USER MANUAL

MAESTRO

Power & Energy Monitor

gentec-eo

121-102013

WWW.GENTEC-EO.COM

WARRANTY

The Gentec-EO MAESTRO 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, at Gentec-EO Inc.'s option, any MAESTRO 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, and prepaid transportation and insurance, to the nearest Gentec-EO agent. Gentec-EO Inc. assumes no risk for damage during 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 conditions 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 MAESTRO if the device or the detector looks damaged, or if you suspect that the MAESTRO is not operating properly.

Appropriate installation must be done for water-cooled and fan-cooled detectors. Refer to the specific instructions for more information. Wait a few minutes before handling the 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. If not installed and used in accordance with the instructions, it 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, 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

TABLE OF CONTENTS

1 THE MAESTRO SINGLE CHANNEL LASER POWER/ENERGY METER 6

1.1 INTRODUCTION 6
1.2 SPECIFICATIONS 7
1.3 FRONT PANEL DESCRIPTION 9
1.4 TOP PANEL DESCRIPTION 10

2 GETTING STARTED 13

2.1 HOW TO ACCESS THE DIFFERENT MENUS OF THE MAESTRO'S USER INTERFACE 14
2.2 QUICK POWER AND ENERGY MEASUREMENT PROCEDURE 16
2.3 DESCRIPTION OF THE MAESTRO NAVIGATION MENU 19
2.4 HOME 20
2.4.1 Set Device 20
2.4.1.1 Date & Time (Not available on this version, check our web site for new versions) 21
2.4.1.2 Number of Digits 21
2.4.1.3 Serial Commands 22
2.4.1.4 Ethernet 23
2.4.1.5 Languages 24
2.4.2 Set Measure 25
2.4.2.1 Wavelength 26
2.4.2.2 Range 28
2.4.2.3 Measure Mode 29
2.4.2.4 Corrections 32
2.4.2.5 Trigger Level 33
2.4.3 Display 34
2.4.3.1 Display Parameters menu bar 35
2.4.3.2 Real time display 38
2.4.3.3 Scope display 38
2.4.3.4 Needle display 40
2.4.3.5 Averaging display 40
2.4.3.6 Statistics display 42
2.4.4 Acquisition 45
2.4.5 Startup Config 48
2.4.6 About 49
2.5 SEARCH 50
2.6 INFO 51
2.7 MANAGE USB 52
2.8 BACK TO MEASURE BUTTON 52

3 SERIAL COMMUNICATION INTERFACE 53

3.1 USB SERIAL COMMUNICATION 53
3.1.1 Installation 53
3.1.1.1 Installation for Windows™: 53
3.1.2 Setting up Communication to the MAESTRO 53
3.1.2.1 Verify COM Port 53
3.1.2.2 Connect to the MAESTRO 53
3.1.2.3 To echo commands 54
3.1.2.4 Test the connection 54
3.1.2.5 HyperTerminal settings shortcut 54
3.2 ETHERNET COMMUNICATION 55
3.3 PC-MAESTRO USER-FRIENDLY SERIAL DATA ACQUISITION SOFTWARE 56
3.4 TRADITIONAL COMMUNICATION SETTINGS 57
3.4.1 Serial Command format 57
3.4.1.1 Serial Protocol Rules: 57
3.4.1.2 Text mode rules: 57
3.4.2 MAESTRO Binary Mode Description 58
3.4.2.1 Description 58

3.4.2.2 Codification....58
3.4.3 Serial Command Directory....59
3.4.3.1 Serial commands....61
3.4.3.2 Error Messages....76
3.4.4 Legacy monitor serial commands....77
3.4.4.1 Emulated SOLO2 Serial commands....77
3.4.4.2 Error Messages for SOLO2 Serial mode....88
4 MAINTENANCE....89
4.1 USB INSTALLATION FOR THE MAESTRO....89
4.2 FREE SOFTWARE UPGRADE....89
4.3 BATTERY CHARGING....89
4.4 TROUBLESHOOTING....89
5 DECLARATION OF CONFORMITY....90
6 APPENDIX A....91
6.1 QED/12/25/50/65/95....91
7 APPENDIX B....93
7.1 RECYCLING AND SEPARATION PROCEDURE....93
7.2 SEPARATION:....93
7.3 DISMANTLING PROCEDURE:....93

LIST OF ILLUSTRATIONS

FIG. 1-1 MAESTRO FRONT PANEL 9
FIG. 1-2 MAESTRO TOP PANEL 10
FIG. 1-3 TYPICAL PULSE SHAPE OF A PYROELECTRIC DETECTOR 12
FIG. 2-1 MAESTRO START UP WINDOW 13
FIG. 2-2 HIERARCHY OF THE MAESTRO'S USER INTERFACE STRUCTURE 14
FIG. 2-3 PARAMETERS MENU TO SET THE DETECTOR'S ZERO LEVEL 17
FIG. 2-4 THE NAVIGATION MENU BAR 19
FIG. 2-5 THE HOME MENU WINDOW 20
FIG. 2-6 THE SET DEVICE MENU WINDOW 21
FIG. 2-7 THE NUMBER OF DIGITS MENU WINDOW 22
FIG. 2-8 SERIAL COMMANDS MENU WINDOW 23
FIG. 2-9 ETHERNET CONFIGURATION MENU WINDOW 24
FIG. 2-10 LANGUAGE CONFIGURATION MENU WINDOW 25
FIG. 2-11 THE SET MEASURE MENU WINDOW 26
FIG. 2-12 THE WAVELENGTH MENU WINDOWS 27
FIG. 2-13 POPUP WINDOW TO ENTER A USER DEFINED WAVELENGTH 28
FIG. 2-14 THE RANGE SELECTION MENU WINDOW 29
FIG. 2-15 THE MEASURE MODE SELECTION MENU WINDOW FOR A THERMOPILE DETECTOR HEAD 30
FIG. 2-16 SETTING CORRECTION MENU 32
FIG. 2-17 TRIGGER LEVEL WINDOW 33
FIG. 2-18 DISPLAY MENU WINDOW 35
FIG. 2-19 THE DISPLAY PARAMETERS MENU BAR 35
FIG. 2-20 REAL TIME DISPLAY 38
FIG. 2-21 SCOPE TIME DISPLAY 39
FIG. 2-22 DIGITAL NEEDLE DISPLAY 40
FIG. 2-23 AVERAGING DISPLAY 41
FIG. 2-24 STATISTICS DISPLAY 42
FIG. 2-25 STATISTICS SETTINGS POPUP WINDOW 43
FIG. 2-26 STATISTICS DURATION SETTINGS POPUP WINDOW 44
FIG. 2-27 DATA SAMPLING PARAMETERS WINDOW MENU 46
FIG. 2-28 STARTUP CONFIG MENU WINDOW 48
FIG. 2-29 ABOUT WINDOW. 49
FIG. 2-30 SEARCH WINDOW. 50
FIG. 2-31 INFORMATION MENU WINDOW 51
FIG. 2-32 MANAGE USB MENU WINDOW 52
FIG. 3-1 MAESTRO ETHERNET COMMUNICATION EXAMPLE APPLICATION 56

1 THE MAESTRO SINGLE CHANNEL LASER POWER/ENERGY METER

1.1 Introduction

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

The MAESTRO 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 intuitively accessible using a touch screen. It is a complete power and energy meter. The MAESTRO provides a statistical analysis of your measurements. It allows you to store data on an external USB key. Moreover, the MAESTRO can be updated by connecting a USB key with the new file available on our web site in the download section.

The MAESTRO has enhanced network capabilities that take further advantage of the USB port for data acquisition and remote control. In addition to the external USB key, it can also transfer data files to a PC for more sophisticated data analysis. Furthermore, the MAESTRO responds to commands through the PC interface using the USB port. To transform your PC screen into a virtual MAESTRO, look for the easy-to-use communications software 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 5 and above. The MAESTRO is already internally set to accept the latest Gentec-EO wattmeter and joulemeter heads with a DB-15 connector. The MAESTRO supports both fast and slow heads with a rise time from 5 μs to 10 s.

The MAESTRO can reread heads in hot plug situation. Before inserting a new head, wait for the MAESTRO to stop displaying numbers. Once the head has been detected, the monitor will wait 2 seconds to ensure that the head is properly inserted. If you do not respect these conditions and the head is not read correctly, reboot the MAESTRO.

Unpacking

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

Visually inspect every MAESTRO 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 by going to our website at www.gentec-eo.com. Download the latest software version anytime and install it on the MAESTRO with the USB key. 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
Power Range	4 pW to 30 kW
Power Scales (photo diode head)	300pW, 1nW, 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, 30kW
Pyroelectric in power mode range (UM-B)	100µW, 300µW, 1mW, 3mW, 10mW, 30mW, 100mW, 300mW
Resolution (digital)	Current scale/8192
Monitor Accuracy	±0.25 % ±5 µV best scale[1]
Response Time (accelerated)[2]	Head dependant (~1 sec)
Statistics	Current value, Max, Min, Average, Std Dev., RMS stability, PTP stability, Time
Data Storage	Continuous on USB stick
	Energy meter specifications
Energy Range	2fJ to 30kJ
Energy Scales [2] (photo diode head)	300fJ, 1 pJ, 3 pJ, 10 pJ, 30 pJ, 300pJ, 1 nJ, 3 nJ, 10 nJ, 30 nJ, 100nJ, 300nJ, 1 uJ, 3 uJ,10uJ, 30uJ, 100µJ, 300µJ, 1mJ, 3mJ, 10mJ, 30mJ
Energy Scales [2] (thermal head)	3mJ, 10mJ, 30mJ, 100mJ, 300mJ, 1J, 3J, 10J, 30J, 100J, 300J, 1kJ, 3kJ, 10kJ, 30kJ
Resolution (digital)	Current scale/8192

[1] The 5µV offset can introduce an error into low power measurements with low sensitivity detectors. It is essential to use the Zero Offset to rezero the Maestro 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.

Accuracy[3]	1.0 %±50 µV < 6 kHz 2%±50 µV 6kHz to 10 kHz
Default Trigger Level	2 %
SOFTWARE TRIGGER LEVEL	0.1% to 99.9%, 0.1% resolution
Repetition Frequency[4]	2 kHz for data acquisition in the real time full screen display, no missing point 1.3 kHz for data acquisition in real time with time stamp, no missing point 2 kHz in statistics mode, no missing point From 2 kHz to 10kHz the MAESTRO will send the latest energy pulse every 500us. (corresponding to a subsampling at 2 kHz).
Frequency Measurement	Accurate frequency measurement up to 14kHz 0-1000 Hz: 0.1% accuracy 1000-2000 Hz: 0.5% 2000-14000 Hz: 1%
Statistics	Current value, Max, Min, Average, Std Dev., RMS stability, PTP stability, Time, Pulse #, Repetition Rate, Avg Power.
Data Storage	Continuous on USB stick
	General Specifications
Digital Display	112.9 x 84.7mm RGB color LCD with touchscreen, 640 x 480 Pixels
Display Rate	3 Hz numeric display 15 Hz bar graph & needle display
Scope	500 divisions
Data Displays	Real time, Scope, Averaging, Statistics, Digital tuning needle
User input correction factors	1 multipliers and 1 offsets (7 digits floating point)
Analog Output	0 – 1 volt, full scale, ± .5%
Internet Upgrades	USB STICK
PC Serial Commands	USB & Ethernet[5] & RS-232
No missing point throughput serial	300 Hz

[3] Including linearity, detector dependant.

[4] In a full size statistic's windows, no scope display and no serial communication.

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

[6] Backlight at 50% in real time display. The scope and averaging displays decrease the autonomy by 20%.

frequency	
Dimensions (without stand)	216 mm(W) x 122 mm (H) x 45.7 mm (D)
Weight (with stand)	0.670 kg
Battery Pack	4 rechargeable 1.2 V Ni-MH AA
Battery life	6.5 hours[6]
Battery charge time	4 hours
Universal External Power Supply	Input: 100/240 VAC 50-60 Hz, Output 9 VDC 1.66 A.

1.3 Front Panel Description

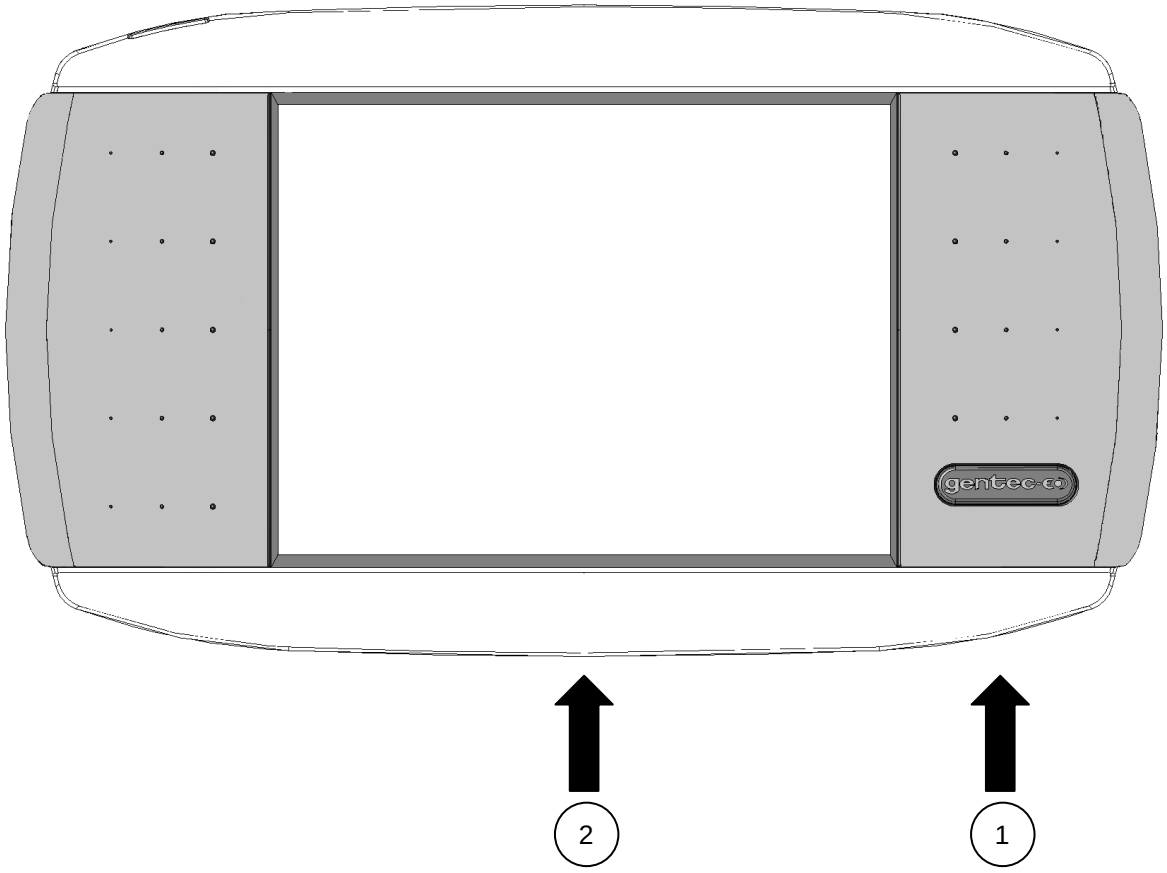

Fig. 1-1 MAESTRO Front Panel

1- I/O control key.

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

2- LCD SCREEN

Dimensions: 112.9 x 84.7mm RGB color Touchscreen LCD, 640 x 480 Pixels.

To access any of the options or menus, simply touch the appropriate icon or button on the screen.

