USER MANUAL

SOLO 2

Power & Energy Monitor

gentec-eo

121-101167

WARRANTY

The Gentec-EO SOLO2 Single Channel Laser Power, Energy and Power/Energy Meter carries a one-year warranty (from date of shipment) against material and/or workmanship defects, when used under normal operating conditions. The warranty does not cover damages related to battery leakage or misuse.

Gentec-EO Inc. will repair or replace, optionally, any SOLO2 that proves to be defective during the warranty period, except in the case of product misuse.

Any attempt by an unauthorized person to alter or repair the product voids the warranty.

The manufacturer is not liable for consequential damages of any kind.

Customers must fill in and mail the warranty card in order to activate the warranty.

In case of malfunction, contact your local Gentec-EO distributor or nearest Gentec-EO Inc. office to obtain a return authorization number. The material should be returned to:

Gentec Electro-Optics, Inc.
445, St-Jean-Baptiste, Suite 160
Québec, QC
Canada G2E 5N7

Tel: (418) 651-8003
Fax: (418) 651-1174
e-mail: service@gentec-eo.com

Website: www.gentec-eo.com

CLAIMS

To obtain warranty service, contact your nearest Gentec-EO agent or send the product, with a description of the problem, transportation and insurance prepaid, to the nearest Gentec-EO agent. Gentec-EO Inc. assumes no risk for the damage in transit. Gentec-EO Inc. will, at its option, repair or replace the defective product free of charge or refund your purchase price. However, if Gentec-EO Inc. determines that the failure is caused by misuse, alterations, accident or abnormal condition of operation or handling, you will be billed for the repair and the repaired product will be returned to you, transportation prepaid.

SAFETY INFORMATION

Do not use the SOLO2 if the device or the detector looks damaged, or if you suspect that the SOLO2 is not operating properly.

Appropriate installation must be done for water-cooled and fan-cooled detectors. Refer to the specific instructions for more information. The user must wait for a while before handling these detectors after power is applied. Surfaces of the detectors get very hot and there is a risk of injury if they are not allowed to cool down.

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

- Reorient or relocate the receiving antenna.
- Increase the distance between the equipment and receiver.
- Connect the equipment to an outlet that is on a different circuit than the receiver.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Changes or modifications not expressly approved in writing by Gentec-EO Inc. may void the user's authority to operate this equipment.

SYMBOLS

The following international symbols are used in this manual:

Refer to the manual for specific Warning or Caution information to avoid any damage to the product.

DC, Direct Current

LIST OF ILLUSTRATIONS

1 THE SOLO2 SINGLE CHANNEL LASER POWER/ENERGY METER

1.1 Introduction

To obtain the full performance from the SOLO2, we recommend that you read this manual carefully.

The SOLO2 is a microprocessor-based power and energy meter that uses the latest technology to provide a multitude of options in a user-friendly environment. It is a complete power and energy meter. The SOLO2 provide a statistical analysis of your measurements. It allows you to store data on the 1-megabyte flash internal memory. Moreover, the SOLO2 can be updated over the internet by connecting the USB or the RS-232 port to a personal computer.

The SOLO2 has enhanced network capabilities that take further advantage of the USB and RS-232 ports for data acquisition and remote control. It can transfer data files to a PC for more sophisticated data analysis and respond to commands through the PC interface. You will find an easy-to-use communications software to transform your PC screen into a virtual SOLO2 on our website.

There is no need to enter the head specifications when connecting the new Gentec-EO power or energy detector heads, for heads version 4 and above. The SOLO2 is already internally set up to accept all the Gentec-EO wattmeter and joulemeter heads with a DB-15 connector. When connecting a QE-xx-x-MT or a XLE-4 the SOLO2 enters in the metallic mode to ensure proper measurements. The metallic mode is available on all SOLO2. The new SOLO2 also has improved performance in joulemeter mode that allows 2 additional lower scales.

Although the default parameter is Watt, you may also choose to measure in dBm.

$$dBm = Log\ (power\ in\ Watts/0.001W)$$

Unpacking

Each Gentec-EO SOLO2 is thoroughly tested and calibrated prior to shipment.

Visually inspect every SOLO2 unit after removing it from the shipping containers. If you see any damage, retain all packaging materials and shipping receipts. Any damage claim should be made promptly to the transportation company. Notify the nearest Gentec-EO representative concerning the claim, so that any repair or replacement can be arranged as soon as possible.

Easy software upgrade

Keep in touch with the latest improvements to our user-friendly software. You can download the latest software version anytime from our website www.gentec-eo.com and install it on the SOLO2 with the serial interface. You will find all the necessary information on downloading and upgrading in section 4.2.

1.2 Specifications

The following specifications are based on a one-year calibration cycle, an operating temperature of 18 to 28ºC (64 to 82ºF) and a relative humidity not exceeding 80%.

Table 1-1 List of Specifications

	Power meter specifications SOLO2
Power Range	0.1 nW to 10 kW
Power Scales (photo diode head)	3nW, 10nW, 30nW, 100nW, 300nW, 1µW, 3µW, 10µW, 30µW, 100µW, 300µW, 1mW, 3mW, 10mW, 30mW, 100mW, 300mW, 1W, 3W
Power Scales (thermal head)	16 scales: 300uW, 1mW, 3mW, 10mW, 30mW, 100mW, 300mW, 1W, 3W, 10W, 30W, 100W, 300W, 1kW, 3kW, 10kW
Resolution (digital)	Current scale/2048
Monitor Accuracy	±0.5 % ±5 µV full scale[1]
Response Time (accelerated)[2]	1 sec
Sampling Frequency	200 kHz
Statistics	Current value, Max, Min, Average, Std Dev., RMS stability, PTP stability, Time
	Energy meter specifications SOLO2
Energy Range	0.1µJ to 20 kJ
Energy Scales	20 scales: 10uJ, 30uJ, 100µJ, 300µJ, 1mJ, 3mJ, 10mJ, 30mJ, 100mJ, 300mJ, 1J, 3J, 10J, 30J, 100J, 300J, 1kJ, 3kJ, 10kJ, 30kJ
Resolution (digital)	5 nJ
Accuracy[3]	1.0 %±50 µV < 500 Hz 2.0 %±50 µV 500 Hz to 1.2 kHz 3%±50 µV 1.2 kHz to 6 kHz (MT mode) 6%±50 µV 6kHz to 10 kHz (MT mode)
Default Trigger Level	2 %
Software Trigger Level	0.1% to 99.9%, 0.1% resolution Metallic mode : hardware set to 3%.

[1] The 5µV bias can introduce an error into low power measurements with low sensitivity detectors. It is essential to use the Zero Offset to rezero the SOLO2 before making a measurement in these conditions. It is always good practice to use the Zero Offset. See section 2.2.

[2] Varies with detector head.

[3] Including linearity, detector dependant.

Repetition Frequency	3 kHz in acquire data, no missing point 2 kHz in statistics mode, no missing point From 3 to 6kHz the Solo will ignore 1 point out of 2 From 6 to 10 kHz the Solo will ignore 2 point out of 3
Statistics	Current value, Max, Min, Average, Std Dev., RMS stability, PTP stability, Pulse #, Repetition Rate, Avg Power.
Data Storage	225,000 points[4]
	General Specifications SOLO2
Digital Display	76.78 x 57.58 mm LCD, 240 x 160 Pixels
Display Rate	3 Hz numeric display 15 Hz bar graph & needle display
Bar Graph	165 divisions
Data Displays	Real time, Line plot, Histogram, Statistics, Digital tuning needle
User input correction factors	2 multipliers and 2 offsets (7 digits floating point)
Analog Output	0 – 1 volt, full scale, ± 1%
Internet Upgrades	USB and RS-232[5]
PC Serial Commands	USB and RS-232[5]
High throughput serial frequency	Up to 200Hz, with a 310 ms delay between burst for Metallic or XLE joulemeters, whereas 45 to 78 ms for MB joulemeter and power heads.
Dimensions (without stand)	210 mm(W) x 122 mm (H) x 44 mm (D)
Weight (with stand)	0.52 kg
Battery Pack	4 rechargeable 1.2 V Ni-MH AA
Battery life	11 hours, 6 hours with backlight
Battery charge time	6 hours
Universal External Power Supply	Input: 100/240 VAC 50-60 Hz, Output 9 VDC 1.66 A.

[4] Maximum if not using any advanced features that require memory.

[5] USB cable included. RS-232 cable must be purchased separately.

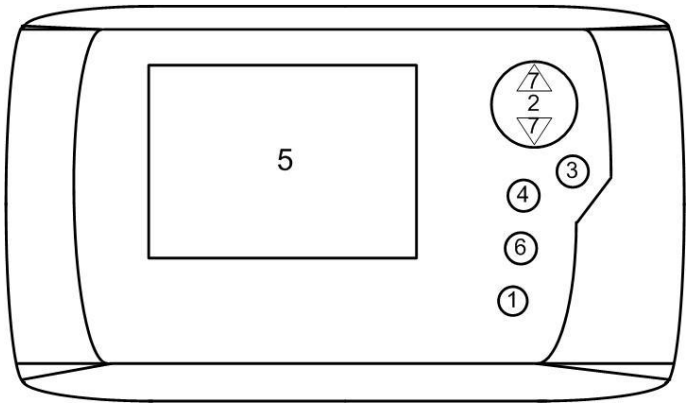

Fig. 1-1 SOLO2 Front Panel

1.3 Front Panel Description

1- I/O and backlight control key.

The I/O key has two functions:

a. SOLO2 on and off

Pressing the I/O key quickly when the SOLO2 is OFF turns the SOLO2 ON (do not hold the I/O key). To turn off the SOLO2, press and hold the I/O key a few seconds. To prevent battery leakage and to increase battery life, we recommend switching off the SOLO2 when not in use.

b. Backlight control

With SOLO2 ON, pressing the I/O key very quickly switches the LCD screen **Backlight ON or OFF**. If you are working without the external power supply, turn the backlight off for longer battery life.

2- ←, ↑, →, ↓ Arrow keys.

a. The Arrow keys allow the user to browse through the menus. Press the **Right** Arrow key until you reach your desired option. To go backwards, keep pressing the **Left** Arrow key

b. When you are not in the Menu, the Arrow keys permits alternative function for quick access button

UP key: Make a physique scale up and the auto-scale is disabled.

Down key: Make a physical scale down and the auto-scale is disabled.

Left key: Makes or remakes a zero offset.

Right key: Activate the custom wavelength keypad.

3- ↵ ENTER key.

The ENTER key selects the highlighted option.

4- Menu Key

The Menu key gives access to the MENU BAR.

5- LCD SCREEN

76.8 x 57.6 mm Liquid Crystal Display Screen, 160 X 240 pixels. Press the shift ket and use the **Up** and **Down arrow** keys (↑ ↓**)** to decrease and increase the LCD screen contrast.

6- Shift key

The shift key gives access to more quick buttons.

Shift-key right : Activate the attenuator for photodiode heads.

Shift-key left : open the data sampling settings menu.

Shift-key up: decrease the contrast level.

Shift-key down: increase the contrast level.

Shift-key menu: open the statistic menu.

7- LCD SCREEN CONTRAST ADJUSTMENT

Press the shift key and use the **Up** and **Down arrow** keys (↑ ↓**)** to decrease and increase the LCD screen contrast.

1.4 Top Panel Description

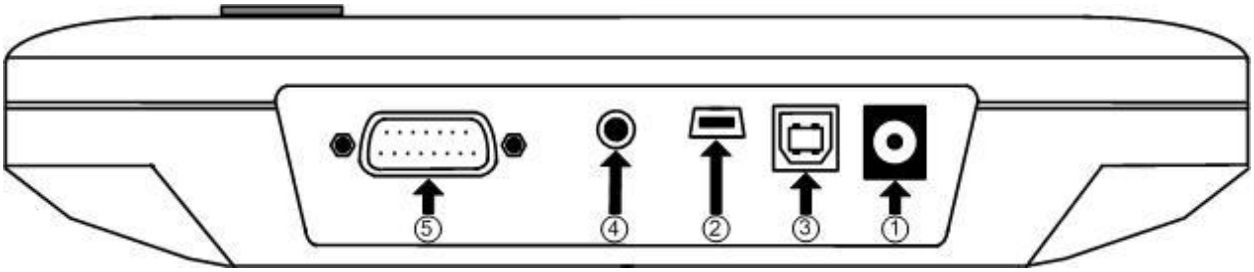

Fig. 1-2 SOLO2 Top Panel

1- EXTERNAL POWER SUPPLY INPUT JACK:

⚠	**CAUTION** **Permanent damage may occur to the optical meter if an external power supply other than the Gentec-eo P/N 200960A is used. Please call Gentec-eo or your local distributor if extra power supplies are needed.**

Input voltage required: 9 VDC/800 mA. For an input of 11 to 15 volts the battery will not charge, but the monitor will work. If input voltage is between 15 and 25 volts the monitor will switch to USB power or battery power. If the input power is above 26 volts either the internal fuse will blow or depending on voltage level and waveform it may damage the monitor.

2- SERIAL INTERFACE CONNECTOR (RS 232):

This interface allows remote control and data transfers between the SOLO2 and a computer, a terminal, or any device that has a serial communication port.

3- USB INTERFACE CONNECTOR:

This interface allows remote control and data transfers between the SOLO2 and a computer that has a USB communication port.

4- 0 to 1 VOLT ANALOG OUTPUT:

For monitoring laser average power or energy by using external equipment such as a chart recorder, a computer with an analog interface, a voltmeter, etc.

The output signal represents the amplified and anticipated power detector response in the case of a power measurement. In the case of an energy measurement, the output signal is a DC voltage representing the pulse energy value.

The 1 V value corresponds to the full scale reading of the selected range. That provides the best signal-to-noise ratio. The measured power or energy is then related to the output voltage and to the selected range according to the following equations:

$$Power = V_{output} \times \text{Max of Range selected}$$

$$Energy = V_{output} \times \text{Max of Range selected}$$

For example:

1.00 V corresponds to 10 Watt on the 10 W range
0.25 V corresponds to 2.5 Watt on the 10 W range
0.10 V corresponds to 30 milliwatts on the 300 mW range

Specifications:

Maximum output voltage:	1 V
Output impedance:	10 kΩ
Connector type:	Female 1/8" jack

5- PROBE INPUT JACK:

The SOLO2 uses a DB-15 female connector to mate with the detector heads (probes).

The **SOLO2** works with all Gentec-EO detectors. It automatically recognizes every power detector head, which ensures accurate auto-calibration. More importantly, it can take advantage of our *Personal wavelength correction*™. It reads the memory in the *Smart Interface* connector (version 5 and higher) to provide a wavelength correction that is based on spectral data measured from that specific detector.

The SOLO2 may not recognize some of the earlier heads. These are identified as "wattmeter."

Energy detector heads prior to version 4 have a BNC connector. The user must use a universal BNC/DB-15 adaptor to connect an energy detector head to the SOLO2. This adaptor is compatible with all the Gentec-EO pyroelectric joulemeters except the EPD.

