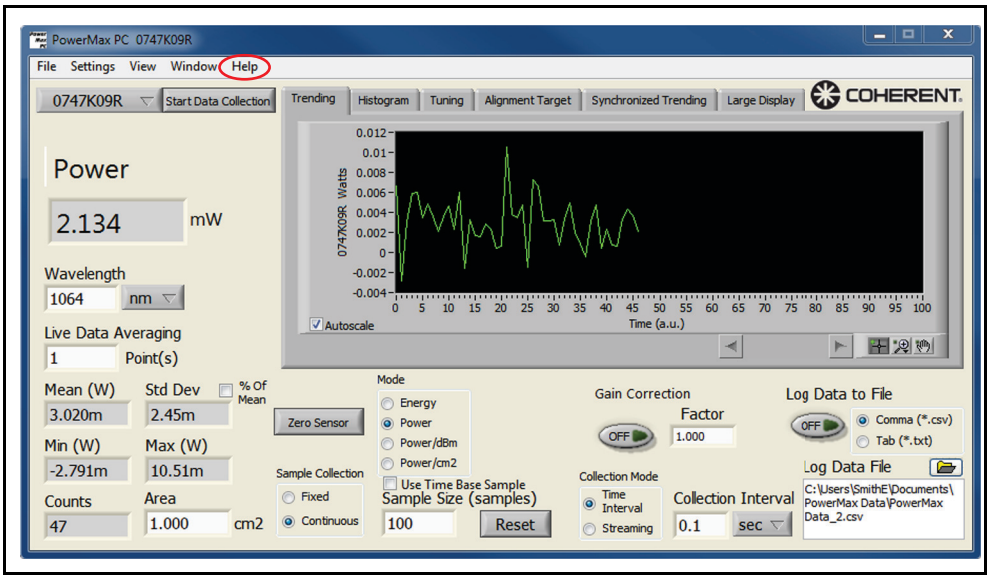


C.4.18 Help Menu

Options available under the Help menu:

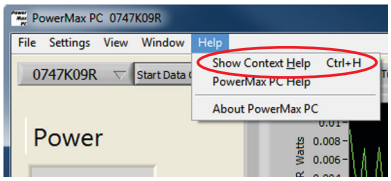
- Show context help ('Show Context Help' (p. 123))

- Display the PowerMax PC help file ('PowerMax PC Help' (p. 124))
- Display version and copyright information about PowerMax PC ('About PowerMax PC' (p. 124))

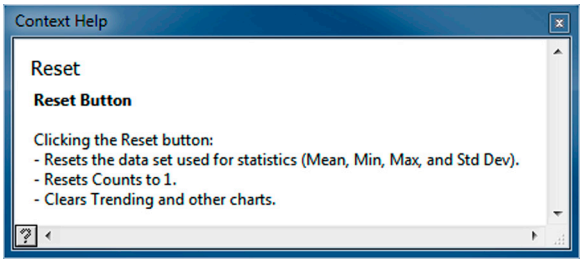


C.4.18.1 Show Context Help

Opens a separate window that displays information about the screen item currently under the mouse cursor (*shortcut:* <***Ctrl***>+<***H***>).



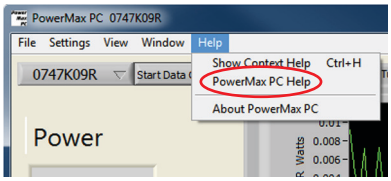
For example, a screen similar to the following will appear if you select *Show Context Help* and then hover the cursor over the Reset button:



To set this feature to Off, either de-select it from the Help drop-down menu, or click the 'X' in the top right-hand corner of the Context Help screen.

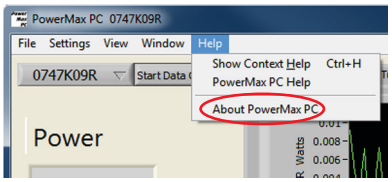
C.4.18.2 PowerMax PC Help

Displays the software Help file.

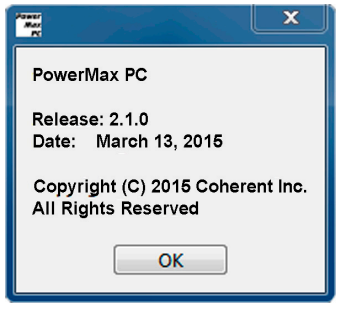


C.4.18.3 About PowerMax PC

Displays version and copyright information for the PowerMax PC software.



Refer to the example:



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PowerMax™ USB/RS Sensor System

COHERENT

INNOVATIONS THAT RESONATE

1169780 AG

PowerMax™ USB/RS Sensor System

Part No. 1169780 Rev AG