1.4 Top Panel Description

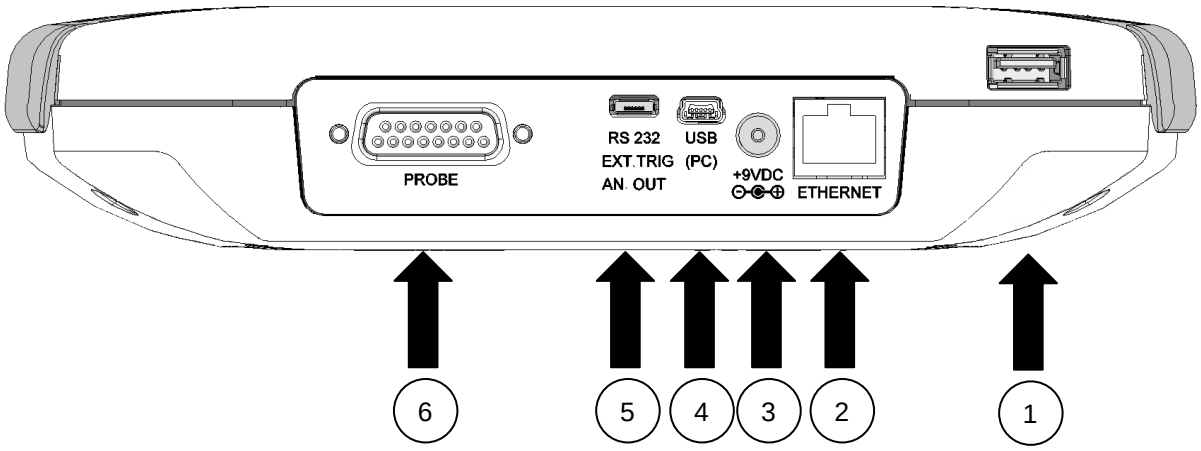

Fig. 1-2 MAESTRO Top Panel

1- USB PORT FOR USB KEY

This interface allows the user to insert a USB key for an easy and quick data transfer without having to connect the monitor to a PC. If your key is not recognized, try using a new one. Old and slow USB keys are not supported.

2- ETHERNET PORT

This interface allows remote control and data transfers between the MAESTRO and a computer that has an ETHERNET communication port.

3- 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/1.66A. 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 the monitor may be damaged, depending on the voltage level and the waveform.

4- USB INTERFACE CONNECTOR:

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

5- SERIAL INTERFACE CONNECTOR (RS-232, Analog out, Ext trigger):

RS-232:

The RS-232 interface allows remote control and data transfers between the MAESTRO and a computer, a terminal, or any device that has a serial communication port. To use the RS-232 port, you must have a special cable (part number 201860).

Analog out:

It allows monitoring the laser average power or energy by using external equipment such as a chart recorder, a computer with an analog interface, a voltmeter, etc. To use the analog output port, you must have a special cable (part number 201958).

For **power measurements:** the output signal represents the amplified and anticipated power detector response.

For **energy measurements:** 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. It 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 mW on the 300 mW range

Specifications:

Maximum output voltage:	1 V
Output impedance:	2 kΩ

External trigger:

To use the external trigger, you must use a special cable (part number 201956). The External trigger is TTL compatible. The maximum voltage is 25 volts, the trigger needs a positive voltage, the minimum width is 1 μs. The monitor detects the trigger on the rising side of the external trigger signal. To measure accurately, the trigger must be just before the laser pulse, or just after. For example:

A QE12SP-S-MT has a 20 μs rise time

The External trigger must be 4 μs before or 19 μs after the laser pulse.

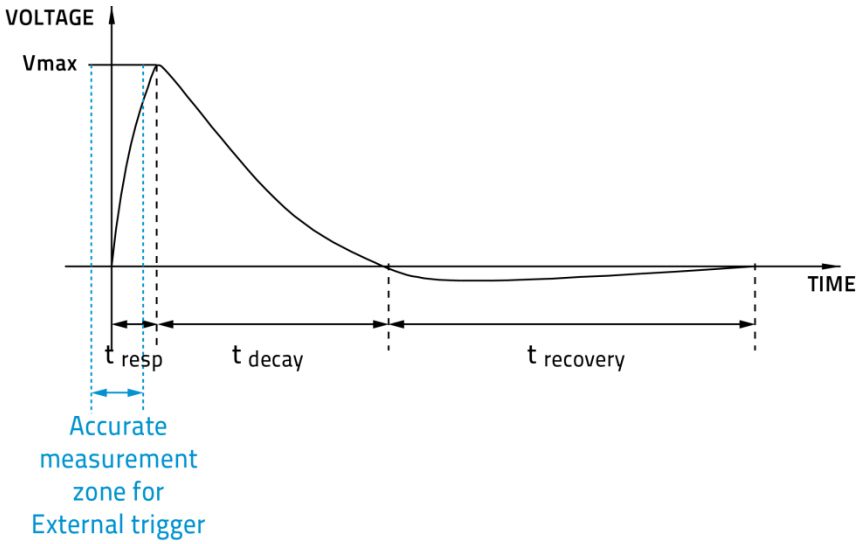

Fig. 1-3 Typical pulse shape of a pyroelectric detector

Connector type: cable sold separately

6- PROBE INPUT JACK:

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

The **MAESTRO** works with all the latest Gentec-EO detectors except the specialty high rep rate 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 MAESTRO may not recognize some of the old heads EEPROM versions. An error message "Detector not supported!" will appear in a popup window. Please contact a Gentec-EO representative to resolve this issue. If no message is displayed, either the head is not supported or it is broken.

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 MAESTRO. This adaptor is compatible with all the Gentec-EO pyroelectric joulemeters except the EPD.

Power detectors of version V5 and higher and **Energy detectors of version V6 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.

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

2 GETTING STARTED

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

The MAESTRO is delivered ready to use. Just insert a detector head in the Probe Input Jack (#6 in Figure 1-2) and press the I/O key. The following window will appear on the monitor (Figure 2-1). It is separated into four different areas.

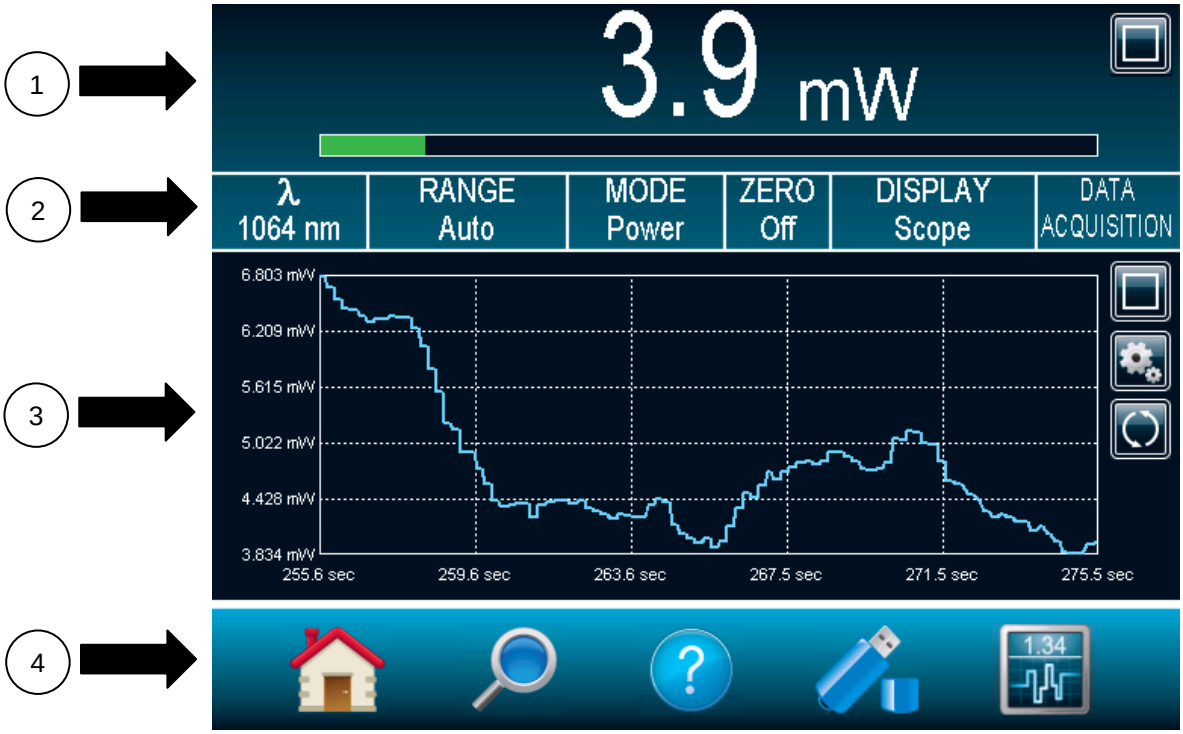

Fig. 2-1 MAESTRO Start up window

1- REAL TIME DISPLAY (in dual mode)

The **Real Time display** shows the current measured value by the detector head (refer to section 2.4.3.2).

2- DISPLAY PARAMETERS MENU

The **Display Parameters menu** gives you quick access to the MAESTRO's main settings (refer to section 2.4.3.1).

3- SCOPE DISPLAY (in dual mode)

The **Scope display** gives a quick look at the laser beam's long-term stability and trend as a function of time. This display can be easily changed using the display parameters menu (refer to section 2.4.3.3).

4- NAVIGATION MENU (main menu)

The **Navigation menu** allows you to navigate through the different menu windows to set the MAESTRO's options to your specific needs (refer to section 2.3).

2.1 How to access the different menus of the MAESTRO's user interface

The powerful CPU of the MAESTRO, combined with the Windows™ CE operating system, provides an easy and intuitive access to all of its functions. The user controls the intuitive interface using the touch screen. To access any option or functionality, simply touch the appropriate icon or button on the touch screen. To help you navigate through the different menus, the following figure represents the MAESTRO's user interface hierarchy. Each menu and submenu is represented by its icon and referenced to its corresponding detailed section. (Some functions may not be available in your software version, check our web site for new release),

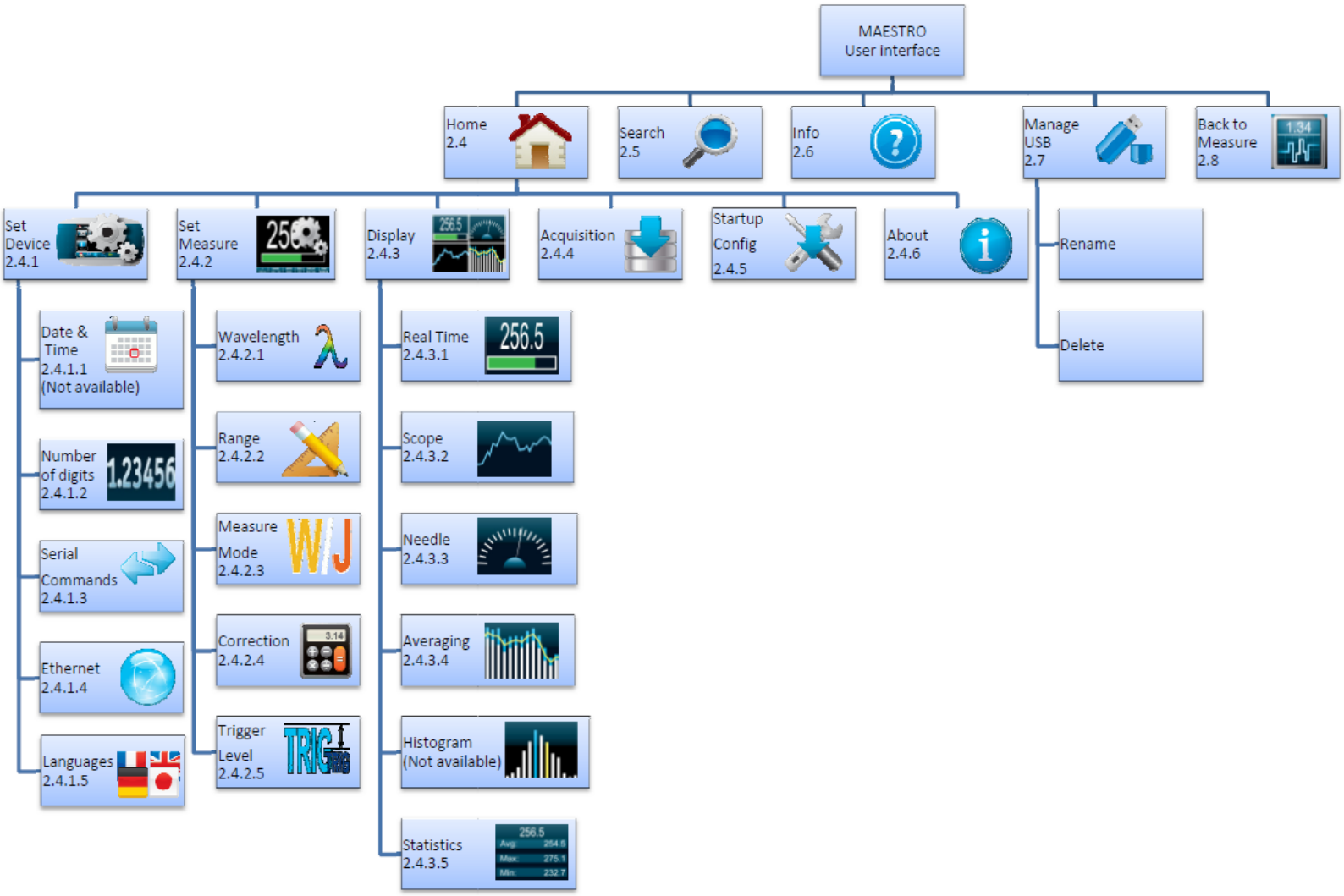

Fig. 2-2 Hierarchy of the MAESTRO's user interface structure

A set of different buttons and icons allows you to interact with the MAESTRO's user interface. The following table describes the different buttons and icons present in the MAESTRO.

Table 2-1 List of Specifications

Icon	***Name***	***Type***	***Description***
	Cancel	Button	Closes current window without saving changes.
	OK	Button	Saves changes and closes current window.
	Warning	Icon	Identifies a warning window.
	Hint	Icon	Identifies a useful hint.
	Full Screen	Button	Switches to the single, full screen display mode.
	Minimize	Button	Switches to the dual screen display mode.
	Settings	Button	Allows the user to change the display settings.
	Play	Button	Starts computing the statistics.
	Refresh	Button	Refreshes the data in the display (used for Scope, Averaging and Histogram).
	Stop	Button	Stops computing the statistics.
	Check Box (empty)	Check Box	Deactivates the option.
	Check Box (full)	Check Box	Activates the option.
	Edit	Button	Allows user to edit the field.
	Delete	Button	Erases the field.

	Add	Button	Automatically adds a file name. Pressing the Add button again increments the name.
	Next Page	Button	Displays the next page in the menu.
	Previous Page	Button	Displays the previous page in the menu.
	Scroll up (Not available)	Button	Displays the upper part of the page.
	Scroll down (Not available)	Button	Displays the lower part of the page.

2.2 Quick power and energy measurement procedure

This section applies to all MAESTRO versions. It will show you the fastest way of making a laser power and energy measurement with the MAESTRO 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 customized technical data required for optimum operation of the detector will be automatically downloaded from the EEPROM in the DB-15 connector. These data include all the necessary head parameters such as sensitivity, model, serial number, version, wavelength correction factors, time response and others. The MAESTRO doesn't support energy detectors before version 4.

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 MAESTRO off** and connect a compatible power or energy detector head to the MAESTRO using the **PROBE INPUT JACK** (see Fig. 1-2). The Maestro allows hot-swapping between heads.

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

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

6- Power heads will default the MAESTRO to power measurement; energy heads will default the MAESTRO to energy measurement. The display will default to a dual display in real time and scope (Fig 2-1) in auto range mode.

7- Remove the head's protective cover and start the laser.

Put the detector head into the laser beam path. Leave it there for a few minutes, until the detector has reached 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.

Adjusting the zero (step 8a for power heads and 8b for photodiode heads)

8- The power read by the MAESTRO when no laser beam is incident on the detector may not be exactly zero. For power measures, this is because the detector is not thermally stabilized OR there was a heat source in the field of view of the detector when you turned on the MAESTRO. As for photodiode measures, zeroing will remove the detector's offset.

a. Block off laser radiation to the detector. To reset the zero, wait until the reading has stabilized and touch **Zero** in the parameters menu. Two options will appear (**On** or **Off**), select **On**. You are now ready to take an accurate measurement. To turn the **Zero Offset** off, select **Off**.

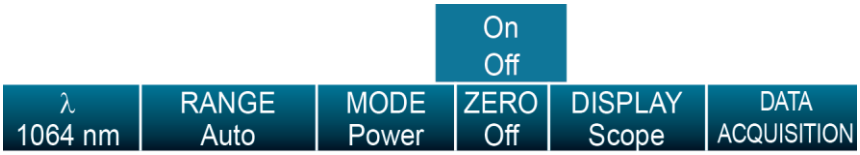

Fig. 2-3 Parameters menu to set the detector's zero level

b. If you have connected a photodiode to the MAESTRO, you must cover the diode and the zero has to be done for all scales. You will not have to do this manually for each scale as this is automatically done when you turn "on" the zero. In some software versions, a message appears requesting you to put the black cover over your photodiode. Touch the OK button after you have done so. The MAESTRO passes through all the scales to determine the zero diode for each scale. The message "Diode Zero Done" appears when the MAESTRO has determined the zero diode.