For these early energy detector heads, a pop-up menu asks the user to select the proper detector model. This does not affect the reading and the measured value is still valid.

Power detectors of version V2 and higher and **Energy detectors of version V4 and higher** are equipped with an "intelligent" DB-15 male connector that mates directly to the DB-15 female connector. They do not require an adaptor.

WARNING: This DB-15 connector, though similar to that of the former TPM-310 and TPM-330 monitors, is incompatible with the power detector heads of PS-310 Series Version 1 and PS-330 Series Version 1. These heads used a different technology and do not have the same pin-out configuration.

A V1 to V2 adaptor can be used in order to connect the power detector heads of PS-310 Series and PS-330 Series Version 1 and 2. Please contact your local Gentec-EO distributor or the nearest Gentec-EO office for further information.

Any attempt to modify connectors of the early version heads to mate with the SOLO2 can result in damage to the monitor.

2 Getting Started

▼

This section contains important information concerning the installation and operation of the SOLO2.

The SOLO2 is delivered ready to use. Just insert a detector head in the Probe Input Jack (#5 in Figure 1-2) and press the I/O key.

2.1 How to use the keys to access the menus

The powerful CPU of the SOLO2, combined with the Windows™ CE operating system, provides easy and intuitive access to all of its functions. This user-friendly Windows™-based interface is controlled by four **Arrow** keys, an ↵ key (**Enter** key) and a **Menu** key. For users familiar with Windows™, it works as any Windows™ menu, with the **ALT** key being replaced by the **F** key.

Pressing the **F** key (see Figure 2-1) provides access at any time to the menu bar and, from there, to the five main menus. Use the **Left** and **Right** arrow keys to go from one menu to the next. The selected menu drops down to show its options. Use the **Up** and **Down** arrow keys to select the desired item from the menu. Once the desired item is highlighted, press the ↵ **Enter** key to activate the function. When a menu option has an arrow "▶" at the end, pressing ↵ **Enter** or the **Right Arrow Key** "→"opens a submenu where you can select the function. For example, in the case of the **Setting** menu, first select **Corrections** with the **Down Arrow key**, followed by the ↵ **Enter or the Right Arrow key** "→" to access the submenu. Move to the desired option with the arrow keys and press the ↵ **Enter** key to activate.

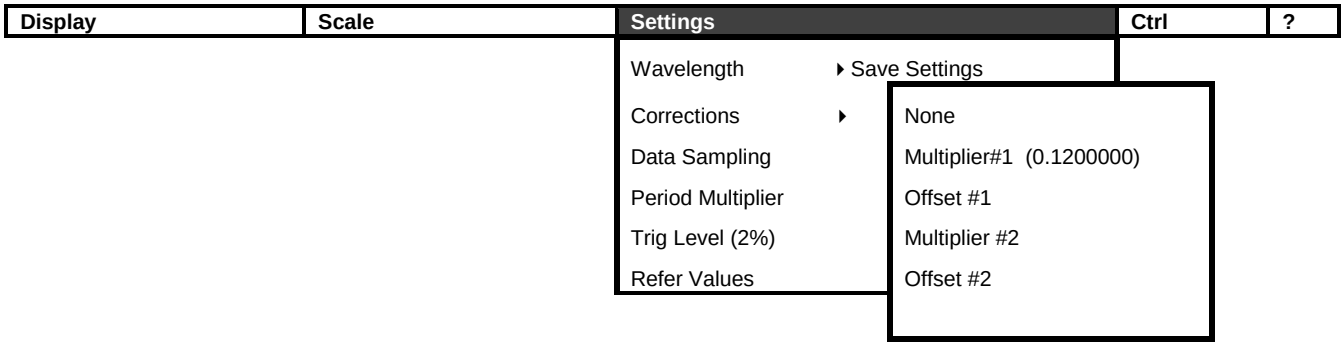

Fig. 2-1 The menu bar

Some menu options require additional information to be activated properly. In this case, a dialog box (see Figure 2-2) appears. There you enter the setting values of your choice. Use the **Arrow** keys to highlight a number and press the ↵ **Enter** key to select it. The selected number will appear in the upper box. Repeat the operation until the desired number has been fully entered. Then go to "OK" and press ↵ **Enter** to validate your number. You can correct a mistake by selecting the **Back** button (←) located in the bottom right of the dialog menu. Use the **Decimal** button (**.**) to enter decimals. The **Percent** button (%) gives you the flexibility to enter a value as a percent rather than a fraction. For example, you can enter the same multiplier as 0.925 or 92.5%.

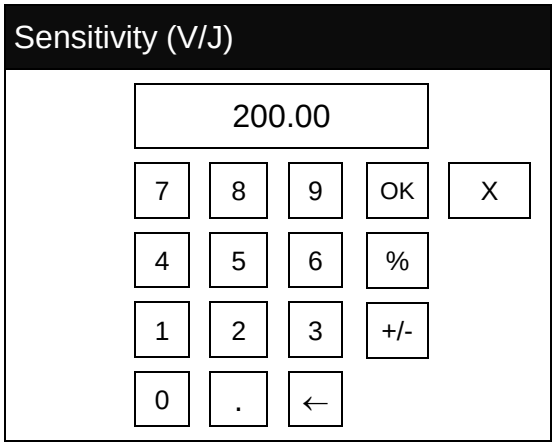

Fig. 2-2 The dialog box

2.2 Quick power and energy measurement procedure

This section applies to all SOLO2 versions. It will show you the fastest way of making a laser power and energy measurement with the SOLO2 and a Gentec-EO power or energy detector.

The monitor automatically recognizes all the Gentec-EO power heads and energy heads of version 4 or higher. All custom technical data required for optimum operation of the detector will be automatically downloaded from the EEPROM in the DB-15 connector. This data includes sensitivity, model, serial number, version, wavelength correction factors, and time response. The Solo2 doesn't support energy detectors before version 4.

Version 7 energy heads

These heads have been calibrated with and without the attenuator at a chosen wavelength. When the connector is attached, a message appears, asking you if the attenuator is in place. If the attenuator is in place, the wavelength menu disappears. If no attenuator is in place, the wavelength menu appears. The attenuator switch is a toggle switch. Select Ctrl / Attenuator to turn it on or off. See Appendix A for more details.

Quick power and energy measurement procedure:

1- Install the power or energy detector head on its optical stand.

2- First, slide the connector latch to the right to unlock the connector.

3- **Turn the SOLO2 off** and connect a version 5 (or higher) power or energy detector head to the SOLO2 using the **PROBE INPUT JACK** (see Fig. 1-2). It is recommended to turn the SOLO2 off before connecting a new head in order to prevent any lost of information from the detector head EEPROM.

4- Slide the latch to the left to lock the connector into place.

5- Switch the SOLO2 ON using the **I/O** key.

6- Power heads will default the SOLO2 to power measurement; energy heads will default the SOLO2 to energy measurement. The monitor will default to autoscale. If you have a photodiode, to obtain measurements in dBm, select Settings / Power Unit / dBm.

7- Remove the head's protective cover.

Put the detector head into the laser beam path. Leave it there for a few minutes, until the detector has reach an equilibrium temperature. The entire laser beam must be within the sensor aperture. Do not exceed maximum specified densities, energies or powers. For the most accurate measurement, spread the beam across 60% to 80% of the sensor area.

Attention: Power heads can be used with both CW and pulsed lasers.

- Energy heads can only be used with pulsed lasers.

For power heads, go to step 8. For energy heads, go to step 11.

Adjusting the zero (steps 8 to 10)

8- Block off laser radiation to the detector.

The power read by the SOLO2 when no laser beam is incident on the detector may not be exactly zero. This is due to the fact that the detector is not thermally stabilized OR there is a heat source in the field of view of the detector when you turned on the SOLO2.

9- To reset the zero, wait until the reading has stabilized and select **Zero Offset** in the **Ctrl** (Control) menu. Then select **Rezero**. You are now ready to make an accurate measurement. To turn the **Zero Offset** off, select **Off**, to reselect the previous offset, select **Undo**.

10- To set the diode to zero, select Ctrl / Set Diode Zero, and press the ↵ **Enter** key. A message appears requesting you to put the black cover on your photodiode and press the ↵ **Enter** key after you have done so. The SOLO2 passes through all the scales to determine the zero diode for each scale. The message "Diode Zero Done" appears when the SOLO2 has determined the zero diode.

Notes:

- Refer to specific power detector documentation for complete installation and operating instructions.

- The power detectors are thermal sensors sensitive to temperature variations.

For high-precision measurements, it is recommended to:

- Allow the power detector temperature to stabilize before zeroing the SOLO2.
- Do not touch the detector head when handling the power detector. Touch only the stand.
- Avoid forced airflow or drafts around the detector.

11- Apply the laser beam to the detector head.

12- The laser beam average power or energy will be displayed in three ways for your convenience:

a. Digitally for real time measure.

b. On a digital needle for an easy visualization of the laser beam power variation during laser fine-tuning.

c. On a histogram to allow the laser beam's long-term stability to be evaluated.

2.3 Description of the top level SOLO2 menus

This section describes in detail the first group of menus essential to the SOLO2 operation. Refer to Figure 2-3 for a schematic view of the menu structure. The menus differ depending on the type of head that is plugged in. The display menu lets you view your measurement in various ways. The scale menu allows you to fix a specific measurement scale instead of autoscaling. Use the settings menu during setup to set the best parameters for the measurement task at hand. They provide the flexibility to accommodate a wide variety of measurement conditions. The more active controls you are likely to use during your measurements are in the CTRL menu. They are described in Section 2.4.

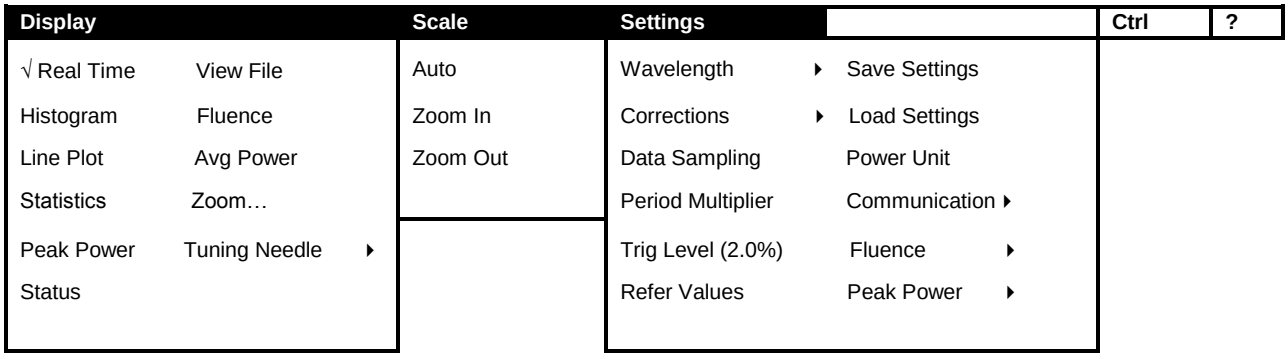

Fig. 2-3 View of the first group of SOLO2 menus

2.3.1 Displays

The various displays offered by the SOLO2 allow you to quickly view your measurement in several different ways. You will appreciate the easy-to-view high resolution 58x38 mm graphic, the LCD display and the backlight for use in poor ambient light conditions. The display menu includes five options, (see

Figure 2-3) that allow you to select the best way to display the measurement according to your specific needs. You can switch from one option to another without interfering with the measurements.

2.3.1.1 Real time display

This display is automatically selected when a head is connected to the SOLO2. The top and bottom of the screen shows important settings so you see the conditions as well as the measurement. (see Figure 2-4). The **Power** or **Energy** Digital display is presented in giant format for easy reading in all conditions. Directly below, the **Bargraph** display, as wide as the screen, presents the measurement in an analog format, very useful for rapidly varying values. On the upper left part of the screen, you can read the **Type of Head** and, under the Bargraph, the current **Scale**. At the bottom of the screen the leftmost box contains the actual power or energy received by the head before any correction factors are applied. The center box gives the resolution and the rightmost box displays the wavelength. The resolution is the smallest increment that the current value may change on a given scale. The wavelength value tells you what NIST-based calibration factor is active. You can find the factors on the Calibration and the *Personal wavelength correction*™ certificates that are shipped with your detector.

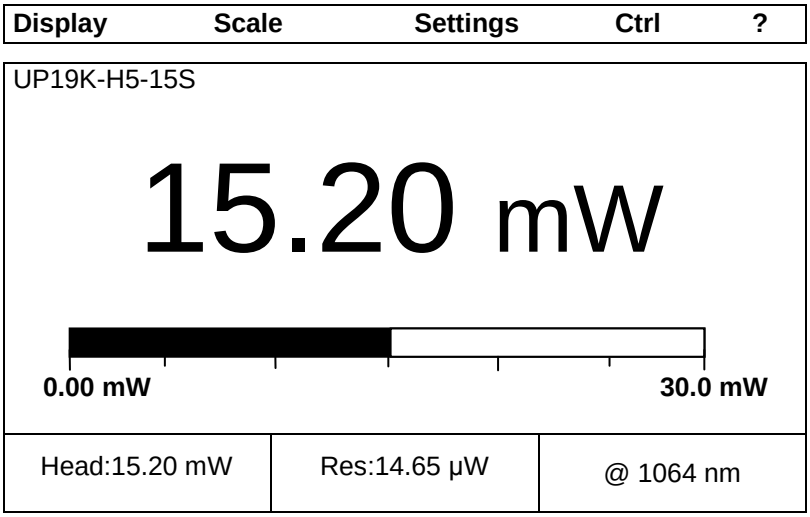

Fig. 2-4 Real time display

With a SOLO2, you can also choose either the high resolution mode for the most significant digits available or the standard resolution to filter out unimportant fluctuations in measurement. This is a setting in the control (Ctrl) menu of the SOLO2.

2.3.1.2 Histogram display

The histogram option gives a quick look at the laser beam's long-term stability and trends. The histogram adds new data points at a rate of 3 Hz and is dynamically scrolled to the left for each new point as soon as it reaches the right side of the screen.

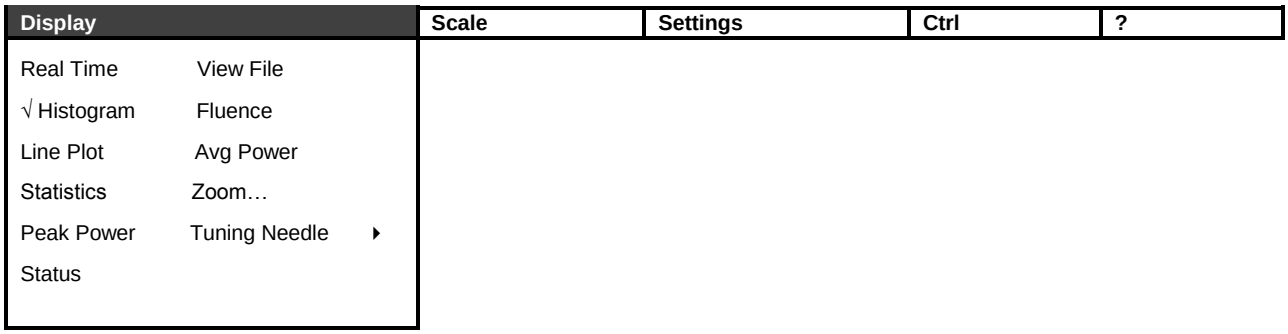

Fig. 2-5 Display options menu

2.3.1.3 Line Plot display

The line plot also shows the trends in your data. Actual values are sometimes easier to read than with the Histogram.