Notes:

- Refer to specific power detector documentation for complete installation and operating instructions.
- Power detectors are thermal sensors and are thus sensitive to temperature variations.

For high-precision measurements, it is recommended to:

- Allow the power detector temperature to stabilize before zeroing the MAESTRO.
- Touch only the stand when handling the power detector. Do not touch the detector head.
- Do not zero adjust the energy detectors, such as the QE series.
- Avoid forced airflow or drafts around the detector.

9- Apply the laser beam to the detector head.

10- The laser beam average power or energy can be displayed in four ways for your convenience:

a. Digitally for real time measurements;

b. On a scope graph to evaluate the laser's variations in time;

c. On a digitally produced analog display using a needle for easy visualization of the laser beam power variation during laser fine-tuning;

d. Averaged over a certain number of measurements;

e. Complete statistical results over a certain period of time.

2.3 Description of the MAESTRO navigation menu

This section describes the first group of menus essential to the MAESTRO's operation. Refer to Figure 2-2 for a schematic view of the menu structure.

The navigation menu bar provides access, at any time, to the five main options by touching the appropriate icon.

Fig. 2-4 The navigation menu bar

Table 2-2 List of Navigation menu bar options

Option	***Icon***	***Description***
HOME		Allows you to manage the MAESTRO's and the detector head's settings. You will have access to: • Device settings • Measurement settings • Display settings • Acquisition settings • Information about the MAESTRO device
SEARCH		This option allows the user to easily access, in alphabetical order, some of the available functions on the MAESTRO.
INFO		Displays the MAESTRO's and the connected detector head's information and settings
MANAGE USB		Allows you to manage the USB key. It displays the files currently on the USB key and lets you rename or delete a file.
BACK TO MEASURE		Returns to the measurement window.

By touching an icon in the navigation menu, the MAESTRO will display the appropriate menu window, allowing you to set or select the desired settings or options.

2.4 Home

The **Home** menu allows you to access and change any settings for the MAESTRO and the connected detector head. You can choose between 5 options:

- **Set Device** controls the MAESTRO's basic parameters;
- **Set Measure** controls the data measured by the detector head;
- **Display** controls the display mode of the data measured by the detector head.
- **Acquisition** controls the acquisition parameters to save the measured data on the USB key.
- **Startup Config** configures the measurement settings at startup.
- **About** displays all the information relative to the current MAESTRO monitor.

Fig. 2-5 The HOME menu window

2.4.1 Set Device

The **Set Device** lets you set and save the MAESTRO with customized parameters. You can set the time and date of the device (not yet available), set the displayed significant digit, set the serial commands, configure the Ethernet, and set the language (English, French, German, or Japanese). To exit the device settings window touch the exit button  or select any other option from the navigation bar at the bottom of the window.

Fig. 2-6 The Set Device menu window

2.4.1.1 Date & Time (Not available on this version, check our web site for new versions)

The **Date & Time** button adjusts the time and date of the monitor's internal clock. This information is used to timestamp files when you are logging data.

2.4.1.2 Number of Digits

To set the significant figures of the numerically displayed value, touch the **Number of Digits** button. You will be able to choose the precision of 3, 4, or 5 digits. You can also choose the default settings, which will let the device choose the best resolution to fit the scale. Absolute accuracy depends on the head. When the number of digits is set, touch the **OK** button 

to save the changes or touch the **cancel** button  to ignore the changes.

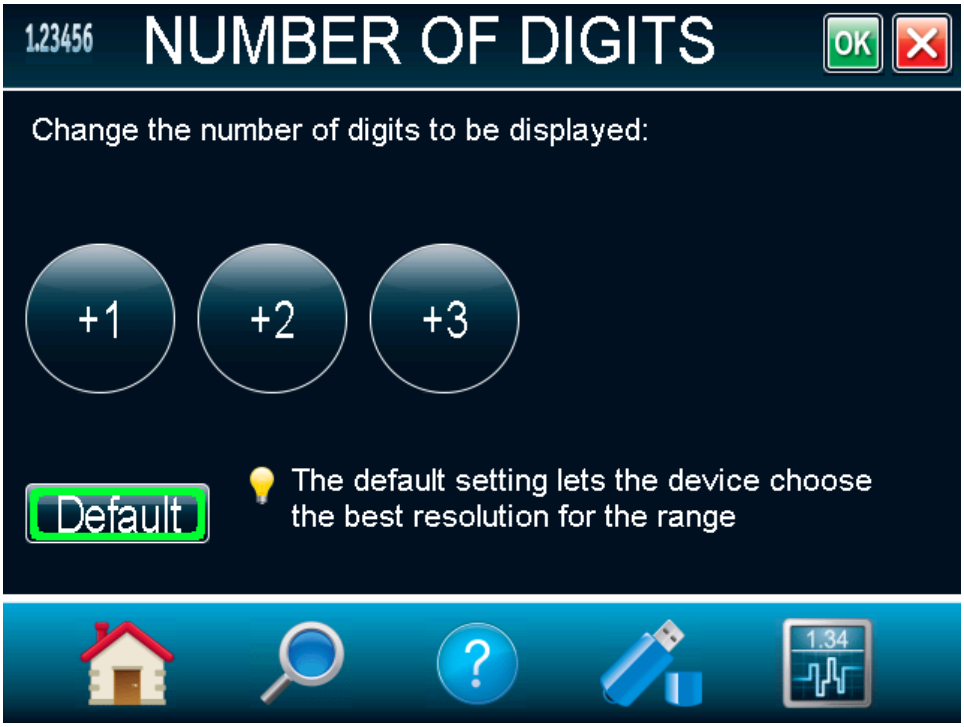

Fig. 2-7 The Number of digits menu window

2.4.1.3 Serial Commands

The Serial Commands Menu allows you to configure the serial communication and input/output port settings. Refer to section 3.4.3 for the complete serial commands directory. All the settings in this menu are automatically saved, which means that at each reboot, the last changed settings will be loaded.

In order to ease the integration of the MAESTRO with setups using our legacy monitors, select **SOLO2 Serial Compatibility**. Note that only the ASCII commands are available. This feature is only available when using the USB port for serial communication. Refer to section 3.4.4 for more information about the available SOLO2 commands.

For fast data acquisition in energy mode, select **Serial Binary Measurement**. Refer to section 3.4.2 for more information on how to use the MAESTRO's serial binary measurement mode.

The serial communication can be done via USB port or RS-232 port. To use the RS-232 port, you must use the special cable (part number 201860). Before using the serial communication after it was changed, you must reboot the MAESTRO.

To use the analog output using the special cable (part number 201958), select **Analog Output**. The MAESTRO will not need to be rebooted. This output allows the monitoring of the laser's average power or energy with external equipment such as a chart recorder, a computer with an analog interface, a voltmeter, etc. In the case of a power measurement, the output signal represents the amplified and anticipated power detector response. 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 is equivalent to 4 watts.

Fig. 2-8 Serial Commands menu window

2.4.1.4 Ethernet

The MAESTRO allows the user to remotely control and acquire data. To configure the Ethernet settings, touch the **Ethernet** button.

By default, the Ethernet capability is disabled, check the box to enable it. Note that enabling the Ethernet port may increase the noise of the device if used without an Ethernet cable. You must always reboot the MAESTRO after changing the Ethernet settings.

The Maestro runs TCP server applications. It can assign static or dynamic IP addresses. It is recommended to use a dynamic IP address for most applications in order to prevent problems on your network. When using a static IP address, please make sure you enter valid and available IP address. **Always ask your IT specialist for an available IP address.** This will prevent conflicts and problems on your network. If you are not sure which IP address to use, please use the dynamic IP address type, which will automatically assign an available address.

Before booting the MAESTRO, connect it to a network cable. Boot the MAESTRO and access the Ethernet Configuration Menu via Home / Set Device. Enable the Ethernet capability. You can choose to specify a static IP address and enter your own IP address, or you can choose a dynamic IP address and the server will automatically assign an IP address to the MAESTRO. If needed, you can change the port number. When you are done with the setup, simply touch the **OK** button 

and reboot the MAESTRO. If the address type was set to dynamic, access the Ethernet Config menu to retrieve the assigned IP address.

The device can now be accessed with a simple TCP client application, such as HyperTerminal. Only native MAESTRO commands are supported with the Ethernet communication. Please make sure that the SOLO2 Serial Compatibility is unchecked in the Serial commands menu (refer to section 2.4.1.3). Please refer to section 3.2 for installation instruction on the PC.

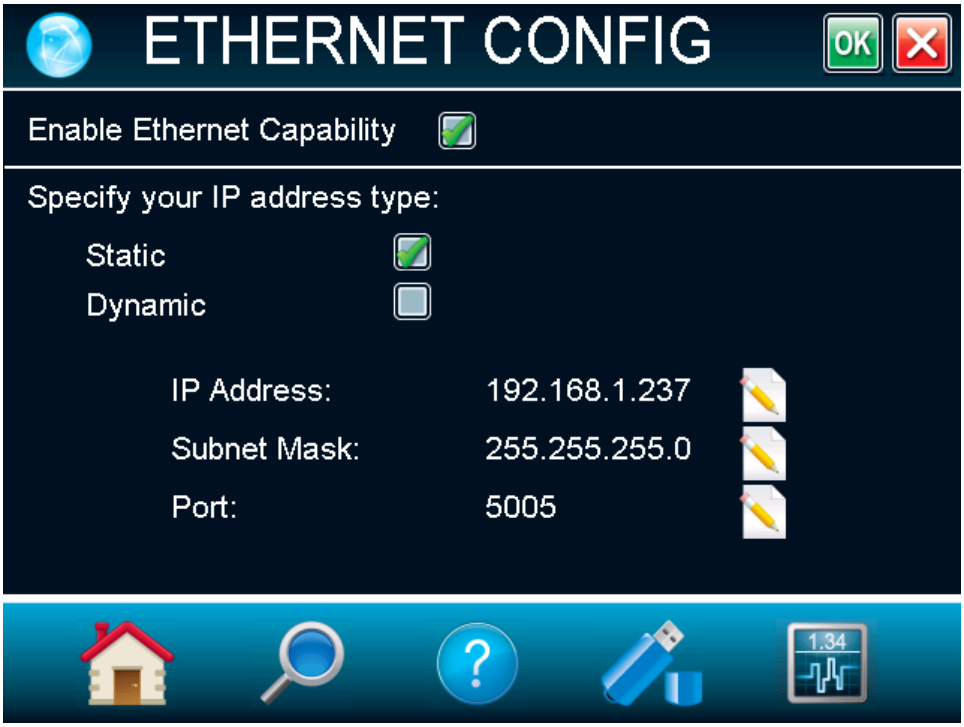

Fig. 2-9 Ethernet Configuration menu window

2.4.1.5 Languages

The Maestro allows the user to choose between an English, French, German, or Japanese display. Chinese will also be available in the future. Check Gentec-EO's website for updates.

Fig. 2-10 Language Configuration menu window

2.4.2 Set Measure

Options in the **Set Measure menu** define user-adjustable measured data parameters. The **Wavelength** can be changed in order to set it to the wavelength at which the detector is used. The power or energy **Range** allows you to adjust the scale in order to obtain the best possible resolution. **Correction** factors that will affect the reading can be easily programmed. They can be used for a beam sampler, attenuator, or other optics that require you to multiply and/or add offsets to the detector reading. **Trigger Level** and **Measure Mode** are also found in the **Set Measure** menu.

Fig. 2-11 The Set Measure menu window

2.4.2.1 Wavelength

The **Wavelength** menu is used to select the proper wavelength at which the detector is used. It applies a correction to adjust for the variation in responsivity at different wavelengths. Pre-programmed wavelength correction factors dedicated to each detector head are available and automatically loaded from the detector EEPROM, for version 5 and higher detector heads. When a new detector is plugged in, the calibration wavelength is the default selection.

To change the wavelength, select the appropriate wavelength from the **Wavelength** menu. For photodiodes, left and right arrows will allow you to access all the available wavelengths. Once the wavelength is set, touch the **OK** button  to save the changes or touch the **cancel** button  to ignore the changes.

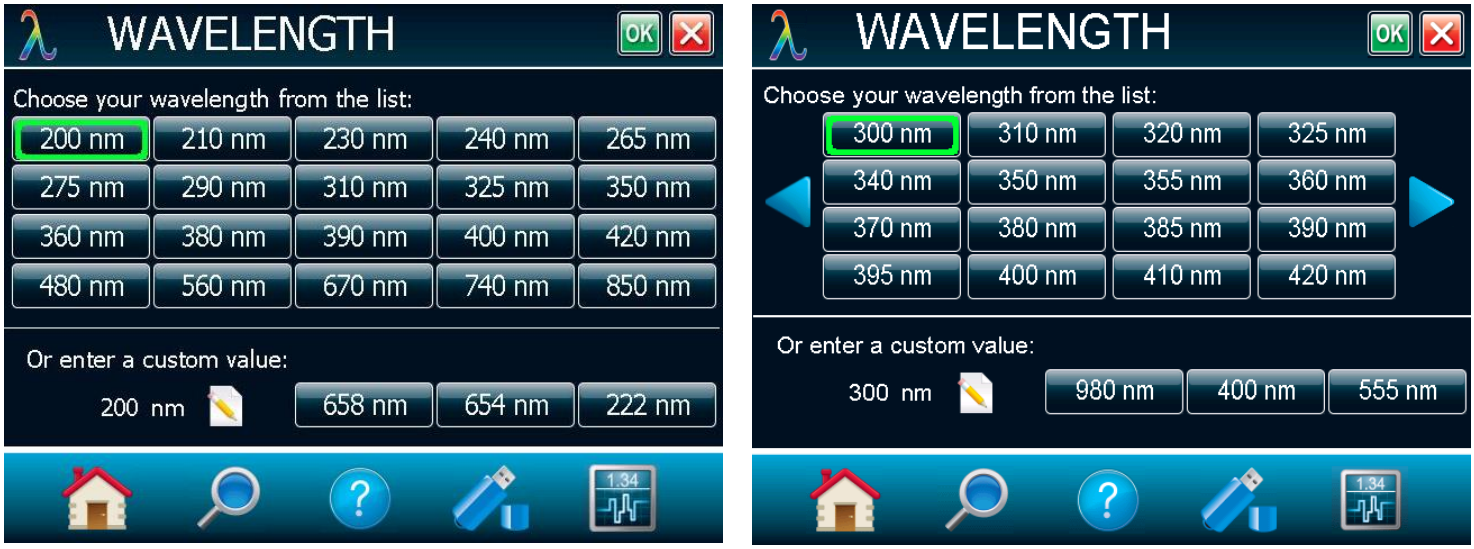

Fig. 2-12 The Wavelength menu windows

The MAESTRO automatically recognizes the latest 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.

You can also adjust for a wavelength other than the preset wavelength. The MAESTRO will use the pre-programmed data in the detector's EEPROM. When working at such a wavelength, it will not be available in the **Wavelength** menu; you must manually enter the desired wavelength by touching the **edit** button. A popup window menu will appear prompting you to enter the wavelength. When the wavelength is set, touch the **OK** button to save the changes, or touch the **cancel** button to ignore the changes. The MAESTRO only allows you to choose values that fall within the detector's range. If you enter an invalid value, a menu pops up to signal the error and the MAESTRO automatically selects the default value, which is the wavelength used for calibration at Gentec-EO during manufacturing or subsequent service.

Fig. 2-13 Popup window to enter a user defined wavelength

Once you have entered a new wavelength in the MAESTRO, you can save your settings (refer to section 2.4.5).

2.4.2.2 Range

The **Range** menu window is used to select the signal level read by a detector head. When a new head is plugged in, the auto mode is the default option. In this condition, the MAESTRO automatically selects the best range for the value being measured. You can also choose a fixed scale according to the specific connected detector head. The MAESTRO only shows range values that fall within the detector head's range. You can only choose from these available ranges

Fig. 2-14 The Range selection menu window

To change the range, simply touch a range value from the appropriate range. When the range is set, touch the **OK** button OK to save the changes, or touch the **cancel** button to ignore the changes.

When in a manually selected range, you should always use the next higher range 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 auto mode adjusts continuously to the measured value, the auto mode in energy mode bases its range selection on the energy of the previous pulse. A pulse with energy less than 2% of the current scale will not be detected. Always set the scale to the best one available. To be sure to measure lower energies, set the scale manually to the lowest level and set the autoscale, the MAESTRO will autoscale to the best scale. In this case, the pulses that saturated the scale while the autoscale was searching for the best scale will be invalid.

2.4.2.3 Measure Mode

Depending on the type of detector head connected on the MAESTRO, you can choose different measure modes. The following figure shows an example of the measure mode menu window when a thermopile detector head is connected to the MAESTRO. Once the measure mode is set, touch the **OK** button OK to save changes, or touch the **cancel** button to ignore the changes.

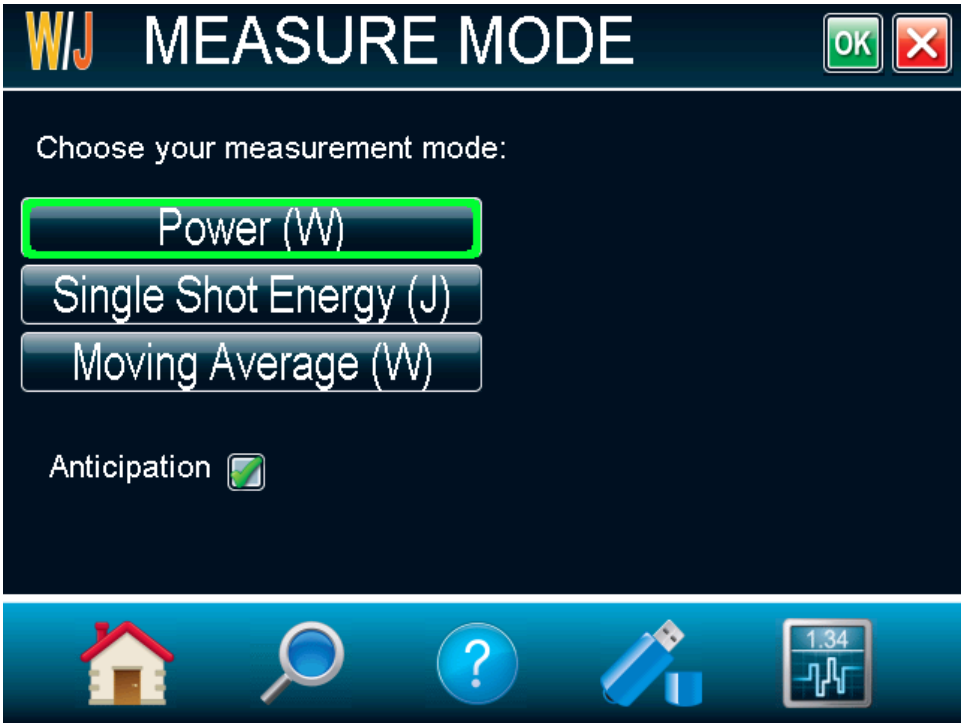

Fig. 2-15 The Measure mode selection menu window for a thermopile detector head

Depending on the type of detector head connected to the MAESTRO, you will have different choices for the measure modes.

For thermopiles, you have the following measure modes:

- Power in Watts (default);
- Single Shot Energy in Joules[7]: (Energy mode/ calorimeter mode);
- Moving Average in Watts.

[7] This function allows you to measure the energy contained in a laser pulse with a Gentec-EO **power detector head**. This mode of operation gives access to the same options as in the case of an energy pyroelectric joulemeter. The only restriction is that the time delay between pulses, $Delay = \left(\frac{1}{Rep.\ Rate} \right)$, must be compatible with the detector specification. (Please refer to the user manual for the specific power detector you are using.)
You must select the range manually because the autoscale is deactivated when you select **Energy Mode**.
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 energy mode is always available for power detectors with a typical sensitivity value. A precision of ±3% in the pulse energy measurement can be achieved if the power detector head is specifically calibrated in energy mode. Please contact your local Gentec-EO distributor or nearest Gentec-EO office for more information on obtaining a pulse energy measurement calibration.

For photo detectors, you have the following measure modes:

- Power in Watts (default);
- Moving Average in Watts;
- Power in dBm (dBm = Log [power in Watts/0.001W]).

For Pyroelectrics

- Energy in Joules (default);
- Average Power in Watts.
- Energy Dose in Joules(Not available on this version, check our website for new versions);
- Moving Average in Joules (Not available on this version, check our website for new versions).

When selecting the **Moving Average** option for thermopiles or photo detectors, or the **Average Power** option for the pyroelectrics, a popup window will appear to select the averaging period. This will automatically turn on the statistics in continuous mode. Please do not turn off the statistics nor change to non-continuous mode to continue using the **Moving Average,** or the **Average Power** options. Also note that if an acquisition is done while the MAESTRO is in one of these modes, the saved data will also be in the same format.

The Moving Average is available for those head types:

- Thermopile
- Photodiode
- Pyroelectrics head that work in average power (radiometer)

The Average Power is available for those head types:

- Pyroelectrics
- Photodiode configured in Energy mode.

Uncheck **Anticipation** to deactivate the power meter acceleration software that provides accelerated response. By using advanced algorithms and known properties of the detector, this software allows the MAESTRO 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 will reduce the noise level and provide a more stable measured value in a noisy environment.

Version 7 energy heads have been calibrated with and without the **attenuator** at a chosen wavelength. When enabling the **attenuator**, only the wavelength at which it has been calibrated will be available in the wavelength menu. Similarly **photodiodes** have been calibrated with and without the **attenuator** at chosen wavelengths. When enabling the **attenuator** and touching the **OK** button 

, the MAESTRO

will prompt the wavelength menu because the available wavelengths with and without the attenuator are different.

A checkmark shows when the **anticipation or attenuator** is activated. It is a toggle switch - select it to change between on and off. For the anticipation, the default is on and for the attenuator, the default is off. However, these defaults can be changed in the startup config menu (refer to section 2.4.5).

2.4.2.4 Corrections

The user can apply a multiplier and an offset value 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 the correction factors that are being applied to the measurements.

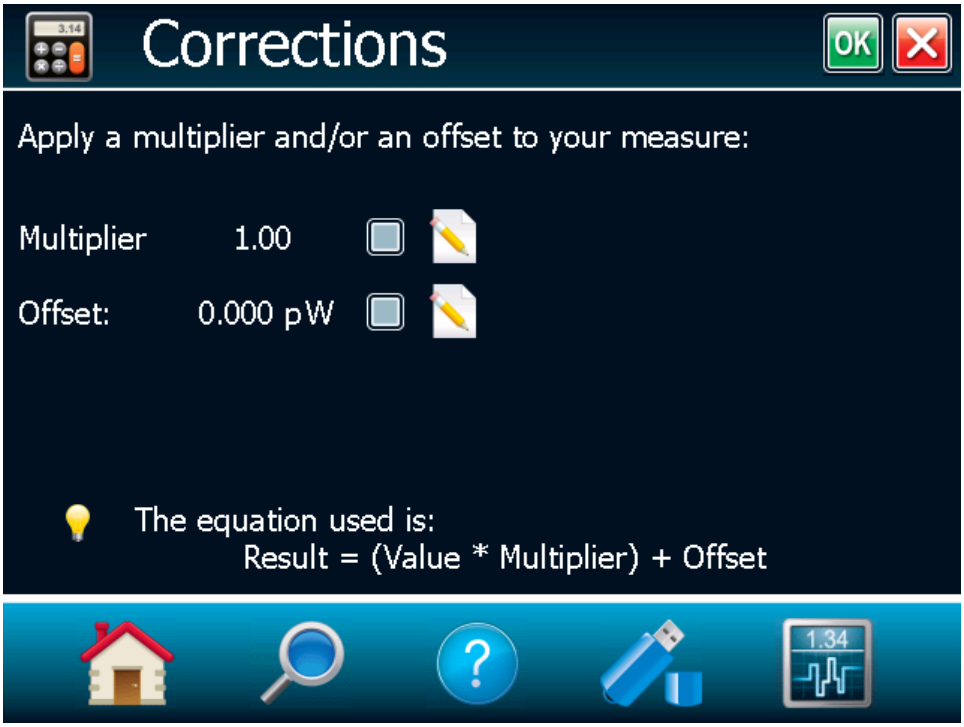

Fig. 2-16 Setting Correction menu

The default value for the multipliers is 1, and the default for the offset is 0. To activate the correction factors, touch **Corrections** in the **Measurement Settings** menu and then select **Multiplier** or **Offset** by touching the appropriate check box. To change the multiplier or the offset's value, touch the **edit** button. A dialog box opens where you can enter the correction value. This number will be multiplied with, or added to the actual measured value, to calculate the corrected value. Once the correction values are set, touch the **OK** button to save the changes or the **cancel** button to ignore the changes. The MAESTRO 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** and enter 1000 in the dialog box. The MAESTRO will display the laser's power rather than the measured 0.1% sample on the main display.

It is essential to make sure that the actual measured value also complies with the power and energy limits of the detector head. The auto range option is the default selection. You can select a specific range but it must always be based on the actual physical measured values and **not on the corrected value**. 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, touch the check box corresponding to the correction factor (multiplier or offset) in the **Corrections** menu window.

2.4.2.5 Trigger Level

The trigger level only functions if an energy detector head is connected or if a power detector head is used in **Pulse Energy (Calorimeter)** mode. This option allows you to change the **Trigger Level** from 2% of the full-scale default value. This proves to be especially useful in noisy environments. Acceptable values range from 0.1% to 99.9% with 0.1% steps. 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 menu window by selecting **Trigger Level** from the **Set Measure** menu. Touch the **edit** button and enter the desired number in percentage. Once the trigger level is set, touch the **OK** button to save the changes or the **cancel** button to ignore the changes. The MAESTRO will not detect pulses with a value under the trigger level. Be careful to select a scale that is close to the measured value, if the trigger level is high. To reset the default value to 2.0%, simply touch the **Default** button.

Fig. 2-17 Trigger Level window

Caution! If you select a high value trigger level, the MAESTRO may not be able to detect all the values of widely varying energy levels in **auto range mode**. The auto range 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 auto range may become caught on a high scale value. To avoid this problem, select a lower value for the trigger level, change the scale manually, or reset the auto range mode by reselecting **auto** in the **Range** menu (section 2.4.2.2).

Erratic triggering?

In electrically noisy environments, it is possible that the MAESTRO will inadvertently trigger on the noise. If this is the 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.

You can also set the MAESTRO to be triggered externally, via the RS-232 port using a special cable (part number 201956). Just touch the **External Trigger** check box.

2.4.3 Display

The various displays offered by the MAESTRO allow you to quickly view measurements in several different ways. You will appreciate the easy-to-view high resolution, color graphic in dual or full-screen mode on the 112.9 x 84.7 mm LCD display. You can choose five different display modes:

- Real Time
- Scope
- Needle
- Averaging
- Histogram (Not available on this version, check our website for new versions).
- Statistics

This allows you to select the best way to display measurements according to your specific needs. You can switch from one option to another without interfering with the measurements.

Fig. 2-18 Display menu window

The MAESTRO allows you to have a single full-screen display or a dual-screen display. To select the desired display touch the appropriate button. If you choose dual display, one of the displays must be **Real Time**. Select **Real Time**, then select any other display mode by touching it. To return to single display mode, simply touch the unwanted display mode to cancel it. Once the selection is made, touch the **OK** button 

or the **cancel** button  to ignore the changes.

The MAESTRO's default mode is dual **Real Time** and **Scope** display (Figure 2-1).

2.4.3.1 Display Parameters menu bar

The full-screen display fills the entire window, hiding the navigation menu bar. The **Display Parameters menu** bar is at the bottom of the window to allow you to quickly view and access different settings. To retrieve the navigation menu bar, switch to the dual screen display mode by touching the **Minimize**  button. In the dual-screen display mode, the **Display Parameters menu** bar is located under the **Real Time** display (see figure 2-1).

Fig. 2-19 The Display Parameters menu bar

The current display settings are easily changed by touching the desired parameter in this menu. Touch anywhere on the screen to deselect the setting.

Table 2-3 List of Display Parameters menu bar options

Option	***Icon***	***Description***
Wavelength (λ)		Sets and displays the source's wavelength. If the desired wavelength is not on display, touch **More…,** which will take you to the **Wavelength** menu window (refer to section 2.4.2.1). 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.
Range		Sets and displays the detector's range. Touch **Auto** to be in auto range mode, **+** to increase the range, and **–** to decrease the range. Touch **More…** to go to the **Range** menu window (refer to section 2.4.2.2).
Mode		Sets and displays the **Measure Mode** depending on the connected detector head. Quickly access all the detector head's available measure modes using this button. For more information, refer to section 2.4.2.3.
Zero		Resets the zero reading level. It does this by subtracting the power reading on the display as soon as the **On** button is touched. 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. Thermal noise is caused by a detector that has not been thermally stabilized OR there was a heat source in the field of view of the detector when the MAESTRO 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 your detector's offset to zero see step 8 in Section 2.2 Quick power and energy measurement procedure. **In Energy mode the zero clears the current value.**

Display		Sets and displays the monitor's display mode. You can choose between the following displays: • **Real Time** • **Scope** • **Needle** • **Averaging** • **Histogram** (Not available on this version) • **Statistics** In the dual-screen mode, it corresponds to the bottom display. For more information, refer to section 2.4.3.
DATA Acquisition		Lets you start, stop, and configure the data acquisition on a connected USB key at any time. Touch **Start** to start the acquisition on the USB key and touch **Stop** to stop before the end of the total duration of the acquisition. Touch **Configure** to access the **Acquisition** menu window (refer to section 2.4.4), which will allow you to set the acquisition parameters.

2.4.3.2 Real time display

The **Power** or **Energy** digital display is presented in giant format for easy reading in all conditions. Directly below it, as wide as the screen, is the **Bar graph** display, which presents the measurement in analog format; very useful for rapidly varying values.

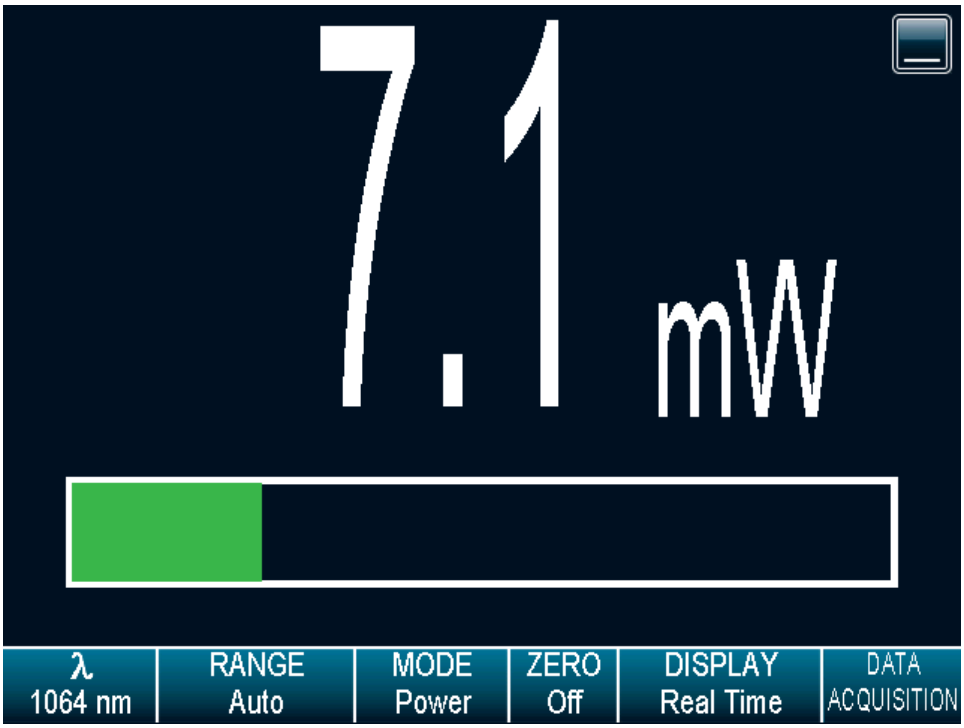

Fig. 2-20 Real time display

With a MAESTRO, you can also choose between the high resolution mode for the most significant digits available or the standard resolution, to filter out unimportant fluctuations in measurement. You can adjust the number of digits in the **Set Device** menu window accessible through the **HOME** menu (section2.4.1.2).

2.4.3.3 Scope display

The **Scope** display gives a quick look at the laser beam's long-term stability and trend as a function of time. The current data is also displayed at the top of the graphic display.