2.3.1.4 Statistics display

In Statistics display mode, the statistical analysis screen pops-up on top of the Main display. This screen (Figure 2-6) gives a complete statistical analysis of the measured data. See section 2.3.3.3 for a detailed description of each item. Select the **Start** button to start or restart the data sampling and statistical calculations. Use the **Stop** button to stop the data sampling and statistics before you reach the end of the selected sampling time. (See Data Sampling section 2.3.3.3.) The last statistical values calculated remain on screen so you can view them later, even if you close and reopen the Statistics window. To set the data to zero, select **Reset**. To restart the data sampling, select **Start**. The **Close** button closes the statistics window so you can see the Main display again but does not interfere with the statistics being computed. The data sampling and statistical calculations continue with this window closed or open, and no matter what display you select. You can open and close the statistics display window to check on the statistics as often as you like.

The values in this display provide an additional digit of resolution to allow you to benefit from the improved precision of large samples. You must understand your sample size well enough to know if this additional digit is significant.

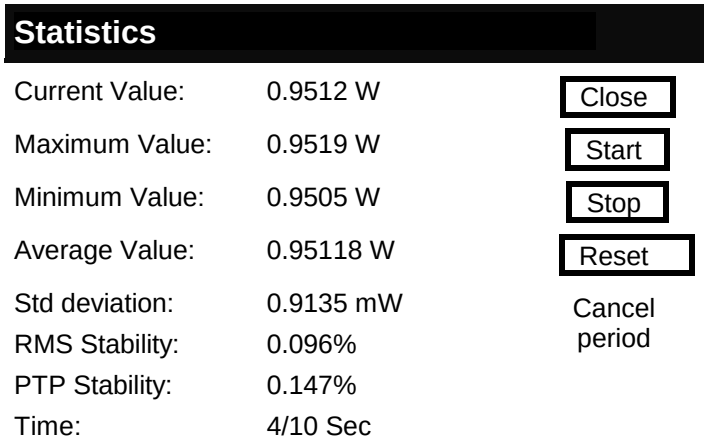

Fig. 2-6 Statistics display

2.3.1.5 Peak Power Display

In Peak Power display mode, the pulse energy measurement of the energy mode is converted to its peak power (watts) and is inversely proportional to the pulse length. This function is active only in energy mode. The user must enter the pulse width, in picosecond to millisecond units using **Settings/Peak Power** in the Settings menu.

2.3.1.6 Status display

The status display mode shows all the major adjustable parameters currently active for the detector head in one convenient place, (see Figure 2-7).

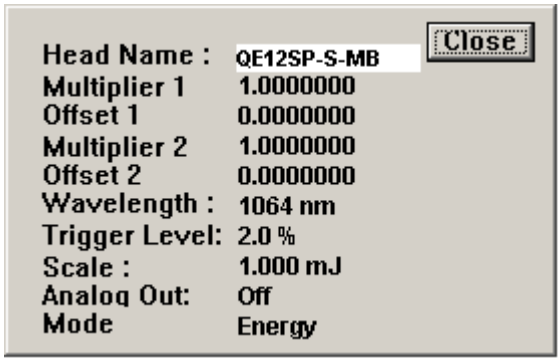

Fig. 2-7 Status display

2.3.1.7 Avg Display

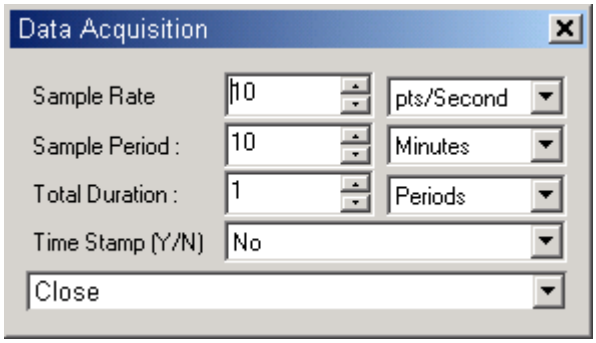

Fig. 2-8 Wattmeter data sampling menu

For Power Detectors:

In the **Avg display** mode, the power measurement is the average value defined in the data sampling menu. You can change your data sampling to your desired average time parameters. Statistics always run in the background in this mode. This mode is a real time average of a group of data defined in the data sampling setting. For optimum averaging, when measuring the average power of a pulsing laser, it is preferable to use a sample period that is a multiple of your laser repetition rate. For instance, if you are running at 1 Hz, use a sample period of 1,2,3 etc… seconds. If it is at 1.5 Hz, use 3, 6, 9 etc… seconds, as the sample period. You don't need to change the sample Rate of 10 Hz in this mode. Set the scale higher then your maximum unfiltered measurement because. Take note that if one data point is out of the current scale, the resulting period average will be OUT.

For Energy Detectors and Single Shot Energy Mode with Power Detectors:

In the **Avg display** mode, the displayed value is an average power calculated by multiplying the measured energy per pulse by the measured repetition rate. You can change your data sampling to your desired average time or number of points. You must run the Statistics in background in this mode. The number of values used for the average depends on the sample period value in the data sampling settings. We recommend setting the total duration in continuous in the data sampling.

2.3.1.8 Exposure mode

For Energy Detectors and Energy Mode with Power Detectors:

In the **Exposure** mode, the displayed value is a cumulative Energy calculated by summing the measured energy of each pulse. The monitor also displays the total number of pulses and elapsed time.

2.3.1.9 View File

The view file mode allows you to view data previously acquired. Choose between standard (Std) notation and scientific (Sci) notation. Do not make a view file when you have more than 1000 points in your last acquisition.

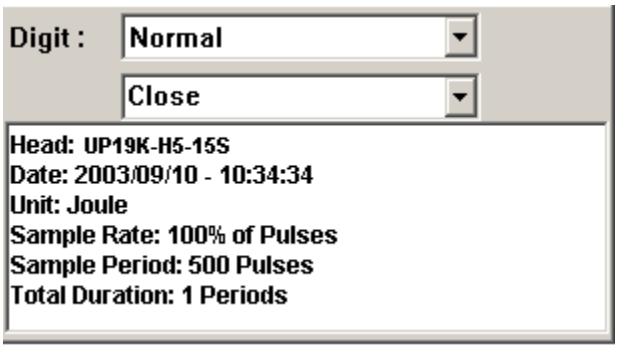

Fig. 2-9 View File screen

2.3.1.10 Fluence Display

In the Fluence display mode, the energy or power measurement is converted into energy density (J/cm^2) or a power density (watts/cm^2) and is inversely proportional to the surface area of the beam. This function is active in the energy and power modes. The user must enter the beam size, see **Settings/Fluence** in the Settings menu.

2.3.1.11 Zoom

In the Zoom display mode, you can adjust the display scale of the line plot display or the histogram display. When zoom is selected, move the first vertical line using the up/down key, then select **Enter**. Move the second vertical lines then select **Enter**. If you want to exit the zoom option, press **the Enter key** two times. To disable the zoom, reselect **zoom** in the display menu.

2.3.1.12 Digital Tuning Needle display

When you select the **Tuning Needle**, a graphical interface shows a real-time digital needle. The deflection of the digital needle is proportional to the real-time measurement. The 15 Hz refresh rate makes it an excellent tool for laser tuning and alignment.

It is marked for use with any scale setting in the SOLO2. Two different views are available. The first view using **Display/Tuning/Standard** shows the 0 at the lowest left of the scale as shown below whereas the second view display the 0 in the center of the scale by selecting **Display/Tuning/Needle in the Middle**.

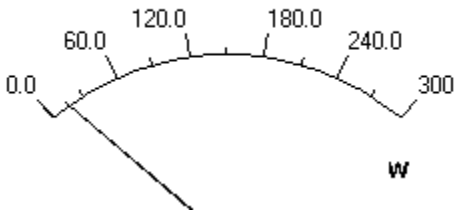

Fig. 2-8 Digital needle display

2.3.2 Scale Menu

The **Scale menu**

The scale can be set in the automatic scaling mode (auto mode) or you can choose a specific fixed scale according to the specific head, using the arrow keys on the keyboard. However, once the Gentec-EO head has been automatically identified from the detector head's EEPROM, the only scale menu available is the one corresponding to the detector head connected to the SOLO2. Figure 2-10 is an example for an energy detector.

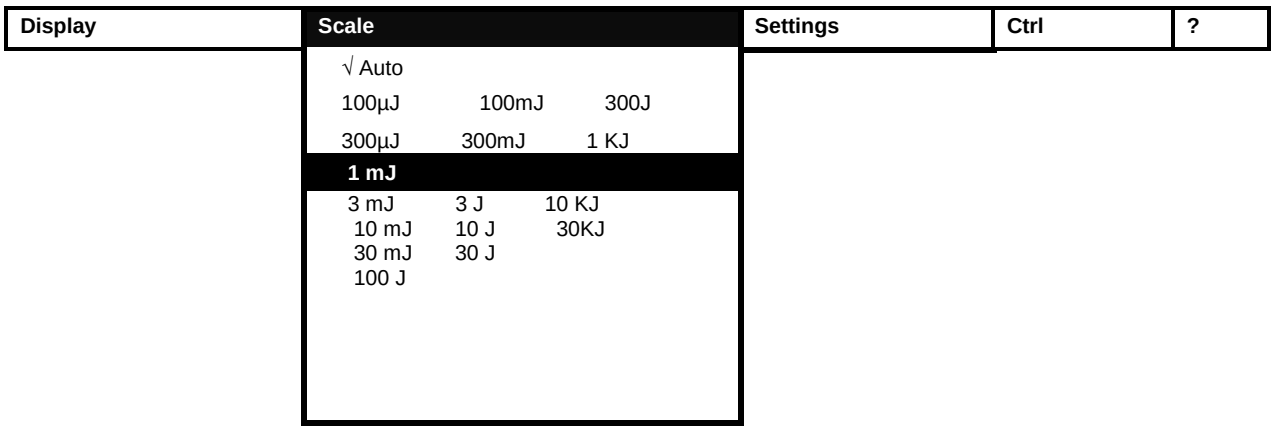

Fig. 2-10 Scale menu

The scale menu is used to select the signal level read with a detector head. When a new head is plugged in, the autoscale is the default option. In this condition, the SOLO2 automatically selects the best scale for the value being measured. The auto scale only auto-scale up for the Metallic joulemeters.

The checkmark beside the scale number shows the currently selected scale. To change the scale, simply select a scale value from the appropriate range. The SOLO2 only shows scale values that fall within the detector head's range.

When in a manually selected scale, you should always use the next higher scale to the measured value, for maximum precision.

Special care must be taken in the case of widely varying pulse energy to ensure that every pulse is detected. Contrary to the case of a power measurement where the autoscale adjusts continuously to the measured value, the autoscale in energy mode bases its scale selection on the energy of the previous pulse. A pulse with energy less than 2% of the energy of the previous pulse will not be detected. To avoid this problem, set the scale manually to a lower level. In this case, you measure this lower level when the higher energy pulses are saturated.

2.3.3 Settings

Options in the **Settings menu** define user-adjustable acquisition parameters. All correction factors that will affect the reading can be easily programmed. That could be for a beam sampler, attenuator, or other optics that require you to multiply and/or add offsets to the detector reading. You can also adjust for a wavelength other than the calibration wavelength. A custom correction factor can also be keyed in. Pre-

programmed wavelength correction factors dedicated to each detector head are also available and automatically loaded from the detector EEPROM, for the version 5 and higher detector heads. Data sampling and trigger level, as well as the commands for saving and loading your settings are also found in the Settings menu.

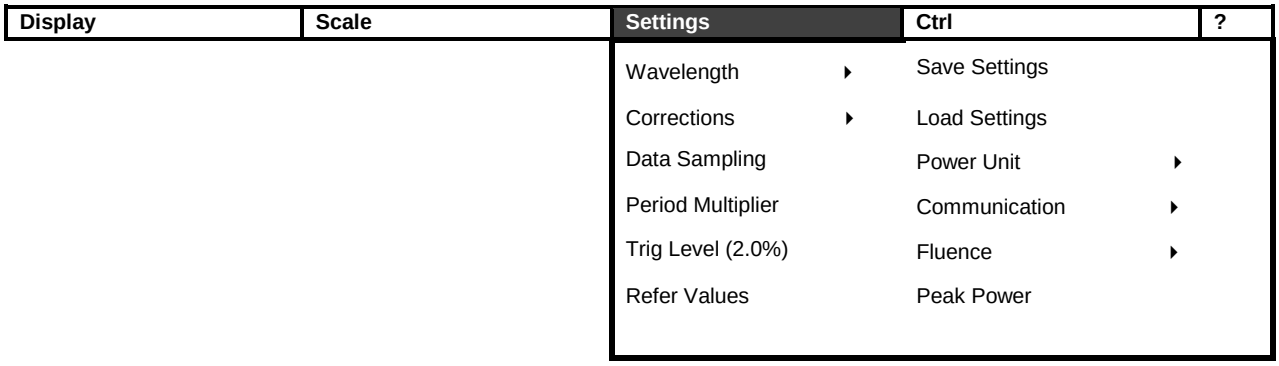

Fig. 2-11 Settings menu

2.3.3.1 Wavelength Setting

The Wavelength menu is used to select the proper wavelength at which the detector is to be used. It applies a correction to adjust for the variation in responsivity at different wavelengths. When a new detector is plugged in, the calibration wavelength is the default selection.

The checkmark beside the wavelength shows clearly the current selection. To change the wavelength, select an appropriate wavelength from the Wavelength menu. The SOLO2 only allows you to choose values that fall within the detector's range. If you select or enter a value that is not valid, a menu pops up to signal the error and the SOLO2 automatically selects the default value. That is the wavelength used for calibration at Gentec-EO during manufacture or subsequent service.

For the version 5 (V5) detector heads, the SOLO2 automatically recognizes every energy and power detector, for accurate auto-calibration. More importantly, it takes advantage of our *Personal wavelength correction*™: it reads the memory in the *Smart Interface* connector to provide a wavelength correction based on spectral data measured from that specific detector. Your measurements across the band have never been this precise or easy.

When working at a wavelength not available in the Wavelength menu, use the custom option in that menu and enter the wavelength you need. The wavelength you enter must be within the range of valid wavelengths. The SOLO2 interpolates a wavelength correction factor using the pre-programmed data in the detector's EEPROM.