To refresh the scope touch the **refresh** button  . The graphic will be erased before new data is displayed. This is useful when an out of range value has been measured.

Touch the **Settings** button  to access the Scope settings. This will allow you to change the X-Axis scale, the Y-Axis scale (not available), and to display the statistics. Just touch the **edit**  button to change the X-Axis and Y-Axis scale (not available). For the X-Axis value, enter the desired display time period. In case you enter an incorrect value, an error popup menu will prompt you to change it to a valid

value. To view the maximum, minimum, and average values of the measured data (in wattmeter mode only), touch the **Display Stats** check box.

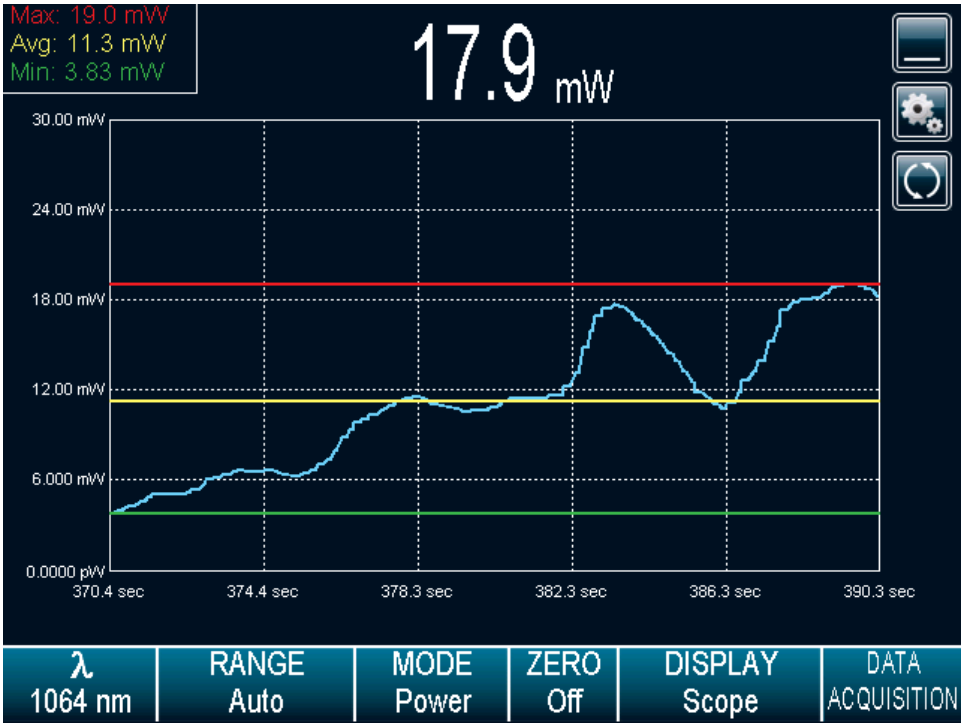

Fig. 2-21 Scope time display

Display Stats. When using the single full-screen mode, this will display the maximum, minimum, and average values of the measured data values in the upper left corner.(available only in wattmeter mode on this version, check our web site for new versions). The graphic yellow line will correspond to the maximum value, the green line to the average value, and the red line to the minimum value. When the scope parameters are set, touch the **OK** button  to save the changes or touch the **cancel** button  to ignore the changes.

2.4.3.4 Needle display

When you select the **Needle**, a graphical interface shows a real-time digital needle. The deflection of the digital needle is proportional to the real-time measurement. The 0 is on the left-hand side of the needle, whereas the range's maximum value is on the right-hand side of the needle.. The numerical value of the real-time measurement is also displayed above the digital needle. The 15 Hz refresh rate makes it an excellent tool for laser tuning and alignment.

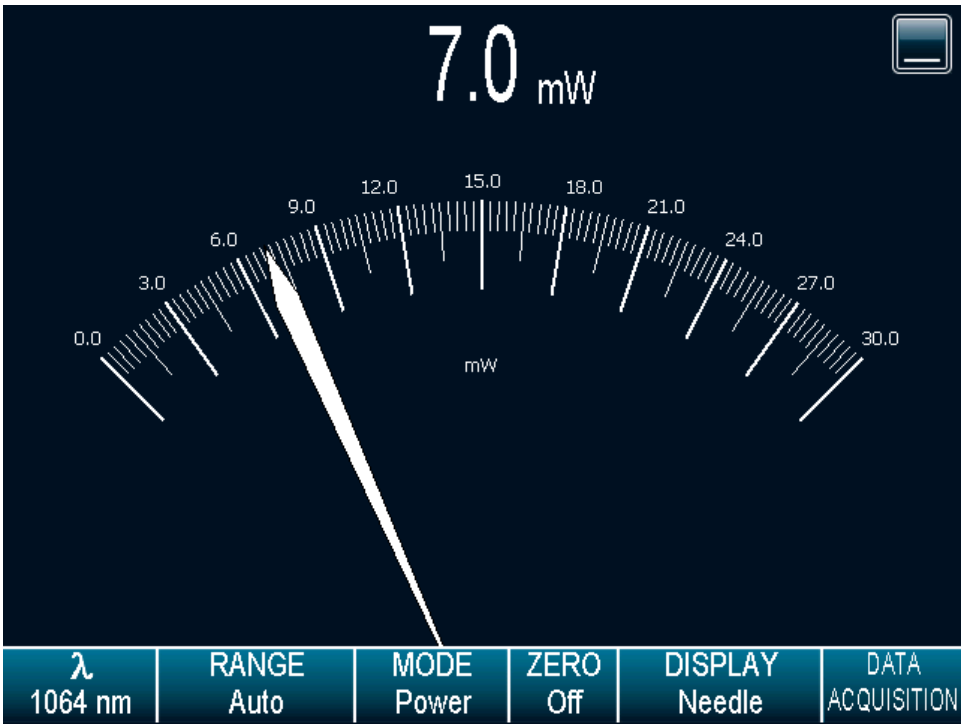

Fig. 2-22 Digital needle display

2.4.3.5 Averaging display

The averaging display is a bar graph that presents the statistics of a set of measures as a function of time. The MAESTRO measures a series of data during a user-defined period of time. Each bar represents the maximum, average, and minimum values of the measured data. The top of the white bar represents the minimum value while the top of the blue bar represents the maximum value. The yellow line represents the average value for each set of bars. This allows you to quickly evaluate the trends of the average, maximum, and minimum values in time. You can change the sampling period by touching the **Settings** button. Just touch the **edit** button to change the period, in seconds. If you enter an incorrect value, an error popup window will prompt you to change it to a valid value between 1 and 120 seconds. When the averaging period is set, touch the **OK** button to save the changes or touch the **cancel** button to ignore the changes. 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.

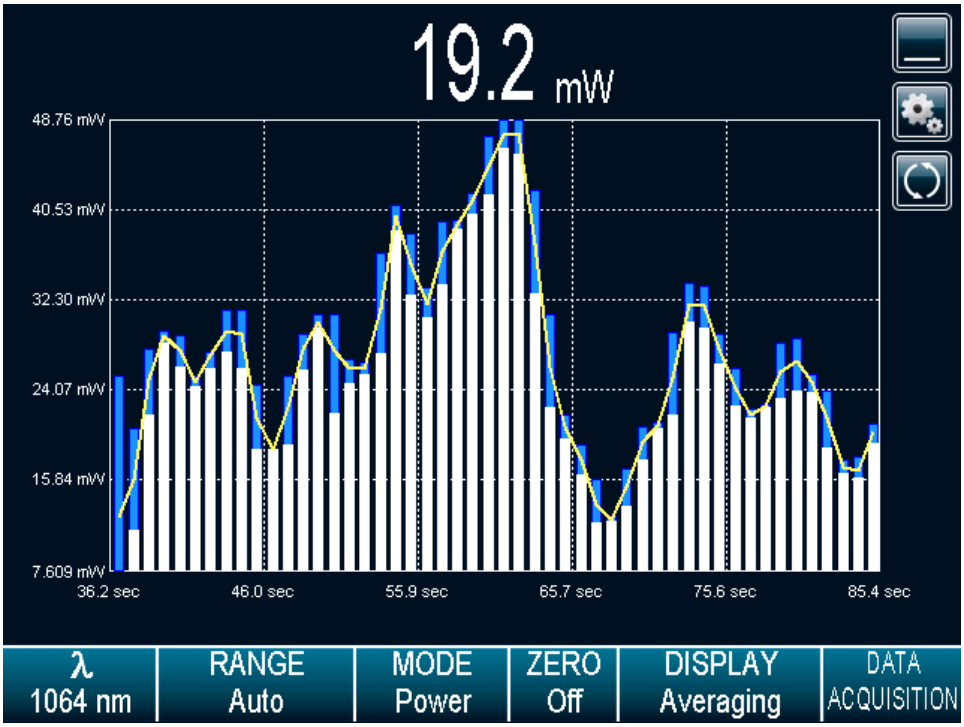

Fig. 2-23 Averaging display

For Power Detectors:

In the **Averaging** display mode, the power measurement is the average value defined in the averaging settings. 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 an average period of 1, 2, 3 etc… seconds. If it is at 1.5 Hz, use 3, 6, 9 etc… seconds, as the sample period. Take note that if one data point is out of the current scale, the resulting period average will be OUT. You should set the scale higher than your maximum unfiltered measurement to avoid this situation.

For Energy Detectors and Power Detectors in Energy Mode:

In the **Averaging** display mode, the Energy measurement is the average value defined in the averaging settings.

To refresh the graphic, touch the **refresh** button  . The bars will be erased before new data is displayed. This is useful when an out of range value has been measured.

2.4.3.6 Statistics display

In the **Statistics** mode, the MAESTRO displays a complete statistical analysis of power or energy measurements. Touch the **PLAY** button to start or restart the data sampling and statistical calculations. Touch the **Stop** button to stop the data sampling and statistics before you reach the end of the selected sampling time. The last statistical values calculated remain on screen so you can view them later, even if you switch display modes and return to the **Statistics** display. The data sampling and statistical calculations continue with this window closed or opened, and no matter what display you select.

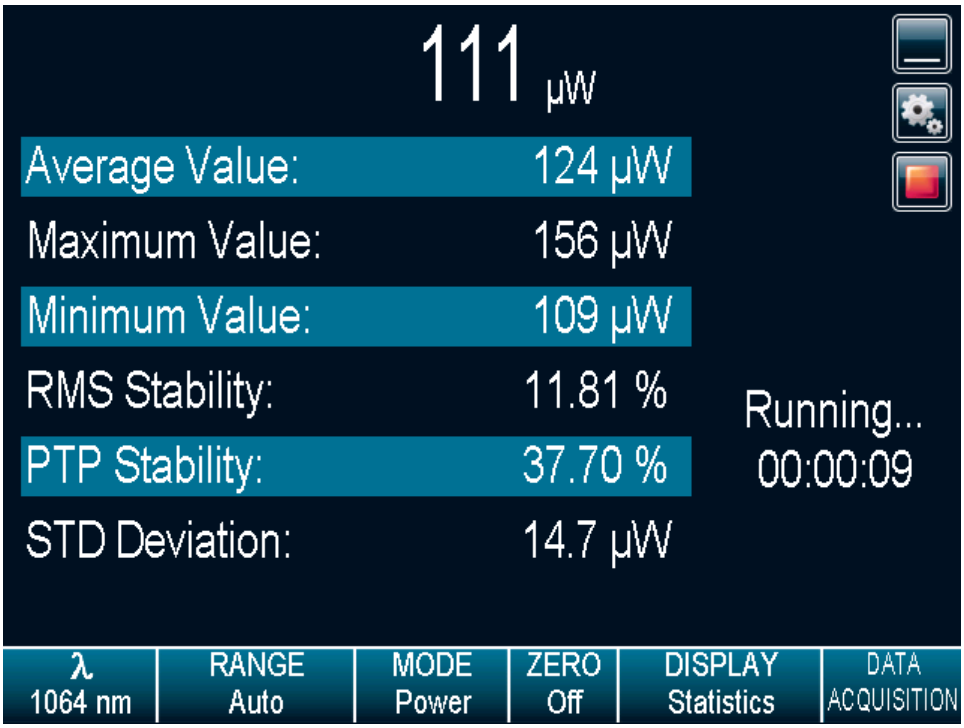

Fig. 2-24 Statistics display

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.

The MAESTRO uses default sample parameters unless you set them yourself. Touch the **Settings** button to access the **Statistics Settings** to set up the data sampling parameters for calculating the statistics. Use the defaults or select your own duration sample period to do the statistics.

You can also decide to save only the statistics instead of the entire acquisition or the entire acquisition followed by the statistics at the end of the file. To do so, check the **Save to File** option and configure the output filename (refer to section 2.4.4 Acquisition). If you want to save only the statistics, press the **Start** button in the **Statistics** mode. If you also want to save the entire acquisition and the statistics, touch the **DATA ACQUISITION** button on the **Display Parameters** menu bar and then touch **Start** (refer to section 2.4.4). In this case, note that the sample rate will only affect the acquisition as the sample rate for the

statistics is fixed[8]. Furthermore, if the acquisition is stopped before the end of the acquisition duration, the statistics will not be saved to the output file.

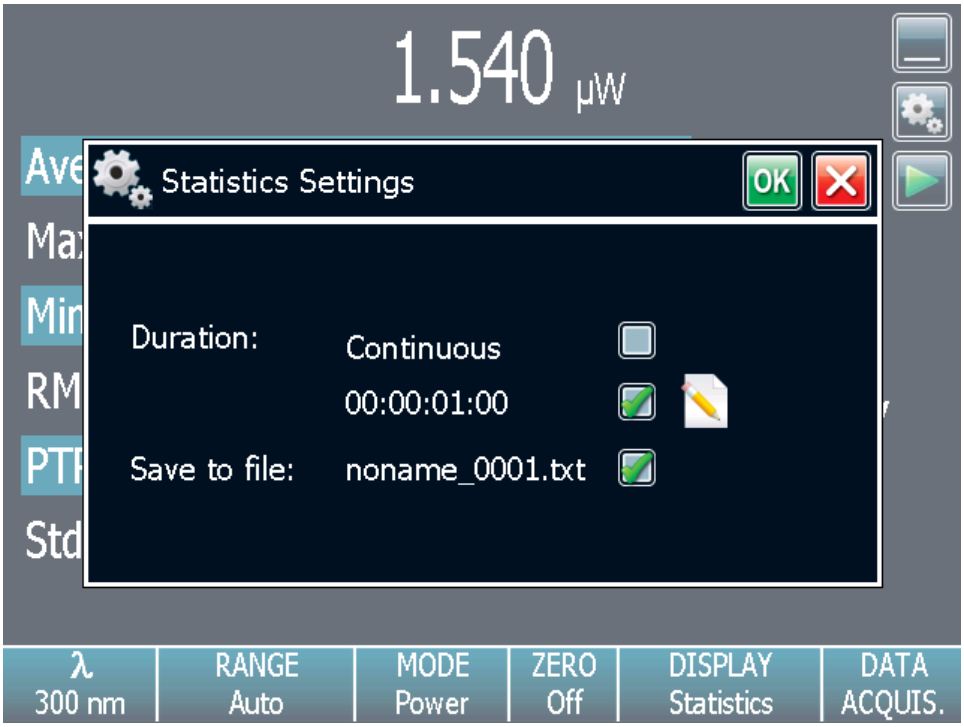

Fig. 2-25 Statistics settings popup window

You can set the MAESTRO either to calculate the statistics for a single sample and stop, or to repeat continuously. Take data for a few seconds or a few days. 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.

You can choose to compute the statistical analysis continuously, which is the default option, or to compute it only during a specific time interval. Touch the **edit** button for the duration in the statistics settings popup window to display the **statistics duration settings** popup window. To change the total duration of the acquisition, touch the **edit** button under each time value. Touch the **OK** button to save the changes or touch the **cancel** button to ignore the changes. The format of the duration is dd:hh:mm:ss, which correspond to days, followed by hours, minutes and seconds. When the total duration is set, touch the **OK** button to save the changes or touch the cancel button to ignore the changes.

The MAESTRO automatically clears and recalculates the statistics at the end of each sample period unless you manually stop it.

[8] The sample rate for the statistics is fixed at 12.302 Hz for power detectors and 1 pulse per pulse for energy detectors.