Once you have entered a new wavelength in the SOLO2, save your settings (refer to 2.3.3.7). This will reload the chosen wavelength and the correction factor automatically, if any, every time you reboot the SOLO2 with the same type of head.

Personal wavelength correction™ is automatic only with version 5 and higher detectors. With version 4 (V4) detectors, you need to use the Corrections menu to manually enter a multiplier to correct for the wavelength. You will find these multipliers on the *Personal wavelength correction*™ Certificate shipped with the detector. You can use both the Wavelength menu and the Corrections menu for all V5 and later detectors.

2.3.3.2 Corrections Setting

The user can apply up to 2 multipliers and 2 offsets to the detector reading. Correction factors are most useful when sampling a percentage of a powerful laser beam or correcting for absorption along an optical chain. The menu displays the values of correction factors that are being applied to the measurements**.** Also view them in the **Display Status menu** (see Figure 2-8).

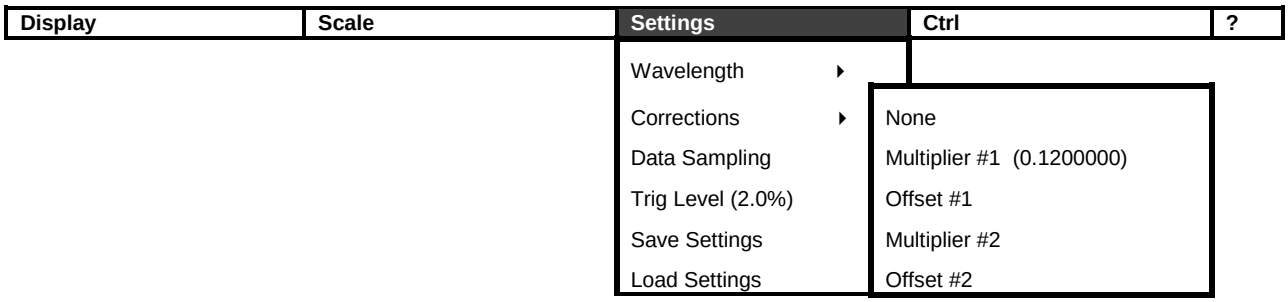

Fig. 2.12 Setting Correction menu

To activate the correction factor, select **Corrections** in the **Settings Menu** and then select Multiplier or Offset. A dialog box opens where you enter the correction value in percentage or in absolute value. This number will then multiply, or add to the actual measured value to calculate the corrected value. The SOLO2 will then display the corrected value.

For example, if you are measuring the laser beam passing through the 99.9% back reflector of a laser (giving 1/1000th of the real value), choose **Multiplier #1** and enter 1000 in the dialog box. The SOLO2 will display the laser's power rather than the measured 0.1% sample on the main display.

The corrections are applied mathematically in the order shown in the menu. Therefore, to apply an offset before a multiplier you would enter a value for Offset #1 and a value for Multiplier #2 and leave Multiplier #1 at the default value. The default value for the multipliers is 1, and the default for the offsets is 0.

When a correction factor is active the "Head" value will be different from the displayed measurement. The Head value is displayed at the bottom left of the screen. The corrected measurement appears in the center or upper right part of the screen depending on the display. (See Figures 2-4 and 2-7).

It is also essential to make sure that the actual measured value complies with the power and energy limits of the detector head. The autoscale option is the default selection. You can select a specific scale but it must always be based on the actual physical measured value and **not on the corrected values**. Of course, the displayed values and the display scale selection are then calculated to take into account the correction factors.

Note that the **Statistics** are computed for the corrected values only.

To disable the correction factor, re-select the Correction Factor (multiplier, offset) in the **Corrections submenu** of the **Settings menu**. To disable all correction factors select **None** in that submenu.

2.3.3.3 Data Sampling Settings

The SOLO2 can display a complete statistical analysis of power or energy measurements. The Data Sampling menu is used to set up the data sampling parameters for calculating the Statistics. You have complete control over the data sampling. Use the defaults or select your own sample rate, sample period, and the time period or number of points to do the statistics. You can set the SOLO2 either to calculate the statistics for a single sample and stop or to repeat continuously. Take data for a few seconds or a few weeks. You have the flexibility to handle any application, from analyzing a single short pulse with high resolution to sampling performance over a period of months.

Selecting the **Data Sampling mode** in the **Settings menu** opens a Dialog Box where you enter the sample rate, the sample period, total duration, and the time stamp, if required.

You can monitor the statistics being captured and calculated simply by selecting **Statistics** in the **Display** menu. You can switch back to any other display mode without affecting the measurement or the statistics. You can also click the **Reset** button in the display to clear all the statistical parameters and start all over again by selecting the **Start** button. In order to have a good frequency accuracy with the MT and XLE joulemeter types, you must at least make a 2 second statistical analysis. The statistical parameters that are calculated are listed in Table 2.1.

Table 2.1. Statistical Parameters

Statistical Parameters	Power	Energy	Definition
Current value	✓	✓	Value of the most recent measurement
Maximum value	✓	✓	Highest value in the sample period, E_{max} or P_{max}
Minimum value	✓	✓	Lowest value in the sample period, E_{min} or P_{min}
Average value	✓	✓	Rolling average of values in the sample, E_{avg} or P_{avg}
Standard Deviation	✓	✓	A measure of the spread of the data around the average. $STD=\sqrt{\frac{\sum_{i=1}^{n}(E_i-E_{avg})^2}{n-1}}$, $STD=\sqrt{\frac{\sum_{i=1}^{n}(P_i-P_{avg})^2}{n-1}}$
RMS stability	✓	✓	Root mean square stability represents the standard deviation as a percent of the average. $RMS=\frac{STD}{E_{avg}}\times 100$, $RMS=\frac{STD}{P_{avg}}\times 100$
PTP Stability	✓	✓	Shows the spread between the highest and lowest point in the sample as a percent. $PTP=\frac{E_{max}-E_{min}}{E_{avg}}\times 100$, $PTP=\frac{P_{max}-P_{min}}{P_{avg}}\times 100$
Time	✓		Time elapsed since beginning the sample.
Pulse #		✓	Number of the last pulse added to the sample.

Repetition Rate		✓	Frequency of pulses coming from the laser, *PRR*
Average Power		✓	Power calculated from the pulse energies and repetition rate. $P_{avg}=E_{avg}\times PRR$

To **Activate the Statistics,** select **Statistics** from the **Ctrl** menu, and then select **Start** in the submenu.

The SOLO2 starts compiling statistics on your measurements as soon as the Statistics mode is activated. Select **Stop** in the same submenu to turn the Statistics mode off. When you stop the statistics, the last values remain in the statistics display window for you to view later. If you click start again, the SOLO2 will resume the statistics from that point compiling the new measurements with the previous. Click **Reset** and all the statistical parameters will be cleared and set to zero. If you click **Reset** without stopping, all the statistical parameters will be cleared and the statistics will begin from zero automatically.

Alternative: From **Display** menu, select **Statistics** to enter the statistics display window. The same commands are available there as buttons. Selecting the **Close** button closes the window but does not turn off the Statistics mode or interfere with the calculations. Selecting the **Stop** button stops the calculation of new statistics but does not close the window so that you can review the final values.

The SOLO2 uses default sample parameters unless you set them yourself.

To **View the Statistics,** select **Statistics** from the **Display** menu.

To **Set the Data Sample Parameters,** select **Data Sampling** from the **Settings** menu**.**

Figure 2-12 shows the window for setting the data sampling parameters. Use the → RIGHT arrow key to move through the parameters and units windows. Move to the one you want to set. Then use the ↑↓ UP and DOWN arrow keys to change the value. If you want to enter a value that is not available using the up and down arrow keys, then press the ↵ **Enter** key instead. The keypad data entry dialogue box shown in Figure 2-2 will pop up to allow you to enter a custom value. When you are finished, use the → RIGHT arrow key to select the CLOSE box and press the ↵ **Enter** key. Table 2-2 defines the various parameters.

The key points to remember whether using a joulemeter or wattmeter are:

Sample Rate	Controls how fast you collect data.	Eg. 10 points/second or 50% of pulses
Sample Period	Controls how much data the statistics are computed for.	Eg. 5 minute or 1 day averages
Total Duration	Controls how long the SOLO2 will acquire data and/or do statistics.	Eg. 1 period, 5 hours or 1000 pulses

Often the Total Duration and Sample Period will be the same but the SOLO2 gives you the flexibility for any application. For example with the SOLO2 you can see 5 minute averages of your laser performance as you check it during the day and have it stop and hold the last 5 minute statistics after 20 hours.

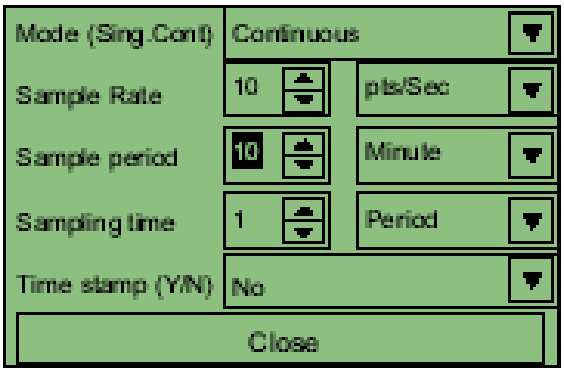

Fig. 2-13 Data sampling parameters window.

Table 2.2 Data Sampling Parameters

PARAMETER	Choices	Description	Default
Sample Rate	Integers 0 to 100 custom value 0 to 300	Sets the time between each sample. Specify it as a number of points per unit of time. *[for example, for 1 second between samples, set to 60 points per minute]]*	10 (Power) *0 (Energy)*
Sample rate units	pts/Second pts/Minute pts/Hour pts/Day	Sets the time period for the number of points entered above. Maximum is 100 points/second, Minimum is 1 point/day. Time between samples = 1/(sample rate)	pts/Second
% of Pulses Sampled **Energy only**	Integers 0 to 100	Sets the fraction of the incoming pulses sampled for the statistics calculations and data recording.	*100 (Energy*)
Sample Period	Integers 0 to 100 custom value 0 to 300 time units **or** 0 to 100,000 points	The time over which samples are to be averaged. Sets the number of samples used in the average and standard deviation *[for example, for each average to be based on 5 minutes of data, set to 5 minutes...].* This is also the time period displayed by the Histogram and Line plot.	10 (Power) *500 (Energy)*
Sample period units	Second Minute Hour Day	Sets the time period for the value entered above. Maximum is 300 weeks or 100,000 pulses Minimum is 1 second or 1 pulse	Minute (Power) *Pulses (Energy)*

	Week Pulses		
Total Duration	Integers 0 to 100 custom value 0 to 300 time units **or** 0 to 100,000 points	The time period for which samples are reported (to the display and output). Select a time period or a number of points *[for example, report statistics for 24 hours].* Often the total duration and sample period will be the same. The SOLO2 automatically clears and recalculates the statistics at the end of each sample period unless you manually stop it.	1
Total Duration units	Continuous Periods Weeks Days Hours Minutes Seconds	Sets the time period for the value entered above. To make the statistics stop after one sample period, select "1" and "Period." Maximum of 100 "periods" can be as high as 100 weeks. Minimum is 1 second.	Period
Time Stamp	Yes No	To have a **time stamp** appear with the data and go directly to the exit mode, select "yes" by pressing the down arrow key until "Yes" appears on the screen, then press the right arrow key. Selecting "Yes" writes a time stamp with each data point. This is a relative time stamp that always begins with zero. Using the time stamp facilitates data analysis but consumes the SOLO2 memory much faster, thus limiting the total number of data points that can be taken. To set the **Time Stamp**, press the down arrow key until "Yes" appears on the screen, then press the **Enter** key. The "set SOLO2 time" dialog box appears. Set Date: To set the date, use the right and left arrow keys to select the date in the format M D Y. The **UP arrow** adds units while the **DOWN arrow** subtracts units. To return to the Time dialog box, press the **Menu** key. Set Time: To set the time, use the **right** and **left** arrow keys to select the time (hours or minutes) using the 24 hour clock. The **UP arrow** adds units while the **DOWN arrow** subtracts units. Press the **Enter** key to validate the selection. SOLO2 time will remain as long as the battery lasts. To save	No

		your selection, press **Done**.	
Exit Mode		The user must make a selection here in order to exit the data sampling parameters input window.	Close
	Close	To close, select **Close** and press Enter.	
	Close & start Statistics	To calculate the statistics, select the **Close and Start Statistics** option, and press Enter.	
	Close & Start Acquisition	To save the acquisition parameters and activate the data sampling, select the **Close and Start Acquisition** option, and press Enter. The SOLO2 begins storing data in memory.	
	Close & Start Both	To calculate the statistics and save the raw data to memory at the same time, select the **Close and Start Both** option.	

2.3.3.4 Trig Level Setting

The trigger level only functions if an energy detector head is connected or if a power detector head is used in **Single Pulse Energy (Calorimeter)** mode. This option allows the user to change the **Trigger Level** from the 2% of full-scale default value. This proves to be especially useful in noisy environments. Acceptable values range from 0.1% to 99.9%. Caution should be taken when choosing a lower trigger level than the 2% default value in a high noise environment.

To change the Trigger Level value, access the dialog box by selecting **Trig Level** from the **Settings** menu and enter the desired number in percentage or in decimals. The SOLO2 will not detect pulses with a value under the Trig level. Be careful to select a scale that is close to the measured value if the Trig level is high.

The value of the Trigger level is shown on the side of the **Trig level** menu confirming that the Trigger level is activated to a specific user level.

Selecting a high value for the trigger level may cause problems with the detection of widely varying energy values in the Autoscale mode. The Autoscale function uses the energy level of the last pulse to set the scale level. Therefore it will not detect the next pulses if they are lower than the trigger level. As a result, the Autoscale may become caught on a high scale value. To solve this problem, select a lower value for the trig level, change the scale manually or reset the autoscale by reselecting autoscale in the **Scale** menu.

Erratic triggering?

For a few detector heads, in electrically noisy environments, it is possible that the SOLO2 will inadvertently trigger on the noise. In that case, increase the trigger level to 3% or higher if necessary.

It is always good practice to reduce electrical noise generation or shield the detector and monitor when measuring very low pulse energies.

With the metallic joulemeters (MT and XLE types), the trig level is set to 3% and cannot be change. If you inadvertently trigger on noise, change to a higher scale.

2.3.3.5 Period Multiplier

The period multiplier applies to the graph. It multiplies the period by the number you enter. For example if the original period is ten minutes and you enter two, then the period will change to twenty minutes. **Use the period multiplier with the Power Meter only.**

2.3.3.6 Refer Values

Use reference values to compare your current measurements to. If your current measurements are within your established **Upper** and **Lower bounds**, then they meet the standards. If they go above or below the bounds, there is a quality problem, which triggers a fail message. The reference values option has two modes: **Threshold** mode and **Pass/Fail** mode.

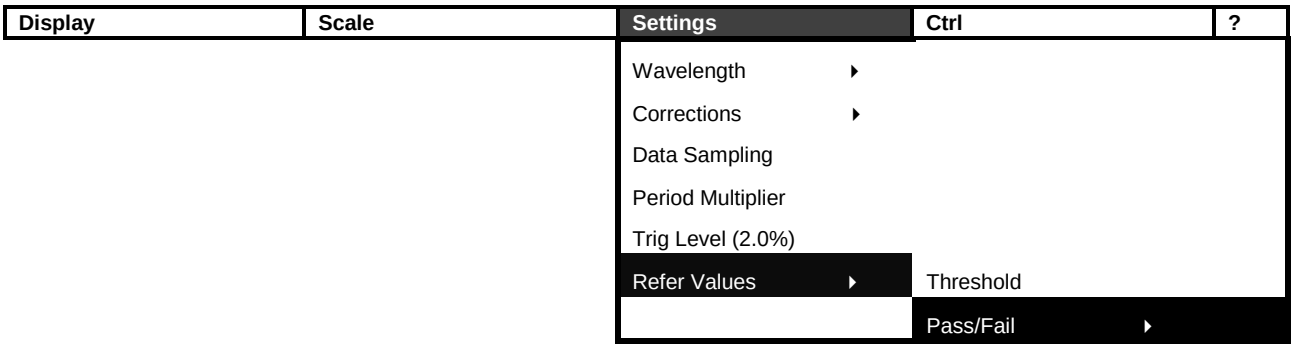

Fig. 2-14 Pass/Fail menu

Threshold mode: Use this mode to set or change the upper and lower bounds, reference values and to restore the last values. To set or change a setting, with the arrow keys, scroll to Set Upper Bound, Set Lower Bound, Close, Set Reference Values, or Restore Last Values. Highlight your choice and press the ↵ **Enter** key. You may select **Upper Bound** only, **Lower Bound** only or both.

Pass/Fail / Graphical mode: View the line plot on the screen with the limits that you selected. If the current power increases to a point above the upper (or lower) bound, "fail" covers the screen.

To reset a failed experiment, press the **Menu** button to see the menu. Scroll to **Settings / Refer Values / Pass/Fail / Reset**, and then press the ↵ **Enter** key. "Pass" appears on the screen as the default. It only changes to "fail" if the current power triggers it.

Pass/Fail Full Display mode: Use this mode to see if the current power passes or fails. The default is "pass". If the current power rises above the threshold or falls below it, you will see "fail". In the **Full Display Mode** select **Settings / Refer Values / Pass/Fail** to see the screen display "pass" or "fail". To get to the Menu Bar, press the **Menu** key.

To reset a failed experiment, press the **Menu** button to see the menu. Scroll to **Settings / Refer Values / Pass/Fail / Reset**, and then press the ↵ **Enter** key. "Pass" appears on the screen as the default. It only changes to "fail" if the current power triggers it.

Analog Out: The analog out mode can be used at the same time as the graphical mode or full display mode. Use the Analog Out option to view the voltage with a voltmeter or with an oscilloscope. The range of the output is 0 to 1 Volt. When the voltage increases about the upper limit and "fail" is displayed, the voltage rises. When the voltage is between the threshold limits the graph is displayed and the voltage remains constant.

2.3.3.7 Save and Load User Settings

The SOLO2 can remember and recall selected settings. This option is activated under the **Save Settings or Load settings** menu items. The display contrast setting is also saved using this option. The saved display contrast is automatically restored the next time the SOLO2 is turned on. All the other parameters are automatically loaded only when the same head is connected to the SOLO2.

2.3.3.8 Power Unit

The **Power Unit** display option allows you to select between dBm and watts. This option is available only in photodiode mode.

$$1\ dBm = 10 \log (Power (mW))$$

2.3.3.9 Communication

The communication option allows you to change the baud rate of the serial port, so that the SOLO2 can communicate with your computer. You need to know the baud rate of your computer. The possible baud rates are:

115200
38400
19200
9600

2.3.3.10 Fluence

The fluence display mode will give you the energy density in joules per square centimeter (J/cm^2) or the power density in watts per square centimeter ($watts/cm^2$). Using this setting, the user must enter the surface area of the beam at the detector surface in square centimeters or enter the beam diameter in centimeters for a round beam.

2.3.3.11 Peak Power

In energy mode, the Peak Power display mode is used to convert a pulse energy measurement to its peak power value in watts. The user must enter the pulse width. Units from picoseconds to milliseconds are available.

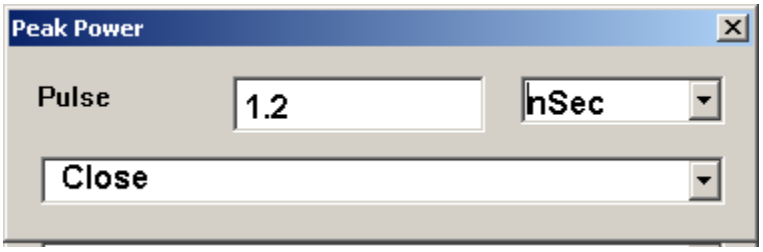

Fig. 2-15 Pulse Width setting for the Peak Power mode

2.4 Real-time Controls and About SOLO2

This section gives a complete description of the last group of menus and options available on the SOLO2 in the Control and help menus. You can refer to Figure 2-16 at all times for a schematic view of the advanced menu structure.

Display	Scale	Settings	Ctrl	?
		Zero Offset	Analog OUT	About SOLO2
		Acquire Data ▸	Anticipation	Service
		Transfer File ▸	Display Hi Res	
		Stats. Mode ▸	Set Diode Zero	
		Relative Mode	View Data ▸	
		Energy Mode	√ Attenuator	

Fig. 2-16 View of the Menu Structure

2.4.1 Control Functions in the Ctrl menu

The following sections describe the Ctrl menu

2.4.1.1 Ctrl – Zero Offset

This function resets the zero reading level. It does this by subtracting the power reading on the display, the moment the command is selected with the ↵ **Enter** key, from all measurements afterward. Subsequent measurements will be relative to this zero power level. The main purpose of this option is to remove reading offset caused by thermal noise in the environment of the detector. This can be caused by the fact that the detector has not been thermally stabilized OR there was a heat source in the field of view of the detector when the SOLO2 was turned on (for example, the hand or body of the user). Use this function once your power meter has achieved thermal equilibrium to ensure accurate measurements**.**

For instructions on the proper way to adjust the offset to zero your detector see steps 8-10 in Section 2.2 Quick power and energy measurement procedure.

This control is only available for power meters.

2.4.1.2 Ctrl - Acquire Data

When you select **Start**, the SOLO2 begins storing data according to your Data Sampling settings (see section 2.3.3.3 and Table 2.2). Those settings will control the rate at which memory is used. The **Stop** command halts the data recording but the SOLO2 will continue to provide measurements to the display.

The SOLO2 records the data in volatile RAM memory. Data in this memory is lost when the SOLO2 is turned off. Select **Save Data in Flash** to save the data in the FLASH memory to keep it after the SOLO2 is turned off. You can also select **Restore Data from Flash** to transfer data from the FLASH back to the RAM memory. This feature is useful when you want to keep the data in the SOLO2 until it can be transferred to a computer at a later time or another location. Do not make a save Data in flash if you have more than 50000 values in RAM. Do not acquire more than 225000 values in ram.

2.4.1.3 Ctrl - Transfer File

This function is recommended to be used when you don't have access to PC-Solo or you have a small acquisition. Use the PC-solo to transfer a file, it is much faster. Select the transfer file from the PC-solo not the Solo2 interface.

This option allows you to send a data file stored in the **SOLO2's RAM** memory to a computer through the RS-232 or USB port. **This function is only available in the SOLO2.**

Establish a HyperTerminal connection between the PC and the SOLO2. (See Section 3.2 if necessary.) You will be able to view transferred data in the HyperTerminal window.

To record data as a file on the PC: At the top of the HyperTerminal window, go to the **Transfer** dropdown menu and execute the following sequence.

Transfer → **Capture text** → enter a filename† → **Start**

† Recommendation: use the **Browse** button to select the directory and folder you want the file in. Enter the file name in that window and click **Save**.

After you have Started and Stopped a data acquisition or restored the data from Flash memory on the SOLO2, select **Data Transfer** in the Ctrl menu or send the serial command ***FDL** from the PC. This will send your data to the PC.

Return to the **Transfer** drop down menu in the HyperTerminal window.

Transfer → **Capture text** → **Stop**

The data is now in the file you named, in text format, with linefeed separated values. If you used a time stamp, the second column data is tab delimited.

Using the data has never been easier. If you drag the icon of your file onto the Excel icon or an open Excel spreadsheet, your data will automatically be put into the first one (or two) columns of a new spreadsheet. You can also open your file from within Excel. Just click **Finish** on the first screen of Excel's Text Import Wizard when it pops up. You can also copy and paste the data from your file into other files and applications. *(With PC-SOLO2 you can save data in a PC file with a single button click. See Section 3.3.)*

2.4.1.4 Ctrl – Statistics Mode

Use this option to activate the statistics computations. Select **Start** in the submenu and the SOLO2 will start compiling statistics. Select **Stop** in the same submenu to turn the Statistics mode off. When you

stop the statistics, the last values remain in the statistics display window for you to view later. If you click start again, the SOLO2 will resume the statistics from that point compiling the new measurements with the previous. Click **Reset** and all the statistical parameters will be cleared and set to zero. If you click **Reset** without stopping, all the statistical parameters will be cleared and the statistics will begin from zero automatically. These same controls appear as buttons in the Statistics Display window. The default when you power up the SOLO2 is off.

2.4.1.5 Ctrl – Relative Mode

Relative mode is similar to **Zero Offset** but it displays the measurement as a percent difference from the value on screen when this option is selected. The reading will become zero the same as with **Zero Offset** but when the power changes it will be display as a percent value.

This is useful for monitoring variation in laser power. For example, in a quality assurance application the user may just want to make sure the power does not vary more than 5% over a certain time period to qualify a system. If the laser power is 40W when this is selected, a laser power of 38 W would be shown as -5%. To do this same task in power units you would select **Zero Offset** when the laser is at 40 W and 38 W would display as -2 W. Refer to **Zero Offset** above. This command is a toggle so a checkmark indicates when it is on. Select it again to turn it off. The default is off.

✓ **Relative mode**	Relative mode is ON
Relative mode	Relative mode is OFF

2.4.1.6 Ctrl – Energy Mode

This function allows you to measure the energy contained in a single pulse with a Gentec-EO **power detector head**. This mode of operation gives access to the same options as in the case of a pyroelectric joulemeter. The only restriction is that the time delay between pulses, $Delay = \left(\frac{1}{Rep.\ Rate} \right)$, must be more than three times the constant time of the detector. (Please refer to the instruction manual for the specific power detector you are using.)

You must select the scale manually because the Autoscale is deactivated when you select **Energy Mode**.

This command is a toggle so a checkmark indicates when it is on. Select it again to turn it off. The default is off.

Keep in mind that the power detectors are optimized to sustain high average power, not high peak energy. Always keep the energy density below the maximum energy density quoted in the manual for that specific detector.

The single pulse energy measured in **Energy Mode** is precise to ±5% of the power measurement calibration. This is larger than the uncertainty in the power measurement (typically ±2.5%) because the energy calibration is computed from the power measurement calibration. A precision of ±3% in the single pulse energy measurement can be achieved if the power detector head is specifically calibrated to measure in single pulse energy mode. Please contact your local Gentec-EO distributor or nearest Gentec-EO office for more information on obtaining a single pulse energy measurement calibration.

2.4.1.7 Ctrl - Analog OUT

This item is a toggle switch. Select it to turn the analog output on and off. A checkmark shows when it is on. The default is off.

This output allows the monitoring of the laser average power or energy with external equipment such as a chart recorder, a computer with an analog interface, a voltmeter, etc.

The output signal represents the amplified and anticipated power detector response in the case of a power measurement. In the case of an energy measurement, the output signal is a DC voltage representing the pulse energy value.

In order to improve the signal to noise ratio, the 1 volt value corresponds to the full scale reading of the selected range. The measured power or energy is then related to the output voltage and to the selected range according to the following equations:

$$Power = V_{output} \times Range$$

$$Energy = V_{output} \times Range$$

For example, an output of 0.4 volts on the 30 W scale corresponds to 12 watts of laser power. If on the 10 W scale, then 0.4 volts signifies 4 watts.

2.4.1.8 Ctrl - Anticipation

Use **Anticipation** to deactivate the power meter acceleration software that provides the "anticipation" response. By using advanced algorithms and known properties of the detector, this software allows the SOLO2 to provide a very accurate power measurement a few seconds faster than the natural response of a thermopile power detector. It accelerates the natural response by a factor of 5 to 10.

Turning off the anticipation will result in a slower response but it can provide a more stable measured value in a noisy environment.

A checkmark shows when it is activated. It is a toggle switch so select it to change it between off and on. The default is on.

2.4.1.9 Ctrl – Display Hi Res

This menu item is a toggle switch that turns on and off a higher precision display mode. It will increase the value displayed numerically on the screen by one significant digit especially for relative changes in power or energy. Absolute accuracy depends on the head.

2.4.1.10 Ctrl – View Data

Use view data to transfer a file in the notation you would like to see it in, scientific or standard. To transfer the file in scientific notation select Ctrl / Sci Notation. To transfer the file in standard notation select Ctrl / Std Notation.

2.4.2 "?"

This menu contains any help and service information available for this version of the SOLO2 firmware. That includes "About SOLO2" to identify the version currently loaded in the instrument as well as contact information for Gentec-EO service. Future help, FAQ, and detector head information will appear here.

2.5 Service

If you should need help or additional information on the SOLO2 or any Gentec-EO products, do not hesitate to contact us. We will be glad to help you.

3 SERIAL COMMUNICATION INTERFACE

3.1 Installation

Connect the SOLO2 USB or RS 232 port, located on the front panel of the instrument (see Figure 1-2), to the host device serial connector using the proper cable. The SOLO2 comes with a standard USB cable.

3.1.1 Installation for Windows™:

Plug the SOLO2 into a USB port on the PC. If the PC supports USB 1.1, Windows detects the new device and prompts you for the software drivers. A window will open that says **Found New Hardware – USB** Device and after several seconds to a minute the Found New Hardware Wizard will appear.

Insert the USB drivers CD-ROM if not done already.

For Windows 2000, XP or Vista: Cancel the wizard and execute the Auto installer "USB driver installer-r2" in the USB Driver folder from the CD-ROM.

Please note that old monitor without the (R2) at the end of the product name needs a different USB drivers which are available on our web site. They do not support Windows VISTA.

At the end of this process, a new serial COM port will be added to the list of communication ports. It may be used as any other serial port. See the Installation PDF to verify or change the COM port assignment. You will need to know the COM port number to set up the serial connection to the SOLO2.