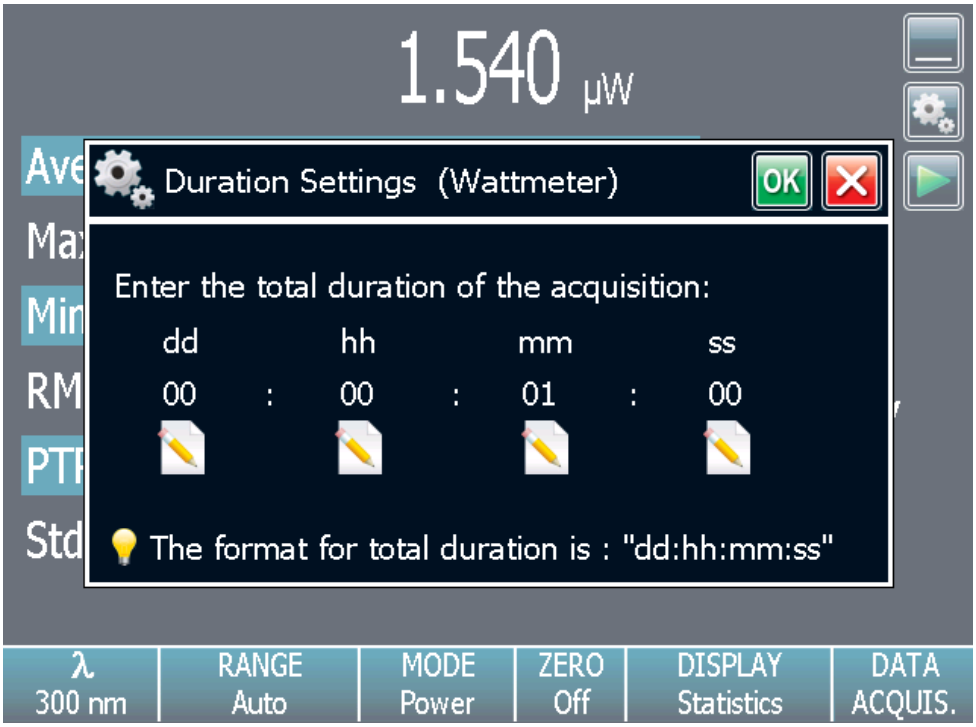

Fig. 2-26 Statistics duration settings popup window

The statistical parameters that are calculated are listed in Table 2.4.

Table 2.4. Statistical Parameters

Statistical Parameters	Power	Energy	Definition
Current value	✓	✓	Value of the most recent measurement
Average value	✓	✓	Average from the start of values in the sample, E_{avg} or P_{avg}
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}
RMS stability	✓	✓	Root mean square stability represents the standard deviation as a percentage 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. $PTP=\frac{E_{max}-E_{min}}{E_{avg}}\times 100$, $PTP=\frac{P_{max}-P_{min}}{P_{avg}}\times 100$

STD Deviation (only available for the single full-screen mode)	✓	✓	A measure of the spread of the data around the average. $STD=\sqrt{\frac{\sum_{i=1}^{n}(E_i-E_{avg})^2}{n-1}}$, $STD=\sqrt{\frac{\sum_{i=1}^{n}(P_i-P_{avg})^2}{n-1}}$
Repetition Rate (only available for the single full-screen mode)		✓	Frequency of pulses coming from the laser, *PRR*
Average Power (only available for the single full-screen mode)		✓	Power calculated from the pulse energies and repetition rate. $P_{avg}=E_{avg}\times PRR$

2.4.4 Acquisition

The MAESTRO allows you to easily acquire data and save it on a USB key for post analysis and processing. If you did not connect a USB key to the MAESTRO, the monitor will prompt an error message and the acquisition option will not be available.

You have complete control over the data sampling. 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 the pulses
Total Duration	Controls how long the MAESTRO will acquire data and/or do statistics.	Eg. 1 period, 5 hours or 1000 pulses

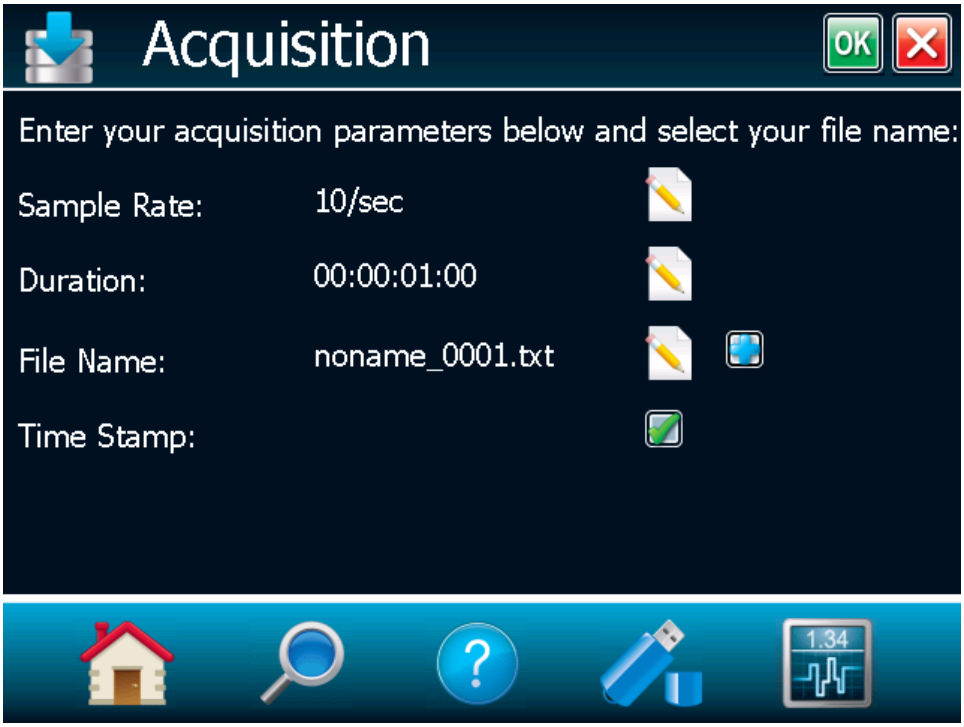

Fig. 2-27 Data sampling parameters window menu.

The different available options are presented in Table 2.5. To edit one of the data sampling parameters, touch the **edit** button. Touch the **OK** button to save the changes or touch the **cancel** button to ignore the changes.

Table 2.5 Data Acquisition Parameters

PARAMETER	**Choices**	**Description**	**Default**
Sample Rate **Power only**	Integers pts/Second pts/Minute pts/Hour pts/Day	Current setting is 10 samples per seconds. Sets the time between each sample. Specify the number of points per unit of time. [for example, for 1 second between samples, set to 60 points per minute]. Next, you must set the time period for the number of points entered. Maximum is 10 points/second, Minimum is 1 point/day. Time between samples = 1/(sample rate).	10 per sec
Sample Rate **Energy only**	Integers 1/x pulses	Sets the fraction (1/x pulses) of the incoming pulses sampled for the statistics calculations and data recording.	1/1 pulses of the incoming pulses
Duration	Time format	The time period for which samples are reported (to the display and output). The format of the	1 minute

Power only	dd:hh:mm:ss 00:00:00:00	duration is dd: hh:mm:ss, which correspond to days, followed by hours, minutes and seconds. The MAESTRO automatically clears and recalculates the statistics at the end of each sample period unless you manually stop it.	
Duration **Energy only**	Integers Number of pulses	Number of pulses for which samples are reported (to the display and output). The MAESTRO automatically clears and recalculates the statistics at the end of each sample period unless you manually stop it.	10000 pulses
File name	Alphanumeric characters Output file name	Use the displayed keyboard to enter the new output file name with an extension (.csv, .txt or .dat). Note that you must enter a file name to be able to start an acquisition. Use the **Add** button  to increment the file name. If no name was entered, the Add button automatically adds a file name.	noname_0001.txt
Time Stamp	Yes No	To have a **time stamp** appear with the data, touch the associated check box. Selecting the check box writes a time stamp with each data point. This is a relative time stamp that always begins with zero. Note that, with the time stamp, the maximum sampling rate without missing points is 1.3 kHz instead of 2 kHz without time stamp.	No

To start the acquisition you must return to the display window in dual or single mode. Touch the **DATA ACQUISITION** button on the **Display Parameters menu** bar and then touch **Start** (refer to section 2.4.3.1). The MAESTRO begins storing data according to your Data Sampling settings. The **Stop** command stops the data recording before the end of the acquisition total duration. Even if the acquisition is stopped, the MAESTRO will continue to provide measurements to the display. If you want to be able to open the file in Excel use .csv in your file name extension.

2.4.5 Startup Config

The MAESTRO can be configured to store and load certain settings for a specific measurement head in the Startup Config Menu. By default, the MAESTRO will always remember the last saved settings and load them at startup (**Autosave**).

To load factory settings at startup, select **Use factory settings**. Note that selecting this option will not change the current configuration, but will only load the factory settings at the next reboot.

It is also possible to save a specific configuration. To do so, change all the desired settings and return to the Startup Config Menu. Touch the **Apply** button. The **Use current configuration** check box will be selected and the MAESTRO's current configure will be saved. Even if the settings are changed after this operation, these changes will not be saved and at startup the MAESTRO will be configured in the same manner as when the **Apply** button was touched.

Fig. 2-28 Startup Config menu window

These are the saved parameters:

- Range;
- Anticipation (on or off);
- Attenuation (on or off);
- Wavelength;
- Multiplier and Offset;
- Trigger level;
- Acquisition sample rate;
- Acquisition and statistics duration
- Acquisition time stamp (on or off);
- Save statistics to file (on or off).
- Measure Mode (Power, Single Shot Energy, dBm, Energy)
- Display (Scope, Needle, Statistics)

If another head is connected, it will not be able to retrieve these saved parameters since they are head specific: *these parameters can be loaded only if the same type of head is connected to the MAESTRO.*

The following settings are always saved automatically on the MAESTRO, regardless of the head that is connected:

- Serial Commands settings
- Ethernet Configuration
- Language

2.4.6 About

The **About** button in the **Home** menu displays any help and service information available for this version of the MAESTRO firmware. You can find all the information about the monitor and the connected detector head such as:

- The monitor's model name (MAESTRO);
- The monitor's firmware version;
- The monitor's last update;
- The connected detector head's model name;
- The connected detector head's serial number.

Fig. 2-29 About window.

You can also find all the information concerning Gentec-EO for service support. If you should need help or additional information on the MAESTRO or any Gentec-EO products, do not hesitate to contact us. We will be glad to help you.

2.5 SEARCH

The **SEARCH** option allows you to quickly look up and find the most common of the MAESTRO's functions. The functions are displayed in alphabetical order. Just touch one of the displayed functions to directly access the corresponding menu window. To exit the SEARCH window, just touch the cancel button .

Fig. 2-30 Search window.

2.6 INFO

The **Information** menu window displays the information about the detector head connected to the MAESTRO and the current measurement settings. In a quick glance you will be able to see the following information:

- Information about the connector detector head:
    - The detector's **Name;**
    - The detector's **Serial Number;**
    - The detector's minimum and maximum **Range.**
- Information about the measurement settings (refer to section 2.4.2):
    - **Correction** factors (multiplier and offset);
    - **Wavelength**;
    - **Measure mode**;
    - **Trigger Level**.

Fig. 2-31 Information menu window

2.7 MANAGE USB

The **MANAGE USB** is a file manager, which lets you work with the file system on the connected USB key. You can easily view the folders and files already on the USB key in an intuitive hierarchy. You can also, rename a file and delete a file. This allows you to have full control over the USB key for easy acquisition.

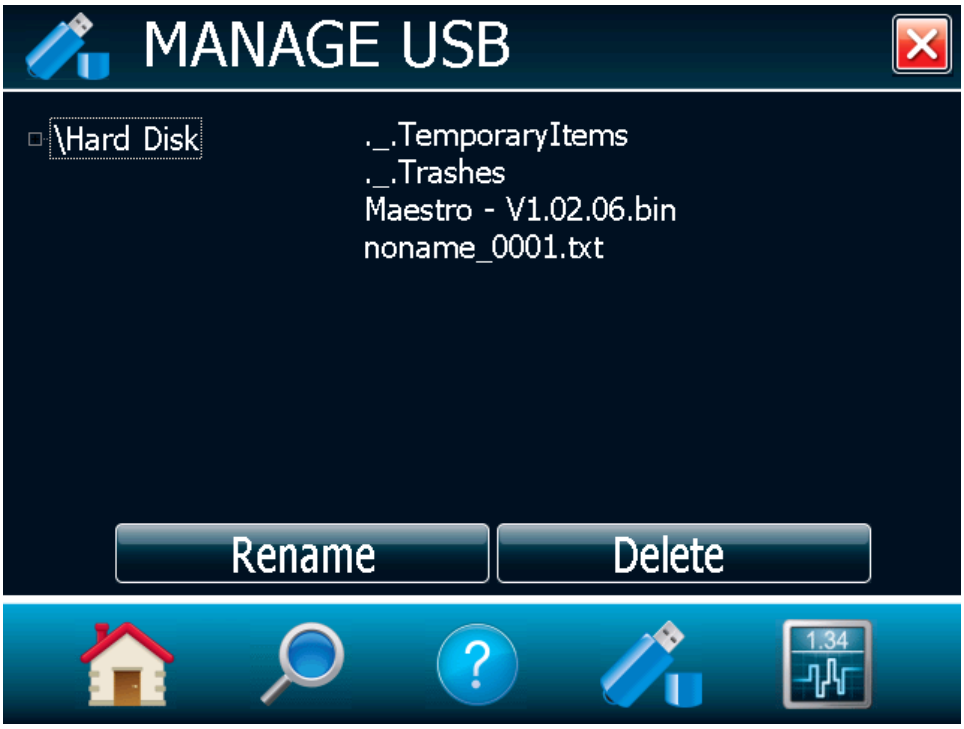

Fig. 2-32 Manage USB menu window

You can scroll up and down the list by sliding your finger on the right hand side of the screen. You can also collapse the USB key's tree structure by touching the small square next to "\Hard Disk". By doing so, you will have access to different folders on your USB key.

2.8 BACK TO MEASURE BUTTON

The "Back to Measure" button allows the user to easily return to the current measurement window. It will return to the user's last selected display option. For instance, if the user was in Needle display, touching the "Back to Measure" button will return to the Needle display.

3 SERIAL COMMUNICATION INTERFACE

3.1 USB Serial Communication

3.1.1 Installation

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

3.1.1.1 Installation for Windows™:

Plug the MAESTRO into a USB port on the PC. If the PC supports USB 1.1, Windows will detect the new device and prompt you for the software drivers. A **Found New Hardware – USB Device** window will open 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 XP, Vista or 7: Cancel the wizard and execute the Auto installer "USB driver installer-r2" in the USB Driver folder from the CD-ROM.

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 MAESTRO.

3.1.2 Setting up Communication to the MAESTRO

3.1.2.1 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.

3.1.2.2 Connect to the MAESTRO

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 3.1.2.1). Select **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.

3.1.2.3 To echo commands

The commands you type will not appear in the HyperTerminal window, unless you setup the HyperTerminal to do so. Only the response from the MAESTRO 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**

3.1.2.4 Test the connection

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

3.1.2.5 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, 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.

3.2 Ethernet Communication

The MAESTRO Ethernet communication is based on Transmission Control Protocol (TCP). Through a well configured channel, the user will be able to send commands and receive a response from the device.

Gentec-EO provides an application to help users communicate with the MAESTRO via Ethernet communication. You can download the **MAESTRO Ethernet Communication Example** application in the Gentec-EO software download section or in the Gentec-EO Labview driver download section.

You must enter the right configuration:

1. Plug the MAESTRO to a network cable;
2. Boot the MAESTRO;
3. Open the MAESTRO **Ethernet Configuration** menu (HOME | SET DEVICE | ETHERNET)
4. Check **"Enable Ethernet Capability**";
5. Choose your IP address type (**Static** or **Dynamic**);
6. If the address type is static, enter a valid and available IP address. Always make sure the IP address is available to avoid any conflicts in your network. Always ask your IT specialist for an available IP address or use the *ping* command followed by the desired IP address in the Windows' cmd application to make sure the address is available;
7. Change the communication port if necessary;
8. Touch the **OK** button 

9. Reboot the device;
10. Open the **MAESTRO Ethernet Communication Example application** on your PC;
11. Enter the MAESTRO's IP address and port number. If the address type is dynamic, return to the **Ethernet Configuration** page to retrieve the assigned address;
12. Click on the Connect button in the **MAESTRO Ethernet Communication Example application**;
13. A popup will ask if you want to start a continuous reading. If you choose yes, the command *CAU will be automatically sent to the MAESTRO and the you will start to receive data from the device;
14. You can send other commands to the MAESTRO using the **Command** edit box and the **Send** button. Note that only native MAESTRO serial commands are valid with Ethernet communication. Please make sure the **SOLO2 Serial Compatibility** check box is disabled in the **Serial Commands** menu.