Note: Although the SOLO2 is equipped with both a mini-serial port and a USB port, they cannot be used at the same time. Only one port should be connected at a time.

3.2 Setting up Communication to the SOLO2

3.2.1 Verify COM Port

To verify the USB installation and find the COM port number click:

Start → Settings → Control Panel → System → Device Manager

Scroll down to **Ports (COM & LPT)** and double click that line. One of the options should be

USB-to-Serial Port (COM#)

Note the COM port number. You need it for the next step.

3.2.2 Connect to the SOLO2

You may use any serial communications software that you are familiar with. Our instructions are for HyperTerminal because it is widely available on PCs with Windows™. Select:

Start → Programs → Accessories → Communications → HyperTerminal

To save communication settings, enter a name for the connection. In the drop down menu for "**Connect using**" select the COM port that the USB driver was installed on (Section 3.2.1). Select (Click?) **OK**.

Input the following settings into the communications parameter window that appears next.

Bits per second	**115,200**
Data bits	**8**
Parity	**None**
Stop bits	**1**
Flow control	**None**

Click **OK** to begin entering serial commands in the HyperTerminal window.

3.2.3 To echo commands

The commands you type will not appear in the HyperTerminal window, unless you set the HyperTerminal up to do so. Only the response from the SOLO2 will be displayed. If you prefer to see the commands you are typing, on the HyperTerminal window click the **File** menu and execute the following sequence:

File → **Properties** → **Settings** (tab) → **ASCII setup** → select "**Echo typed characters locally**" → **OK**

3.2.4 Test the connection

In the HyperTerminal window type ***VER**, press ↵ **ENTER**. If the response you receive tells you the version of your SOLO2, you are successfully connected and ready for serial command action.

3.2.5 HyperTerminal settings shortcut

When you end the session, HyperTerminal asks if you want to save your settings. To avoid inputting the communication parameters again in the future, save by clicking **Yes**. The next time you execute the string of commands shown in section 3.2.2 above, the name of your session will appear after HyperTerminal. Clicking on the session name will open the connection using the saved settings. To avoid re-entering the string of commands, put a shortcut to this file on your desktop:

Search for the file name. Select the file. Right click and select Shortcut in the drop down menu.

3.3 PCSOLO user-friendly serial data acquisition software

User-friendly communication software specially made for the SOLO2 is available for free through our website (www.gentec-eo.com). This software basically transforms your PC screen into a large SOLO2 screen enabling you to control and see your information from a distance, while saving data. LabView™ drivers are also available to let you customize SOLO2 applications on your PC.

You can download the PCSOLO program. Contact your local Gentec-eo representative to obtain a copy of the user manual. Access our website and go to the **Downloads** section. Click on the file name and download it to your PC. The specific actions necessary vary by browser and browser settings. After it is

transferred open the file on your PC and follow the instructions to uncompress and install it. You may consult the download instructions document that is also in the downloads section of our website.

3.4 Traditional Communication Settings

The traditional serial communication interface also allows you to operate the SOLO2 from a remote location. We recommend using the specific serial data acquisition software PCSOLO if no automated acquisition is involved because it is much easier to use. In the case of automated measurement controlled by other software, use the following commands to control the SOLO2. They are divided into two groups:

- The **control commands** allow you to change the SOLO2's settings without using the SOLO2's keypad. Remote control commands do not yield any data, they only confirm that the command has been executed.

- The **acquisition commands** are used to obtain information on the current status of the SOLO2. They do not change the settings of the SOLO2, they return the requested information.

When it receives a valid input command, the SOLO2 sends an acknowledgement of the command to the host device under the form of a short message describing the change that has been made.

3.4.1 Serial Command format

3.4.1.1 Serial Protocol Rules:

Commands can be sent as text strings OR numerical values (text mode & binary mode). The device automatically recognizes whether the received data is a text command or a binary command. You are therefore free to send data in either way anytime. Humans read text mode data, while computers process binary mode data . All commands receive a response. The response will either be data or an ACK character.

3.4.1.2 Text mode rules:

All text commands must begin with a trig character (*) and must end with a line-feed, a carriage-return, or both. All parameters must be separated by one or many spaces. The characters do not have to be capitals and mixed case is ok. Replies to all text mode commands are also in text mode, and end with a carriage-return and line-feed.

Example	Text Command	Response from SOLO2
Turn on backlight	*BKL 1 <enter>	ACK <CR><LF>
Get data value	*CVU <enter>	Current Value: 1.616 E-3 <CR><LF>
Check battery	*BAT <enter>	The Battery Power is Low <CR><LF>
Get Statistics	*VSU <enter>	**Version 1.00.17 and up** High resolution ASCII mode The format representation of the number may vary between scientific and decimal depending what is shorter to have around a resolution of 1/10000. Current Value: 0.000561081 Maximum: 0.00085062 Minimum: 9.7094E-005 Average: 0.000639539 Standard

		Deviation: 0.000161187 RMS Stability: 21.0824% PTP Stability: 117.823% Time: 9 Acquisition Time: 600 Uncorrected Value: 0.000561 <CR><LF> **Older Version** Current Value: 0.000561081 Maximum: 0.00085062 Minimum: 0.000097094 Average: 0.000639539 Standard Deviation: 0.000161187 RMS Stability: 21.0824% PTP Stability: 117.823% Time: 9 Acquisition Time: 600 Uncorrected Value: 0.000561 <CR><LF>

In case of an error, the reply string is in the following format:

Error X: reason [enter]

X is the error code, and **reason** is an explanation. See Error Codes at the end of this section.

Because all Text Mode replies end with a **CR** or **LF** (or both), a text reply contains tabulations when many elements need to be separated in the string. This is useful when exporting data to a spreadsheet.

3.4.1.3 Binary Mode rules:

Binary commands ("Handles") are much faster since the values are not converted for human comprehension and less data needs to be transferred. They are expected to be sent with the correct number of parameters. Otherwise, an error message will be returned. The binary commands are two-byte words, and all the following parameters are four-byte double words. The command is executed when the device receives the expected amount of data for the command handle and all the parameters.

Binary data are sent from the PC in big-endian format. That is the data is sent in chunks of 2 or 4 bytes with the most significant byte sent first. You can program the commands in decimal for sending from the PC. The SOLO2 send data in big endian format, that is, the most significant byte comes first. You may need to convert to little-endian depending on the software and computer you are using.

Binary command example (backlight ON):	Command	Parameter
Text mode	*BKL	1

Binary mode in decimal	1003		1			
	2 byte word		4 byte word			
Byte:	1st	2nd	1st	2nd	3rd	4th
in Hex, big endian	03	EB	00	00	00	01
as sent by PC in little endian	EB	03	01	00	00	00

Replies to binary commands are also in binary mode, and have a four-byte header and a variable amount of parameters. The header contains two words. The first word is the error indicator: 10= success, 11=error. The second word is an indicator of the size (in bytes) of the reply parameters or, in the case of an error, the error number.

An example of how you can use the binary commands is shown below in pseudocode.

Structure {	Definition of variables
WORD Handle	Reserves address space of a 2 byte word to store the variable Handle
DWORD ParameterA []	Reserves address space of one 4 byte word to store ParameterA. (4 byte word is a double word)
DWORD ParameterB [6]	Reserves address space of 6 double words to store an array of 6 parameters called ParameterB
} PackedData	
…	Later in the program
Handle = 1003	Assign the value for the Backlight command to Handle
ParameterA = 1	Assign to value for ON to the variable ParameterA
SendStringToSerialPort(PackedData, 6)	This routine transfers the data found at the address of structure PackedData to the serial port. 6 bytes used, 2 for the Handle, 4 for the DWORD ParameterA

3.4.2 Serial Command Directory

DISPLAY COMMANDS

Command name	Command	Description	Handle
Set Display	SDU	Change on-screen display mode.	1157
Set Scale	SSA	Manually set scale.	1130
Set High Resolution Display	SHL	Change to high resolution display	1161
Set dBm display	DBU	Change the on-screen display to dBm	1159

MEASUREMENT COMMANDS

MEASUREMENT DATA ACQUISITION

Command name	Command	Description	Handle
Query Current Value	CVU	Get the value currently displayed on the screen.	1200,
Query New Value Ready	NVU	Determine if new reading is available.	1201,
Query Statistic Data	VSU	Read statistics data.	1202,
Set Logging Start /Stop	LOG	Start storing data in monitor (PCMCIA card or EEPROM).	1171
File Download	FDL	Retrieve a file stored in the monitor.	1172
Download points			
Download points	CAU	Send the values in ASCII to the serial port with the data sampling setting.	N/A
Stop the CAU Command	CSU	**Stop the CAU Command**	

MEASUREMENT SETUP N/A

Command name	Command	Description	Handle
Set Personal Wavelength Correction	SWA	Specify the wavelength.	1125
Set Multipliers	SMU	Set the value of the multipliers.	1128
Set Offsets	SOU	Set the value of the offsets.	1129,
Query Data Sampling Settings	RDS	Get current data sampling parameters.	1151
Configure Data Sampling	DSU	Set the data sampling parameters.	1152
Set Trigger Level	TLA	Set the internal trigger level when measuring pulse energy.	1112,
Save Profile	SSS	Save current settings.	1700

MEASUREMENT CONTROL

Command name	Command	Description	Handle
Enable Statistics	ESU	Start, stop or reset the statistic calculations.	1155
Set Energy Mode	SCA	Turn energy mode on or off.	1160
Set Anticipation	EAA	Turn power measurement anticipation on or off.	1123
Set Zero Offset	EOA	Zero the reading to remove noise.	1120

INSTRUMENT AND DETECTOR INFORMATION COMMANDS

Command name	Command	Description	Handle
Query version	VER	Get firmware version of the monitor.	1001
Query Head Name	HEA	Get model name of the detector head.	1100
Query Status	STA	Retrieve detector information and monitor settings.	1005
Query Battery Power	BAT	Get state of remaining battery power.	1009

INSTRUMENT CONTROL COMMANDS

Command name	Command	Description	Handle
Set Backlight	BKL	Turn the display backlight on or off.	1003
Set Analog Output	ANO	Enable or disable the analog output port.	1150

COMMUNICATIONS COMMANDS

Command name	Command	Description	Handle
Test Communication	KPA	Test communication between monitor and PC.	1000

3.4.3 Serial commands

CONVERSION OF VALUES TRANSFERRED WITH BINARY COMMANDS

To prevent cross-platform floating-point conversion error all of the numerical values are transferred as integers. That means floating point values must be converted. The monitor multiplies the value and converts it from float to integer and then transfers it to you. As a result, you must convert and divide it by the same large number to obtain the original floating point value. **Unit Value**: Every value that needs to be adjusted as a floating point is transferred along its divider. Therefore, 1.645 W would be transferred in two parts: the integers 1645 and a second value that indicates the divider unit. Simply divide the value by its unit to obtain the original data.

Indicator	1	2	3	4	5	64
Divider Unit	1E0	1E3	1E6	1E9	1E12	1E15

SERIAL COMMAND FORMAT

All serial commands that use parameters must have a space between the command and the list of parameters, and between the parameters themselves.

DISPLAY COMMANDS

Set Display

This command is used to change the devices on-screen display mode.

Text Command	Binary Command	Parameters	Return
SDU	1157	Display Mode	ACK

Available display modes:

Parameter

- **0** Real-Time Display — Default display mode. It shows the current measured value.
- **1** Histogram — Shows a short history of the acquired data.
- **2** Statistic — Shows all data relevant to statistics.
- **3** Digital Needle — Provides a simulated analog needle.

Set Scale

This command is used to force the display of the current data into a specific range. The lower range is always zero, and the higher ranges can be found in the table below. The Auto scale applies the best scale for the current values in real time. In text mode, the parameter must be one

of the identifiers in the table below. In binary mode, send the index of the identifier. Remember that the serial protocol is not case-sensitive in text mode.

Text Command	Binary Command	Parameters	Return
SSA	1130	Scale identifier or index	ACK

Scale Identifiers:

Text Mode	Binary Mode	*Scale*
Auto	0	*optimum*
1p	1	*1 picowatt or picojoule*
3p	2	*3 picowatts or picojoules*
10p	3	*10 picowatts or picojoules*
30p	4	*30 picowatts or picojoules*
100p	5	*100 picowatts or picojoules*
300p	6	*300 picowatts or picojoules*
1n	7	*1 nanowatt or nanojoule*
3n	8	*3 nanowatts or nanojoules*
10n	9	*10 nanowatts or nanojoules*
30n	10	*30 nanowatts or nanojoules*
100n	11	*100 nanowatts or nanojoules*
300n	12	*300 nanowatts or nanojoules*
1u	13	*1 microwatt or microjoule*
3u	14	*3 microwatts or microjoules*
10u	15	*10 microwatts or microjoules*
30u	16	*30 microwatts or microjoules*
100u	17	*100 microwatts or microjoules*
300u	18	*300 microwatts or microjoules*
1m	19	*1 milliwatt or millijoule*
3m	20	*3 milliwatts or millijoules*
10m	21	*10 milliwatts or millijoules*
30m	22	*30 milliwatts or millijoules*
100m	23	*100 milliwatts or millijoules*
300m	24	*300 milliwatts or millijoules*
1	25	*1 Watt or Joule*
3	26	*3 watts or joules*
10	27	*10 watts or joules*
30	28	*30 watts or joules*
100	29	*100 watts or joules*
300	30	*300 watts or joules*
1k	31	*1 kilowatt or kilojoule*
3k	32	*3 kilowatts or kilojoules*
10k	33	*10 kilowatts or kilojoules*

30k	34	*30 kilowatts or kilojoules*
100k	35	*100 kilowatts or kilojoules*
300k	36	*300 kilowatts or kilojoules*
1meg	37	*1 megawatt or megajoule*
3meg	38	*3 megawatts or megajoules*
10meg	39	*10 megawatts or megajoules*
30meg	40	*30 megawatts or megajoules*
100meg	41	*100 megawatts or megajoules*
300meg	42	*300 megawatts or megajoules*

Set dBm display

This command changes the on-screen display unit to dBm. This option is only available with photodiodes.

Text Command	Binary Command	Parameters	Return
DBU	1159	**1** to turn On, **0** to turn Off	ACK

Default: Off

Set High Resolution Display

This command is used to add significant digits to the on-screen reading.

Text Command	Binary Command	Parameters	Return
SHL	**1161**	**1** to turn On, **0** to turn Off	ACK

Default: Off

MEASUREMENT COMMANDS -- DATA ACQUISITION

Query Current Value

This command is used to query the value that is currently being displayed on the device's screen. The value is displayed in watts or in joules.

Text Command	Binary Command	Parameters	Return
CVU	1200		Current value

For example, a 12 milliwatts reading would be displayed like this:

Current Value: 0.012

In binary mode, 4 parameters are returned:

-the Current Value

-the Current Value's unit divider

-the Uncorrected Value (raw value before the multipliers and offsets)

-the Uncorrected Value's unit divider

The values should be divided by their Unit divider. This is to prevent any cross-platform floating-point conversion error (See 3.4.3).

Example		Response from SOLO2
Text Command:	*CVU <enter>	0.00500095 <CR> <LF>
Binary Command:	Handle = 1200	000A0014004C4EF400000004000000010000000100000016

Translation:

Header:	000A 0014	
		000A = 10, No Error
		0014 = 20 bytes following header
Reply parameters:	004C 4EF4	= Hex for 5000948
	0000 0004	= Hex for 4, divide by 1E9
	0000 0001	= Hex for 1
	0000 0001	= Hex for 1
	0000 0016	= Hex for 22

Query New Value Ready

This command is used to check whether a new value is available from the device. Though optional, its use is recommended when used with single pulse operations.

Text Command	Binary Command	Parameters	Return
NVU	1201		Available/ Not Available <CR> <LF> 1/0

Example		Response from SOLO2
Text Command:	*NVU <enter>	New Data Not Available <CR> <LF>
Binary Command:	Handle = 1201	0

Note that the **Query Current Value** and **Query Statistic Data** commands will return the current values from the device even if they have not been updated since the last query.

Query Statistic Data

This command is used to read all the statistics data, provided that the device has previously been set into statistic mode.

Text Command	Binary Command	Parameters	Return
VSU	1202		Statistics

In text mode, all the data and relevant identifiers are formatted into a tab-separated string. In binary mode, the following structure is sent:

Statistics:

Current Value	This value should be divided by the Current Value Unit.
Current Value Unit	This is a divider
Maximum	This value should be divided by the Maximum Unit.
Maximum Unit	This is a divider
Minimum	This value should be divided by the Minimum Unit.
Minimum Unit	This is a divider
Average	This value should be divided by the Average Unit.
Average Unit	This is a divider
Standard Deviation	This value should be divided by the Standard Dev Unit.
Standard Dev Unit	This is a divider
RMS Stability	This value should be divided by 1000.
PTP Stability	This value should be divided by 1000.
Current Time In Period	Power measurement only. Default is 0.
Total Time of Period	Power measurement only. Default is 0.
Pulse Number	Energy measurement only. Default is 0.
Total Pulses	Energy measurement only. Default is 0.
Average Power	Energy measurement only. Default is 0. This value should be divided by the Avrg Power Unit
Avrg Power Unit	This is a divider
Repetition Rate	Energy measurement only. Default is 0. This value should be divided by the Rep Rate unit.
Rep Rate Unit	This is a divider
Uncorrected Value	This value should be divided by the Uncorrected Value Unit
Uncorrected Value Unit	This is a divider

Set Logging Start/Stop

This command is used to log data on the device's media (PCMCIA card, if available, otherwise in the EEPROM).

Text Command	Binary Command	Parameters	Return
LOG	1171	**0** to Stop, **1, 2, or 3** to Start	ACK

This command begins or stops logging data in the device's volatile memory. This is done using the Data Sampling settings (sample rate, time, period...). If you do not want to use the Data Sampling default settings, you must use the DSU command prior to this one (or set the Data Sampling settings manually on the monitor).

Passing 0 as parameter stops the acquisition. 1 starts a raw data acquisition. 2 starts saving statistics. 3 saves both raw data and statistics.

The Logging starts when the command is issued.

The log file created in the device can then be downloaded to a PC using the File Download (FDL) command, or it can be saved in the device's non-volatile memory.

File Download

This command is used to retrieve a logged file from the device.

Text Command	Binary Command	Parameters	Return
FDL	1172	File Sequence Number	File data

In text mode, once the command is issued, it is possible to start saving all received data until the terminator is received (the terminator is the character string "EOF" followed by a line feed).

In binary mode, here are the reply parameters:

-Size of the text header (in bytes)

-Size of the file's data (in bytes)

-Text header, read as a text string, size specified as parameter 1

-File Data, read as a stream of DWORDs (4 byte chunks). You should keep receiving and saving data until the receipt of the correct amount (specified as parameter 2). Every DWORD read must be divided by the following DWORD. The file data is transferred in an interlaced fashion so that all data is followed by its Unit value.

The file data is structured: Each record contains a tag that specifies what it contains:

TAG	Content of record
0	Raw Value
1	Time Stamp, Raw Value

2	average, max value, min value, ptp stability, RMS stability, standard deviation
3	average, max value, min value, ptp stability, RMS stability, standard deviation, average power

The following example is for a file 400 bytes long with timestamps, and containing a 20 char text header.

Example		Response from SOLO2
Text Command:	*FDL <enter>	<File 0 data> … <"EOF"> <LF>
Binary Command:	Handle = 1172 Parameter1 = 0	20, 180, <20 letters Text Header>, 1, 1(Tag is 1, divide by 1), 2,2 (Time stamp, 0.002 second), 01243,3(Raw Value, 0.001243 watt), ... (new Tag, loop until data size reached)

Download data

This command is used to send data to the serial port according to the data sampling setting. The maximum transfer speed is 200Hz.

Text Command	Binary Command	Parameters	Return
CAU	**N/A**	None	Data in ASCII

Stop the CAU Command

This command is used to stop the real time transfer enable by the CAU Command.

Text Command	Binary Command	Parameters	Return
CSU	**N/A**	None	N/A

MEASUREMENT COMMANDS -- SETUP

Set Personal Wavelength Correction

This command is used to specify the wavelength being used on the detector. The EEPROM in the detector contains measured spectral data for a wide range of wavelengths. If the wavelength input by the user is different from the predefined list of wavelengths on the device, a custom value is interpolated. Specifying zero as a wavelength or providing an out-of-bound value as a parameter restores the default settings. A valid value is set between the lowest and highest wavelengths supported by the device, and it should not be a floating point value.

Text Command	Binary Command	Parameters	Return
SWA	1125	Wavelength	ACK

Default: Calibration wavelength, (typically 1064 nm)

Set Attenuator

This command is used to adjust the processing of the monitor with the readings of the head, depending if the head is using an external attenuator or not

Text Command	Binary Command	Parameters	Return
ATU	1162	**1** to turn On, **0** to turn Off	ACK

Default: Off

Set Multipliers

This command is used to set the value of the multipliers.

Text Command	Binary Command	Parameters	Return
SMU	1128	Multiplier **1** (or **2**), <Multiplier value>	ACK

Default: 1

There are two multipliers and two offsets that are automatically applied in the following order:

Multiplier 1 → Offset 1 → Multiplier 2 → Offset 2

It is possible to modify the values of the multipliers by selecting (indexing) them in the first parameter (1 or 2) and entering a new value in the second parameter. In binary mode, the value should be multiplied by 10000, and converted into an integer (instead of a floating point value). This is to prevent any cross-platform floating-point conversion error.

The following example sets multiplier 2 = 3.3

Example		Response from SOLO2
Text Command:	*SMU 2 3.3 <enter>	ACK <CR> <LF>
Binary Command:	Handle = 1128	ACK
	Parameter1 = 2	
	Parameter2 = 33000	

Set Offsets

This command is used to set the value of the offsets.

Text Command	Binary Command	Parameters	Return
SOU	1129	Offset **1** (or **2**), <Offset value>	ACK

Default: 0

There are two multipliers and two offsets that are automatically used in the following order:

Multiplier 1 → Offset 1 → Multiplier 2 →> Offset 2

It is possible to modify the values of the offsets by selecting (indexing) them in the first parameter (1 or 2) and entering a new value in the second parameter. In binary mode, an extra parameter is required: the scale at witch the value is set. This is to prevent any cross-platform floating-point conversion error.

The following example sets offset 1 = 1.5 milli.

Example		Response from SOLO2
Text Command:	*SOU 1 0.0015 <enter>	ACK <CR> <LF>
Binary Command:	Handle = 1129 Parameter1 = 1 Parameter2 = 15 Parameter3= 17 (100u scale)	ACK

The other option available is the Zero-offset. The Zero-offset operation is done first, before those of the Multipliers and Offsets

Query Data Sampling Settings

This command is used to read the current data sampling settings

Text Command	Binary Command	Parameters	Return
RDS	1151		Sampling Settings info

Settings data:

Text mode returns a string containing all of the sample settings. Binary mode returns numerical values in the following structure:

Binary Mode response:

Sample Rate	Integer value of the sample rate.
Sample Rate Unit	**0** = Seconds **1** = Minutes **2** = Hours **3** = Days **4** = Percentage of Pulses Sampled
Sample Period	Integer value of the sample period.
Sample Period Unit	**0** = Seconds **1** = Minutes

	2 = Hours **3** = Days **4** = Weeks **5** = Number of Pulses
Total Duration	Integer value of the total duration of sampling or statistics..
Total Duration Unit	**0** = One Sample Period **1** = Seconds **2** = Minutes **3** = Hours **4** = Days **5** = Weeks **6** = Continuous (loop when done) **7** = Predefined number of points
Timestamp	**0** = Off **1** = On

Configure Data Sampling

This command provides the data sampling parameters for the logging and statistics environments. These settings are used when saving data on the device's data storage media, and also to process statistics.

Text Command	Binary Command	Parameters	Return
DSU	1152	Sample Rate, Sample Rate Unit, Sample Period, Sample Period Unit, Total Duration, Total Duration Unit, Time Stamp(On/Off)	ACK

Defaults: See Table 2.2

Parameters:

Sample Rate	Integer value	Times per unit
Sample Rate Unit	0 = Seconds 1 = Minutes 2 = Hours 3 = Days 4 = percentage of pulses (energy only)	
Sample Period	Integer value	
Sample Period Unit	0 = Seconds 1 = Minutes 2 = Hours 3 = Days 4 = Weeks 5 = Pulses (energy only)	At the end of a period, statistics are reset.

Total Duration	Integer value	
Total Duration Unit	**0** = Sample Period(s) **1** = Seconds **2** = Minutes **3** = Hours **4** = Days **5** = Weeks **6** = Continuous **7** = Predefined number of points	May be a fixed amount of time or points, one or many periods, or non-stop.
Timestamp	**0** = Off **1** = On	Adds a time stamp for all logged data in the sample.

The following example sets a single data acquisition run for 90 minutes with timestamps at 4 hertz.

Example		Response from SOLO2
Text Command:	*DSU 4 0 90 1 1 0 1 <enter>	ACK <CR> <LF>
Binary Command:	Handle = 1152 Parameter1 = 4 Parameter2 = 0 Parameter3 = 90 Parameter4 = 1 Parameter5 = 1 Parameter6 = 0 Parameter7 = 1	ACK

Set Trigger Level

This command sets the internal trigger level when using the device in energy reading mode.

Text Command	Binary Command	Parameters	Return
TLA	1112	Trigger Level (percentage)	ACK

Default: 2%

The value should be set between 1 and 100 (floating point values are allowed). In text mode, you may add a "%" symbol after the value for clarity. In binary mode, the value must be multiplied by 1000 and sent as an integer.

Example		Response from SOLO2
Text Command:	*TLA 15.4% <enter>	ACK <CR> <LF>
Binary Command:	Handle = 1112 Parameter1 = 15400	ACK

MEASUREMENT COMMANDS -- CONTROL

Enable Statistics

This command is used start, stop and reset the statistics calculating process on the data currently acquisitioned by the specified channel (upper or lower).

Text Command	Binary Command	Parameters	Return
ESU	1155	**0**, **1** or **2** (to Disable, Enable or Reset)	ACK

Default: Disable

Prior to enabling the statistics, the user should use the **LG1**, **LG2** and **LG3** commands to setup the data logging environment.

Set Energy Mode

This command is used to toggle Energy mode when using a wattmeter.

Text Command	Binary Command	Parameters	Return
SCA	1160	**1** to turn On, **0** to turn Off	ACK

Default: Off

Set Anticipation

This command is used to enable or disable the anticipation processing when the device is reading from a wattmeter. The anticipation is a software-reading acceleration algorithm that provides faster readings using the detector's calibration.

Text Command	Binary Command	Parameters	Return
EAA	1123	**1** to turn On, **0** to turn Off	ACK

Default: On

Zero Offset

This command subtracts the current value from all future measurements the moment the command is issued to set a new zero point.

Text Command	Binary Command	Parameters	Return
EOA	1120	**0** to turn Off, 1 to turn On, 2 to undo.	ACK

Default: Off

INSTRUMENT AND DETECTOR INFORMATION COMMANDS

Query Version

This command is used to query the device to get information about the firmware version and the device type.

Text Command	Binary Command	Parameters	Return
VER	1001		Version number and device type.

The following example is for SOLO2 version 1.2. There are four parameters in binary mode. In this case they would be:

Binary parameters	Example	
Header:		
Acknowledge	10	2 byte word
Length of transmission (excluding header)	16	2 byte word
Reply parameters:		
Version number	1	4 byte word
Version Extension	2	4 byte word
Length of Device name string	4	4 byte word
Device name string	SOLO2	Text string in ASCII code

For this one example we show the binary response as the computer would see it.

Example		Response from SOLO2
Text Command:	*VER <enter>	SOLO2 Version 1.00.18 <CR> <LF>
Binary Command:	Handle = 1001	000A0028534F4C4F20322056657273696F6E20312E30302E31380A0D

Translation:

Header: 0 10 0 16

0 10 = ACK
0 28 = 28 bytes following header

Reply parameters: 534F 4C4F 2032 = ASCII code for "SOLO 2"
2056 6572 7369 6F6E = ASCII code for " Version"
2031 2E30 302E 3138 = ASCII code for " 1.00.18
0A0D = ASCII code for " CR LF"

Query Head Name

This command is used to query the model name of the current head.

Text Command	Binary Command	Parameters	Return
HEA	1100		Name of the current heads

The following example is an QE-25-SP-MB Joulemeter. There are four parameters in binary mode. In this case they would be:

Binary parameters	Example	
Header:		
Acknowledge	10	2 byte word
Length of transmission (excluding header)	16	2 byte word
Reply parameters:		
Length of Head name string	10	4 byte word
Detector model name	QE-25-SP-MB	10 bytes

Example		Response from SOLO2
Text Command:	*HEA <enter>	QE-25-SP-MB <CR> <LF>
Binary Command:	Handle = 1100	51452D32352D53502D4D50

Query Status

This command is used to view data that is relevant to currently used Detector Head on channel A *or* B.