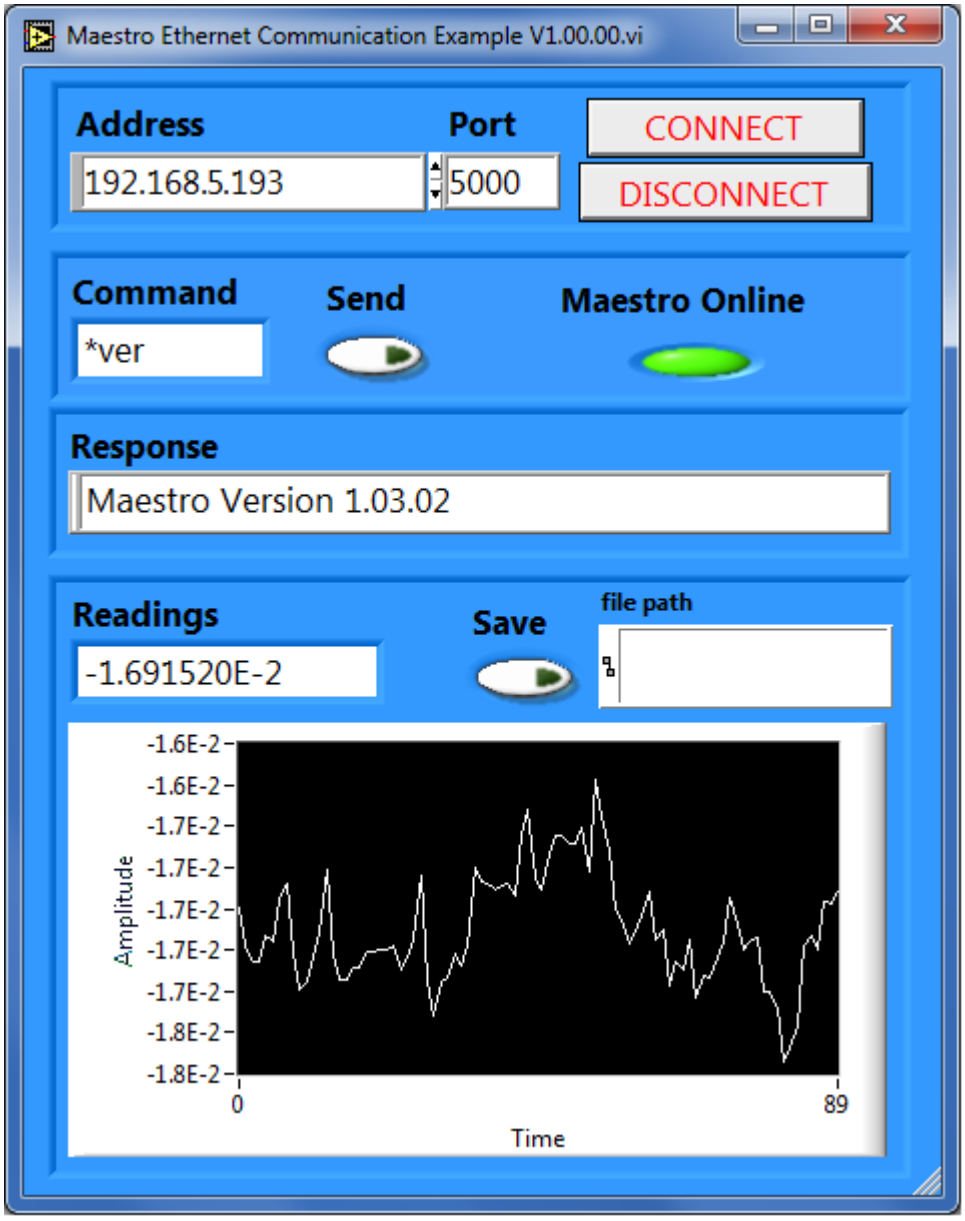

Fig. 3-1 MAESTRO Ethernet Communication Example application

3.3 PC-MAESTRO user-friendly serial data acquisition software

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

You can download the PC-MAESTRO program. 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 decompress and install it.

The user manual is integrated in the PC-MAESTRO's interface. The **Context Help** window displays basic information about the PC-MAESTRO's functionalities when you move the cursor over each object and button. You can display the **Context Help** window by selecting **Help/Show Context Help** in the menu bar or by pressing the <Ctrl-H> keys.

If you try to install the same PC-MAESTRO version twice on your computer, you will have the following warning:

Installation Summary:
No software will be installed or removed.

In such a case, please press enter and continue using the installed version of PC-MAESTRO.

When disconnecting a head on the MAESTRO while using PC-MAESTRO, the PC-MAESTRO might not see the disconnection and might continue to try to read data. In such a case, please close and restart the application.

3.4 Traditional Communication Settings

The traditional serial communication interface also allows you to operate the MAESTRO from a remote location. We recommend using the specific serial data acquisition software PCMAESTRO, 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 MAESTRO. They are divided into two groups:

- The **control commands** allow you to change the MAESTRO's settings without using the MAESTRO's touch screen. 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 MAESTRO. They do not change the MAESTRO's settings, they return the requested information.

3.4.1 Serial Command format

3.4.1.1 Serial Protocol Rules:

Commands are sent as text strings. The response will either be data or an empty string.

3.4.1.2 Text mode rules:

All text commands must begin with a trig character (*). You do not need to end with a line-feed, a carriage-return, or both. Parameters must NOT be separated by any spaces. Characters do not have to be capitals, mixed upper and lower case is ok. Replies to all text mode commands are also in text mode, and end with a carriage-return and line-feed.

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 carriage return <**CR>** or line-feed <**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.

3.4.2 MAESTRO Binary Mode Description

3.4.2.1 Description

The MAESTRO has two Communication Modes: the Binary Mode for FAST data acquisition and the ASCII mode. The resolution is 14 bits for both cases.

Only the joulemeters support the binary mode. Thermopiles in energy mode, thermal heads in standard mode and photodiodes are coded in ASCII. To select the binary mode select Home/Set Device/Serial Commands/ Serial Binary Measurement. If you wish the MAESTRO to remember this setting, touch the **Set as Default** button.

The value in binary mode is coded in two bytes.

Binary Joulemeter MODE

Byte #1

O	Y	X	X	X	X	X	X

Byte #2

O	X	X	X	X	X	X	X

B = The sign.

Y = The MSB for the Wattmeter Mode.

X = Bits of the Codification.

FOR ALL MODES

O = Order

0 = First byte (MSB)

1 = Second Byte

3.4.2.2 Codification

Measurement in Joule = Current Scale *Value in Decimal/16382

Example 1:

For 151 mJ on the 300 mJ scale on Channel 1
The MAESTRO will send you: 40B6 HEX VALUE, where:
10 = 0 1000000
The first second bit (0) is the order of the MSB
1000000 is the MSB of the codification
9B =10110110
The first bit (1) is for the order so this is the LSB of the codification
The Total Codification is 10000000110110, which is 8246 in decimal (8246/16382 * 300mW = 151.007 mW)
The codification 11111111111111 = No connector
The codification 11111111111110 = OUT detected

3.4.3 Serial Command Directory

Command name	Command	Description
DISPLAY COMMANDS		
Set Range	SCS	Manually set range.
Set Range Up	SSU	Change scale to the next higher range.
Set Range Down	SSD	Change scale to the next lower range.
Get Current Range Index	GCR	Returns scale index between 0 to 41
Get Autoscale	GAS	Returns autoscale status
Display Valid Scale	DVS	Displays the valid ranges for the connected detector head.
Set trigger level	STL	Set the internal trigger level when measuring pulse energy.
Get Trigger Level	GTL	Returns trigger level value
Get Mode Display	GMD	Returns the current display mode on MAESTRO
MEASUREMENT COMMANDS		
MEASUREMENT DATA ACQUISITION		
Query Current Value	CVU	Get the value currently displayed on the screen.
Download points	CAU	Send the values in ASCII to the serial port with the data sampling setting.
Stop the CAU Command	CSU	Stop the CAU Command.
Query New Value Ready	NVU	Determine if new reading is available.
Set the autoscale	SAS	Set the autoscale.
Get the laser rep rate frequency	GRR	Send the value in ASCII to the serial port.
Set the joulemeter binary mode	SS1	Set the joulemeter binary mode or ASCII mode
Get Binary Joulemeter Mode	GBM	Returns binary joulemeter mode or ASCII mode
Set Analog Output	ANO	Enables or disables analog output
MEASUREMENT SETUP		
Set Personal Wavelength Correction	PWC	Specify the wavelength.
Get Wavelength	GWL	Returns wavelength in nm
MEASUREMENT CONTROL		
Set Anticipation	ANT	Turn anticipation on or off.
Get Anticipation status	GAN	Returns the anticipation status
Set Zero Offset	SOU	Zero the reading.
Clear Zero Offset	COU	Undo the zeroing of the reading.
Get Zero Offset	GZO	Returns zero offset status
Set diode Zero Offset	SDZ	Zero the reading for all scale's for the photodiode.
Set User Multiplier	MUL	Set the value of the multiplier's correction value.
Get User Multiplier	GUM	Returns the current multiplier's correction value
Set User Offset	OFF	Set the value of the Offset correction value.
Get User Offset	GUO	Returns the current offset correction value
SET Single shot Energy mode	SSE	Set the Energy mode for the calorimeter mode.
Set attenuator	ATT	Set the attenuator.
Get Attenuator	GAT	Returns the attenuator status
INSTRUMENT AND DETECTOR INFORMATION COMMANDS		
Query version	VER	Get firmware version of the monitor.
Query Status	STS	Retrieve detector information and monitor settings.
Query Extended Status	ST2	Returns extended status

The serial commands format is as such:

*MUL+ 8 character numeral value Ex: « ***MUL1.000000 » or « *MUL-1.34e-3 » or «*MUL0.000543 »**

*OFF + 8 character numeral value like above

*STL+4 character numeral value like « *STL10.2 » or « *STL0.22 »

*SSE1 **/ ***SSE0 : Single Shoot Energy ON or OFF

*ATT1 / *ATT0: Attenuator ON / OFF (When available)

3.4.3.1 Serial commands

SERIAL COMMAND FORMAT

All text commands must begin with a trig character (*) and DO NOT end with a line-feed or a carriage-return. All parameters must NOT have a space between the command and the list of parameters, nor between the parameters themselves. 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 do not end with a carriage-return and line-feed.

DISPLAY COMMANDS

Set Range

This command is used to force the display of the current data into a specific range. The lower range is always zero, the higher ranges can be found in the table below. The Auto range mode applies the best range for the current values in real time. The parameter must be one of the identifiers in the table below and have 2 digits.

Command	Parameters	Return
SCS	Range index	

Range Identifiers:

Range index	Range
00	1 picowatt or picojoule
01	3 picowatts or picojoules
02	10 picowatts or picojoules
03	30 picowatts or picojoules
04	100 picowatts or picojoules
05	300 picowatts or picojoules
06	1 nanowatt or nanojoule
07	3 nanowatts or nanojoules
08	10 nanowatts or nanojoules
09	30 nanowatts or nanojoules
10	100 nanowatts or nanojoules
11	300 nanowatts or nanojoules
12	1 microwatt or microjoule
13	3 microwatts or microjoules
14	10 microwatts or microjoules

15	30 microwatts or microjoules
16	100 microwatts or microjoules
17	300 microwatts or microjoules
18	1 milliwatt or millijoule
19	3 milliwatts or millijoules
20	10 milliwatts or millijoules
21	30 milliwatts or millijoules
22	100 milliwatts or millijoules
23	300 milliwatts or millijoules
24	1 Watt or Joule
25	3 watts or joules
26	10 watts or joules
27	30 watts or joules
28	100 watts or joules
29	300 watts or joules
30	1 kilowatt or kilojoule
31	3 kilowatts or kilojoules
32	10 kilowatts or kilojoules
33	30 kilowatts or kilojoules
34	100 kilowatts or kilojoules
35	300 kilowatts or kilojoules
36	1 megawatt or megajoule
37	3 megawatts or megajoules
38	10 megawatts or megajoules
39	30 megawatts or megajoules
40	100 megawatts or megajoules
41	300 megawatts or megajoules

Default: Auto range.

The following example sets the range to 3 nanowatts or nanojoules.

Example	Response from MAESTRO
Command: *SCS08	

Get Current Range Index

This command returns the range index between 0 and 41. Please refer to Set Range command (SCS) details for the complete range index table.

Text Command	Parameters	Return
GCR	None	Index from 0 to 41

Example		Response from MAESTRO
Command:	*GCR	Range : 10 \r\n

Set Range Up

This command is used to force the display of the current data into a higher range

Command	Parameters	Return
SSU	None	

Set Range Down

This command is used to force the display of the current data into a lower range.

Command	Parameters	Return
SSD	None	

Set Autoscale

This command is used to force the display into autoscale.

Command	Parameters	Return
SAS	0 = off 1 = on	

Get Autoscale

This command returns whether or not the autoscale option is activated.

Text Command	Parameters	Return
GAS	None	1: On 0: Off

Example		Response from MAESTRO
Command:	*GAS	AutoScale : 1 \r\n

Display Valid Range

This command is used to display all of the valid ranges the connected head supports. The ranges are displayed in scale index. Please refer to the Set Range section for the table correspondence.

Command	Parameters	Return
DVS	None	The valid scale index.

The following example is for a UP19K connected to the MAESTRO, which can have the following ranges:

- 100 mW;
- 300 mW;
- 1 W;
- 3 W;
- 10 W;
- 30 W.

Example		Response from MAESTRO
Command:	*DVS	[22] : 100.0 m <CR> <LF>
		[23] : 300 m <CR> <LF>
		[24] : 1.000 <CR> <LF>
		[25] : 3.00 <CR> <LF>
		[26] : 10.00 <CR> <LF>
		[27] : 30.0 <CR> <LF>

Set Trigger Level

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

Text Command	Parameters	Return
STL	Trigger Level (in percentage) must be 4 numeral values	

Default: 2%

The value should be set between 0.1 and 99.9.

Example		Response from MAESTRO
Text Command:	*STL15.4 (15.4%)	
	*STL0.20 (.2%)	

Get Trigger Level

This command returns the trigger level in %. The value is between 0.1% and 99.9%.

Text Command	Parameters	Return
GTL	None	Returns the trigger level in %.

Example		Response from MAESTRO
Command:	*GTL	Trigger Level : 2.0 \r\n

Get Mode Display

This command returns the MAESTRO's power mode. Depeding on the head, it can be power mode in W, power mode in dBm (DBM), energy mode in J, Single Shot Energy mode in J (SSE), or simply no detector is connected to the MAESTRO.

Text Command	Parameters	Return
GMD	None	POWER = 0 ENERGY = 1 SSE = 2 DBM = 6 NO_DETECTOR = 7

Example		Response from MAESTRO
Command:	*GMD	Mode : 0 \r\n

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	Parameters	Return
CVU	None	Current value

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

Example		Response from MAESTRO
Command:	*CVU	0.012 <CR> <LF>

Continuous transmission of 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	Parameters	Return
CAU	None	Data in ASCII

Stop the CAU Command

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

Text Command	Parameters	Return
CSU	None	

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	Parameters	Return
NVU		Available/ Not Available <CR> <LF> 1/0

Example		Response from MAESTRO
Text Command:	*NVU <enter>	New Data Not Available <CR> <LF>

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.

Get the Laser frequency

This command is used to get the laser frequency.

Text Command	Parameters	Return
GRR	None	**Data in ASCII**

Set the joulemeter binary mode

This command is used to set the monitor in binary or ASCII mode. Refer to section 3.4.2 for the MAESTRO binary mode description.

Command	Parameters	Return
SS1	0= ASCII 1= Binary	

Get Binary Joulemeter Mode

This command returns whether or not the binary joulemeter mode is activated for serial communication. Refer to section 3.4.2 for the MAESTRO binary mode description.