Text Command	Binary Command	Parameters	Return
STA	1005		Current static and dynamic configuration values

Configuration values:

	Field name	Text Mode Data	Binary Mode Data
1	**Head Type**	Indicates whether the current detector is a wattmeter, a joulemeter or a photodiode.	1 = wattmeter 2 = joulemeter 3 = photodiode
2	**Head Version**	Number identifying the version of the detector head	same
3	**Head Serial Number**	Alphanumeric string indicating the serial number for the head.	Size indicator. The Serial number string is located at the end of the binary data.
4	**Calibration Sensitivity**	Sensitivity at default wavelength, in V/W	This is specified in V/W for the Default Wavelength. Divide this value by 100000. [1]
5	**Default Wavelength**	Default Wavelength in nm	same
6	**Active Sensitivity**	Currently used sensitivity, it may have been modified by variables such as the Active Wavelength	This is specified in V/W for the Active Wavelength. Divide this value by 100000. [1]
7	**Active Wavelength**	Currently used Wavelength in nm	same
8	**Scale Min Power (wattmeters) OR Max Power (joulemeters)**	Wattmeters: minimum scale index (see Set Scale command). Joulemeters: Maximum power supported by the detector (in Watts).	same
9	**Scale Max Power (wattmeters) OR Max Energy (joulemeters)**	Wattmeters: maximum scale index (see Set Scale command). Joulemeters: Maximum energy supported by the detector (in Joules).	same
10	**Scale Min Energy**	Minimum scale index when reading energy	same
11	**Scale Max Energy**	Maximum scale index when reading energy	same
12	**Current Scale**	Currently used scale index (see the Set Scale command)	same
13	**Calo Mode**	Is the Wattmeter being used as a calorimeter? On/Off or N/A.	1 = On , 0 = Off

14	**Anticipation**	Is Anticipation enabled? On/Off or N/A	1 = On , 0 = Off
15	**External Trig**	Is the External Trig enabled? On/Off or N/A	1 = On , 0 = Off
16	**Trig Level**	Internal trigger level, specified as a percentage [1-100]	Integer number representing a percentage (from 1 to 100). Divide this value by 1000
17	**Zero Offset**	Currently used offset (see Zero Offset command)	Divide this value by the Zero Offset Unit. [1]
18	**Zero Offset Unit**	For Binary mode only	This is a divider
19	**Multiplier #1**	Value of the first multiplier	Divide this value by the Mult#1 Unit
20	**Mult #1 Unit**	For Binary mode only	This is a divider
21	**Offset #1**	Value of the first offset	Divide this value by the Offset#1 Unit .
22	**Offset #1 Unit**	For Binary mode only	This is a divider
23	**Multiplier #2**	Value of the second multiplier	Divide this value by the Mult#2 Unit.
24	**Mult #2 Unit**	For Binary mode only	This is a divider
25	**Offset #2**	Value of the second offset	Divide this value by the Offset#2 Unit.
26	**Offset #2 Unit**	For Binary mode only	This is a divider
27	**Currently Logging data**	Is the device saving data? Yes / No	1 = On , 0 = Off
28	**Analog Output**	Is the analog output enabled? Yes / No	1 = On , 0 = Off
29	**Resolution**	Resolution of the detector	Divide this value by the Resolution Divider
30	**Resolution Divider**	For Binary mode only	This is a divider
31	**Currently Calculating Stats**	Are statistics enabled in the device? Yes / No	1 = On , 0 = Off
32	**High Resolution Display**	Does the device display more numbers after the comma? On/Off	1 = On, 0 = Off
33	**Min Wavelength**	From 0 to 19, this is an index for the Wavelength table	0 to 19
34	**Max Wavelength**	From 0 to 19, this is an index for the Wavelength table	0 to 19
35	**Upper Bound**	For the Pass/Fail test, this is the upper bound	Divide this value by the Upper Bound Unit

36	**Upper Bound Unit**	For Binary mode only	This is a divider
37	**Lower Bound**	For the Pass/Fail test, this is the lower bound	Divide this value by the Lower bound Unit
38	**Lower Bound Unit**	For Binary mode only	This is a divider
39	**Reference Value**	For the Pass/Fail test, this is the Reference Value	Divide this value by the Reference Unit
40	**Reference Unit**	For Binary mode only	This is a divider
41	**Pass/Fail Status**	Is the Pass/Fail test active? On/Off	1= On, 0 = Off
42	**Threshold**	Has the Pass/Fail test failed? Fail/Pass	1 = Failed, 0 = Pass

Query Battery Power

This command is used to query the device battery's remaining power. In text mode, it returns a string mentioning whether the power is low, medium or high:

Text Command	Binary Command	Parameters	Return
BAT	1009		Low, High 1, 3 (one 4 byte double word)

Example		Response from SOLO2
Text Command:	*BAT <enter>	The battery power is High
Binary Command:	Handle = 1009	3 (as one 4 byte word in binary)

Set the Internal Clock

This command is used to adjust the time and date of the monitor's internal clock. This information is used to timestamp files when data logging.

Text Command	Binary Command	Parameters	Return
CLK	**1165**	**day, month, year, hour, minute, second, AM/PM**	ACK

Day: 1 to 31

Month: 1 to 12

Year: 1970 to 2999

Hour: 0 to 23 (PM is assumed if over 12)

Minute: 0 to 59

Second: 0 to 59

AM/PM: 0 = Am, 1 = PM

INSTRUMENT CONTROL COMMANDS

Set Backlight

This command is used to turn the backlight of the device display on or off.

Text Command	Binary Command	Parameters	Return
BKL	1003	**1** to turn On, **0** to turn Off	ACK

Default: Off

Set Analog Output

This command is used to enable or disable the output of the current value on the analog port of the device.

Text Command	Binary Command	Parameters	Return
ANO	1150	**1** to Enable, **0** to Disable	ACK

Default: Disabled

COMMUNICATIONS COMMANDS

Test Communication

This command is used to test communication with your SOLO2. The PC is communicating with the monitor if you receive the ACK response.

Text Command	Binary Command	Parameters	Return
KPA	1000		ACK

3.4.4 ERROR MESSAGES

#	Error	Comment
1	Command not found	Command is invalid.
2	Invalid Parameter	The parameter value is out of valid range, or not of expected type (text, numeric, flag).
3	Not Enough Parameters	The expected number of parameters should always be sent.
4	Head is not available	Verify that the detector's DB15 connector is fully engaged with the meter.
6	Scale setting not available for specified head	Refer to the Scale table in the Set Scale command.
8	No Data available	The current configuration cannot provide the requested data.
10	Analog output is not available with External Trigger	Cannot use the same connection for output and trigger at the same time.
11	Anticipation is not available	Make sure that the detector is in power-reading mode.
12	Statistics are not available	Statistics must first be enabled.
13	PWC is not available	Make sure that the detector head version supports Personal Wavelength Correction
14	Invalid Command: Too long.	The command must not be over 255 characters long.
15	Too many Parameters	The correct number of parameters must be sent to the device.
16	Invalid Baud Rate	Verify that the device supports the selected baud rate.
18	Energy mode is not available with current head	Energy Mode works only with 818P Series High Power Detectors.
20	Statistics are already enabled	Disable before re-enabling
21	No storage space left	Remove files from the storage media before logging new ones
22	Head is not a Joulemeter	Make sure the head is an Energy Detector.
23	Already logging data	Disable before re-enabling
24	File does not exist	In order to download a file, first run an acquisition, or load it from the EEPROM.
25	Text Mode is not supported for this command	Make sure that the correct mode is used.
26	Option only available with photodiode	Make sure the head is a photodiode.
27	Data Sampling settings are invalid	Make sure the parameters are valid.
28	Attenuator not available with current head	Make sure the head support attenuator.

4 MAINTENANCE

4.1 USB installation for the SOLO2

The SOLO2 has a USB type B port. When connected to a PC it emulates a standard serial port. This means that it is possible to connect many SOLO2s on one computer, without tying up the ordinary serial ports, while keeping a simple interface that is easy to design software for. The SOLO2 can function using the USB port power only. It does not utilize the battery energy when linked to a computer through the USB port.

4.2 Free Software Upgrade

Keep up to date with the latest version of the SOLO2 software including new features and options. As new and improved versions of the device's firmware are created, it is in your best interest to update your SOLO2. The latest device firmware can be downloaded from the Gentec-EO website.

Access our website at www.gentec-eo.com. Go to the **Downloads** section. Click on the name of the SOLO2 upgrade instructions file to open or download the instructions. You may want to print the instructions. Find the file that corresponds to your SOLO2 in the Downloads section and follow our simple, easy to use instructions.

In summary you will download and execute the file by selecting it and pressing the return key, it will extract and start the Firmware Updater automatically. You will set the SOLO2 in Update Mode by turning it off, and holding the → RIGHT arrow key while turning it on again. Make sure that the correct COM port is selected in the Firmware Updater. You can use the "Test communication with device" button to make sure that everything is well linked. If the device is correctly connected to the computer, simply press the "Update Device" button to start the upload. This should take a few minutes, after which you will need to turn off and restart the SOLO2. The upgrade instructions file in the Downloads section contains more detailed step by step instructions for the procedure.

4.3 Battery Charging

As mentioned previously, the SOLO2 meter is operated using four standard rechargeable Ni-MH batteries. When the **low battery** indicator shows on the lower right corner of the screen, recharge the batteries by connecting the external power supply for six hours. The SOLO2 can be either on or off during this procedure. One battery charge provides up to 11 hours of operation autonomy.

The SOLO2 may not function properly when the battery level is very low. In that case, connect the power supply to the SOLO2 to recharge the battery.

You can operate the SOLO2 by plugging it into a USB port when the battery is low, or even removed, but it will not recharge. Recharging requires the external power supply.

DECLARATION OF CONFORMITY

Application of Council Directive(s): 2004/108/EC EMC Directive

Manufacturer's Name:	Gentec Electro Optics, Inc.
Manufacturer's Address:	445 St-Jean Baptiste, suite 160 (Québec), Canada G2E 5N7
European Representative Name:	Laser Components S.A.S.
Representative's Address:	45 bis Route des Gardes 92190 Meudon (France)
Type of Equipment:	Laser Power/Energy Meter
Model No.:	SOLO2
Year of test & manufacture:	2011

Standard(s) to which Conformity is declared:
EN 61326-1: 2006 Emission generic standard

Standard	Description	Performance Criteria
CISPR 11 :2009 A1 :2010	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement	Class A
EN 61000-4-2 2009	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques- Electrostatic discharge.	Class B
EN61000-4-3 2006+A2:2010	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques- Radiated, Radio Frequency, electromagnetic field immunity test.	Class A
EN 61000-4-4 2004 +A1:2010	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques- Electrical fast transient/burst immunity test.	Class B
EN 61000-4-5 2006	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques- Surge immunity test.	Class B
EN 61000-4-6 2009	Electromagnetic compatibility (EMC) – Part 4: Testing and measurements techniques- Section 6: Immunity to conducted Radio Frequency.	Class A
EN 61000-4-11 2004	Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurements techniques - Voltage dips. Short interruptions and voltage variations immunity tests	Class B Class B Class C Class C
EN 61000-3-2:2006 +A1:2009	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)	Class A

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Place: Québec (Québec)
Date :May 4, 2011

(President)

5 Appendix A

QED

5.1 QED/12/25/50

Attenuator/Diffuser Calibration Procedure

Introduction;

These "Attenuator/Diffusers" must be **user** calibrated. The calibration procedure is relatively simple. You will first measure without the attenuator, and then with the attenuator. The ratio of these will be your correction. This procedure is suitable at any wavelength.

When using an oscilloscope;

Divide the joulemeter voltage output by the calibration sensitivity we provide to calculate the energy reading (see joulemeter manual).

To use this procedure at a wavelength other than the wavelength stated on the calibration certificate, you must first manually adjust the sensitivity value (of the cal. certificate) with the wavelength ***correction multiplier*** *from the Personal Wavelength Correction certificate. Use this wavelength-adjusted sensitivity to calculate the energy readings used in the procedure that follows.*

When using a Gentec-EO SOLO2 :

The *Attenuator* setting in the *Control* menu **must not be checked**. That is, it must be off. Otherwise you cannot access the wavelength correction (*Settings → Corrections menus*). You need this to input the wavelength that you are calibrating at (see monitor manual). The *Attenuator* setting should also be checked off if you are redoing a calibration at the same wavelength stated on joulemeter calibration certificate.

Procedure:

Step 1: Setup your joulemeter to measure the energy of your pulsed laser. If you are working at a wavelength other than the calibrated wavelength, adjust the sensitivity of your joulemeter for that wavelength; see *When using an oscilloscope or When using a Gentec-EO SOLO2,* above. Make sure that the energy level is below the detector's damage threshold and your laser still has a good stability.

Step 2: Apply energy for a few minutes to warm up the detector. This will reduce any thermal bias.

Step 3: Measure the energy level without the attenuator. To reduce random uncertainty you should average a number of shots. We recommend at least one hundred shots. This should reduce random errors by a factor of 10. (Square root of "n" assuming Gaussian distribution)

Step 4: Install the attenuator. Without changing the laser settings measure the energy level by averaging the same number of shots. All laser settings must be the same as Step 3 (including beam size and position on the detector).

Step 5: Repeat the first measurement (Step 3) to make sure that nothing changed enough during the procedure to invalidate the calibration. A change larger than the uncertainty of your measurements means that something in the laser or environment changed. You can add this to your ± uncertainty when you use the attenuator or try to stabilize the laser and environment and begin again with Step 3.

The correction multiplier for the revised DUO (rev 2.0), the SOLO2 and an Oscilloscope will be given by:

$$T_f = \frac{\text{Reading without attenuator}}{\text{Reading with attenuator}} \qquad \text{(no unit)}$$

Now use this calibration factor for the "Attenuator/Diffuser" when using it at the wavelength established in Step 1.

6 Appendix B

6.1 Recycling and separation procedure.

This section is used by the recycling center when the monitor reaches its end of life. Breaking the calibration seal or opening the monitor will void the SOLO2 warranty.

The complete Monitor contains

1 Monitor

1 Power supply (not manufactured by Gentec-eo)

1 USB cable

1- Battery pack

1 Instruction manual

1 Calibration certificate

1 Software cdrom

6.2 Separation:

Paper : Manual and certificate

Plastic: monitor enclosure, LCd enclosure.

Wires: USB cable and power supply plug.

NimH batteries: inside the monitor.

Liquid crystal display: Less than 100 cm^2.

Printed circuit board: inside the monitor.

6.3 Dismantling procedure:

Remove the DB15 post using pliers

Remove the 4 screw on the bottom of the monitor using a Philips screwdriver.

Disconnect the Battery and LCD.

Remove the 4 screws that hold the LCD using a Philips screwdriver.

Inside the monitor.

GENTEC-EO
WORLDWIDE

LEADER IN LASER BEAM MEASUREMENT SINCE 1972

CANADA

445 St-Jean-Baptiste, Suite 160
Quebec, QC, G2E 5N7, Canada

T (418) 651-8003
F (418) 651-1174
1 (888) 5GENTEC (Canada and USA only)
service@gentec-eo.com

UNITED STATES

5825 Jean Road Center
Lake Oswego, OR, 97035, USA

T (503) 697-1870
F (503) 697-0633
1 (888) 5GENTEC (Canada and USA only)
service@gentec-eo.com

Calibration Centers

445 St-Jean-Baptiste, Suite 160
Quebec, QC, G2E 5N7, Canada

Werner von Siemens Str. 15
82140 Olching, Germany