Text Command	Parameters	Return
GBM	None	1: On 0: Off

Example		Response from MAESTRO
Command:	*GBM	Binary Joulemeter Mode : 0 \r\n

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	Parameters	Return
ANO	**1** to Enable, **0** to Disable	

MEASUREMENT COMMANDS -- SETUP

Set Personal Wavelength Correction

This command is used to specify the wavelength in nm 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. The input parameter must have 5 digits. If the desired wavelength does not have 5 digits you must enter a zero-padded number. For example 514nm, you must enter 00514.

Text Command	Parameters	Return
PWC	Wavelength	

Default: Calibration wavelength, (typically 1064 nm)

The following example sets the wavelength to 1550 nm.

Example		Response from MAESTRO
Command:	*PWC01550	

Get Personal Wavelength

This command returns the wavelength in nm being used on the detector.

Text Command	Parameters	Return
GWL	None	Returns the wavelength value in nm

Example		Response from MAESTRO
Command:	*GWL	PWC : 1064 \r\n

MEASUREMENT COMMANDS -- CONTROL

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	Parameters	Return
ANT	**1** to turn On, **0** to turn Off	

Default: On

The following example sets the anticipation.

Example		Response from MAESTRO
Command:	*ANT1	

Get Anticipation Status

This command returns the anticipation status. If the anticipation is not available, it will always be at "off".

Text Command	Parameters	Return
GAN	None	1: On 0: Off

Example		Response from MAESTRO
Command:	*GAN	Anticipation : 0 \r\n

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	Parameters	Return
SOU	None	

Clear Zero Offset

This command undoes the Zero Offset command to set the zero point at zero.

Text Command	Parameters	Return
COU	None	

Set diode zero.

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

Text Command	Parameters	Return
SDZ	None	DONE

Set User Multipliers

This command is used to set the value of the multipliers. The default value is 1.

Text Command	Parameters	Return
MUL	8 characters numeral value	

The following example sets multiplier = 33

Example		Response from MAESTRO
Text Command:	*MUL3300000 Or *MUL3.3000e3	

Get User Multiplier

This command returns the MAESTRO's correction multiplier value.

Text Command	Parameters	Return
GUM	None	Current multiplier value

Example		Response from MAESTRO
Command:	*GUM	User Multiplier : 1 \r\n

Set User Offset

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

Text Command	Parameters	Return
OFF	8 characters numeral value	

Default: 0

The following example sets offset to 1.5 milli.

Example		Response from MAESTRO
Text Command:	*OFF0.001500 OR *OFF1.500e-3	

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

Get User Offset

This command returns the MAESTRO's correction offset value.

Text Command	Parameters	Return
GUO	None	Current offset value

Example		Response from MAESTRO
Command:	*GUO	User Offset : 0 \r\n

Get Zero Offset

This command returns whether the zero offset has been activated or not.

Text Command	Parameters	Return
GZO	None	1: On 0: Off

Example		Response from MAESTRO
Command:	*GZO	Zero : 0 \r\n

Set Energy Mode

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

Text Command	Parameters	Return
>SSE	**1** to turn On, **0** to turn Off	

Default: Off

Set Attenuator

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

Text Command	Parameters	Return
ATT	**1** to turn On, **0** to turn Off	

The following example sets ATT On, this means that the attenuator in on the detector

Example		Response from MAESTRO
Text Command:	*ATT1	

Default: Off

Get Attenuator

This command returns the attenuator status. If the attenuator is not available, it will be always off.

Text Command	Parameters	Return
GAT	None	1: On 0: Off

Example		Response from MAESTRO
Command:	*GAT	Attenuator : 0 \r\n

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	Parameters	Return
VER	None	Version number and device type.

Example		Response from MAESTRO
Command:	*VER	MAESTRO Version 1.00.18 <CR> <LF>

Query Status

This command is used to query the device to get information about the following characteristics:

- Measure Mode (not yet available);
- Maximum, minimum and current scale;
- Maximum, minimum and current wavelength with and without attenuation;
- Attenuator availability and status;
- Detector's head model;
- Detector's serial number.

Text Command	Parameters	Return
STS	None	A hexadecimal structure described in the table below.

The first byte represents the validity of the structure: 0 represents a valid line while 1 is the end of the structure. The next 4 bytes represent the address line and the last 4 bytes are the actual value. The values are written on 32 bits, which means that all the values are written on two lines. The first line represents the LSB and the second line represents the MSB.

The following table shows the output when a XLP12-3S-H2-D0 serial number 199672 is connected to the MAESTRO.

Hexadecimal structure			Converted	Definition
Valid	Address	Value	Value	
:0	0000	0003	3	Reserved
:0	0001	0000	0	Reserved
:0	0002	0003	3	Reserved
:0	0003	0000	0	Reserved

:0	0004	0000	0	Measure Mode LSB (not yet available)
:0	0005	0000	0	Measure Mode MSB (not yet available)
:0	0006	0015	21	Current scale LSB (refer to scale index *SCS)
:0	0007	0000	0	Current scale MSB (refer to scale index *SCS)
:0	0008	0019	25	Maximum scale LSB (refer to scale index *SCS)
:0	0009	0000	0	Maximum scale MSB (refer to scale index *SCS)
:0	000A	0011	17	Minimum scale LSB (refer to scale index *SCS)
:0	000B	0000	0	Minimum scale MSB (refer to scale index *SCS)
:0	000C	0428	1064	Current wavelength LSB (nm)
:0	000D	0000	0	Current wavelength MSB (nm)
:0	000E	2968	10600	Maximum wavelength LSB (nm)
:0	000F	0000	0	Maximum wavelength MSB (nm)
:0	0010	00C1	193	Minimum wavelength LSB (nm)
:0	0011	0000	0	Minimum wavelength MSB (nm)
:0	0012	0001	1	Is Attenuator available LSB (1= yes 0 = no)
:0	0013	0000	0	Is Attenuator available MSB (1= yes 0 = no)
:0	0014	0000	0	Is Attenuator on LSB (1= yes 0 = no)
:0	0015	0000	0	Is Attenuator on MSB (1= yes 0 = no)
:0	0016	2968	10600	Maximum wavelength with attenuation LSB (nm)
:0	0017	0000	0	Maximum wavelength with attenuation MSB (nm)
:0	0018	00C1	193	Minimum wavelength with attenuation LSB (nm)
:0	0019	0000	0	Minimum wavelength with attenuation MSB (nm)
:0	001A	4C 58	X L	Detector name (You must convert the hexadecimal
:0	001B	31 50	P 1	values in ASCII characters)
:0	001C	2D 32	2 -	
:0	001D	53 33	3 S	
:0	001E	48 2D	- H	
:0	001F	2D 32	2 -	
:0	0020	30 44	D 0	
:0	0021	00 00		0000 = Null termination character
:0	0022	00 00		The rest of the characters aren't valid until line 002A
:0	0023	00 00		
:0	0024	1F 00		
:0	0025	40 03	@	
:0	0026	00 1A		
:0	0027	00 00		
:0	0028	E1 20	á	
:0	0029	00 3A	:	
:0	002A	39 31	1 9	Detector serial number (You must convert the

:0	002B	36 39	9 6	hexadecimal values in ASCII characters)
:0	002C	32 37	7 2	
:0	002D	00 00		0000 = Null termination character
:1	0000	00 00		End of structure

Query Extended Status

This command is used to query the device to get information about the following characteristics:

- Measure Mode
- Maximum, minimum and current scale;
- Maximum, minimum and current wavelength with and without attenuation;
- Attenuator availability and status;
- Detector's head model;
- Detector's serial number.
- Trigger level (0.001 to 0.999)
- Autoscale mode
- Anticipation mode
- Zero offset mode
- User correction multiplier
- User correction offset

Text Command	**Parameters**	**Return**
ST2	None	A hexadecimal structure described in the table below.

The first byte represents the validity of the structure: 0 represents a valid line while 1 is the end of the structure. The next 4 bytes represent the address line and the last 4 bytes are the actual value. The values are written on 32 bits, which means that all the values are written on two lines. The first line represents the LSB and the second line represents the MSB.

The following table shows the output when a XLP12-3S-H2-D0 serial number 199672 is connected to the MAESTRO.

Hexadecimal structure			Converted	Definition
Valid	Address	Value	Value	
:0	0000	3	3	Reserved
:0	0001	0	0	Reserved
:0	0002	3	3	Reserved
:0	0003	0	0	Reserved
:0	0004	0	0	Measure Mode LSB
:0	0005	0	0	Measure Mode MSB
:0	0006	11	17	Current scale LSB (refer to scale index *SCS)

:0 7 0	0	Current scale MSB (refer to scale index *SCS)
:0 0008 19	25	Maximum scale LSB (refer to scale index *SCS)
:0 0009 0	0	Maximum scale MSB (refer to scale index *SCS)
:0 000A 11	17	Minimum scale LSB (refer to scale index *SCS)
:0 000B 0	0	Minimum scale MSB (refer to scale index *SCS)
:0 000C 428	1064	Current wavelength LSB (nm)
:0 000D 0	0	Current wavelength MSB (nm)
:0 000E 2968	10600	Maximum wavelength LSB (nm)
:0 000F 0	0	Maximum wavelength MSB (nm)
:0 0010 00C1	193	Minimum wavelength LSB (nm)
:0 0011 0	0	Minimum wavelength MSB (nm)
:0 0012 1	1	Is Attenuator available LSB (1= yes 0 = no)
:0 0013 0	0	Is Attenuator available MSB (1= yes 0 = no)
:0 0014 0	0	Is Attenuator on LSB (1= yes 0 = no)
:0 0015 0	0	Is Attenuator on MSB (1= yes 0 = no)
:0 0016 2968	10600	Maximum wavelength with attenuation LSB (nm)
:0 0017 0	0	Maximum wavelength with attenuation MSB (nm)
:0 0018 00C1	193	Minimum wavelength with attenuation LSB (nm)
:0 0019 0	0	Minimum wavelength with attenuation MSB (nm)
:0 001A 4C 58	X L	Detector name (You must convert the hexadecimal
:0 001B 31 50	P 1	values in ASCII characters)
:0 001C 2D 32	2 -	
:0 001D 53 33	3 S	
:0 001E 48 2D	- H	
:0 001F 2D 32	2 -	
:0 0020 30 44	D 0	
:0 0021 0 0		0000 = Null termination character
:0 0022 0 0		The rest of the characters aren't valid until line 002A
:0 0023 0 0		
:0 0024 1F 0		
:0 0025 40 3	@	
:0 0026 0 1A		
:0 0027 0 0		
:0 0028 E1 20	á	
:0 0029 0 3A	:	
:0 002A 39 31	1 9	Detector serial number (You must convert the
:0 002B 36 39	9 6	hexadecimal values in ASCII characters)
:0 002C 32 37	7 2	
:0 002D 0 0		0000 = Null termination character

:0	002E	D70A	0.0200	Trigger Level LSB (between 0.001 and 0.999)
:0	002F	3CA3		Trigger Level MSB (between 0.001 and 0.999)
:0	0030	0001	1	Is autoscale mode on? LSB
:0	0031	0000	0	Is autoscale mode on? MSB
:0	0032	0000	0	Is anticipation on? LSB
:0	0033	0000	0	Is anticipation on? MSB
:0	0034	0000	0	Is zero offset on? LSB
:0	0035	0000	0	Is zero offset on? MSB
:0	0036	0000	1.0000	Correction Multiplier LSB
:0	0037	3F80		Correction Multiplier MSB
:0	0038	0000	0.0000	Correction Offset LSB
:0	0039	0000		Correction Offset MSB
:1	0000	0000	0	End of structure

3.4.3.2 Error Messages

#	**Error**	**Comment**
1	Command not found	Command is invalid.

3.4.4 Legacy monitor serial commands

The MAESTRO has the ability to emulate the Serial Commands of our legacy monitors, Set the MAESTRO In home/Set device/Serial Commands/ to SOLO2 Serial Compatibility (refer to section 2.4.1.3). You can make it the default setting when the MAESTRO boots up in the same window.

Supported Legacy Monitor:

- SOLO2, The SOLO2 binary commands' are not supported.

3.4.4.1 Emulated SOLO2 Serial commands

SOLO2 SERIAL COMMAND FORMAT

All text commands must begin with a trig character (*) and must end with a line-feed or a carriage-return. 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.

DISPLAY COMMANDS

Command name	Command	Description
Set Scale	SSA	Manually set scale.
Set High Resolution Display	SHL	Change to high resolution display
Set dBm display	DBU	Change the on-screen display to dBm

MEASUREMENT COMMANDS

MEASUREMENT DATA ACQUISITION

Command name	Command	Description
Query Current Value	CVU	Get the value currently displayed on the screen.
Query Statistic Data	VSU	Read statistics data.
Set Logging Start /Stop	LOG	Start storing data in monitor (PCMCIA card or EEPROM).
Download points	CAU	Send the values in ASCII to the serial port with the data sampling setting.
Stop the CAU Command	CSU	Stop the CAU Command
Set Analog output	ANO	Enable or disable analog output

MEASUREMENT SETUP

Command name	Command	Description
Set Personal Wavelength Correction	SWA	Specify the wavelength.
Set Multipliers	SMU	Set the value of the multipliers.
Set Offsets	SOU	Set the value of the offsets.
Set Trigger Level	TLA	Set the internal trigger level when measuring pulse energy.

MEASUREMENT CONTROL

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

INSTRUMENT AND DETECTOR INFORMATION COMMANDS

Command name	Command	Description
Query version	VER	Get firmware version of the monitor.
Query Head Name	HEA	Get model name of the detector head.
Query Battery Power	BAT	Get state of remaining battery power.

INSTRUMENT CONTROL COMMANDS

Command name	Command	Description
Set Backlight	BKL	Turn the display backlight on or off.

COMMUNICATIONS COMMANDS

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

*SSA

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. Remember that the serial protocol is not case-sensitive in text mode.

Text Command	Parameters	Return
SSA	Scale identifier or index	ACK

Scale Identifiers:

Text Mode	Scale
Auto	optimum
1p	1 picowatt or picojoule
3p	3 picowatts or picojoules
10p	10 picowatts or picojoules
30p	30 picowatts or picojoules
100p	100 picowatts or picojoules
300p	300 picowatts or picojoules
1n	1 nanowatt or nanojoule
3n	3 nanowatts or nanojoules
10n	10 nanowatts or nanojoules
30n	30 nanowatts or nanojoules
100n	100 nanowatts or nanojoules
300n	300 nanowatts or nanojoules
1u	1 microwatt or microjoule
3u	3 microwatts or microjoules
10u	10 microwatts or microjoules
30u	30 microwatts or microjoules
100u	100 microwatts or microjoules
300u	300 microwatts or microjoules
1m	1 milliwatt or millijoule

3m	3 milliwatts or millijoules
10m	10 milliwatts or millijoules
30m	30 milliwatts or millijoules
100m	100 milliwatts or millijoules
300m	300 milliwatts or millijoules
1	1 Watt or Joule
3	3 watts or joules
10	10 watts or joules
30	30 watts or joules
100	100 watts or joules
300	300 watts or joules
1k	1 kilowatt or kilojoule
3k	3 kilowatts or kilojoules
10k	10 kilowatts or kilojoules
30k	30 kilowatts or kilojoules
100k	100 kilowatts or kilojoules
300k	300 kilowatts or kilojoules
1meg	1 megawatt or megajoule
3meg	3 megawatts or megajoules
10meg	10 megawatts or megajoules
30meg	30 megawatts or megajoules
100meg	100 megawatts or megajoules
300meg	300 megawatts or megajoules

Example		Response from MAESTRO
Text Command:	*SSA <space> 10 m <enter>	ACK <CR> <LF> and the MAESTRO is set to the 10 mW or 10 mJ range

*SHL

Set High Resolution Display

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

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

Default: Off

*DBU

Set dBm display

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

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

Default: Off

*CVU

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	Parameters	Return
CVU		Current value

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

Current Value: 0.012

Example		Response from MAESTRO
Text Command:	*CVU <enter>	Current Value : 0.00500095 <CR> <LF>

*VSU

Query Statistic Data

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

Text Command	Parameters	Return
VSU		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

*LOG

Set Logging Start/Stop

This command is used to log data on the connected USB stick (be sure you have a USB stick connected and that you have configured an acquisition file name).

Text Command	Parameters	Return
LOG	**1** to Start, **0** to Stop	ACK

This command starts or stops logging data on the USB stick. This is done using the Data Sampling settings (sample rate, time, period...).

Passing 0 as parameter stops the acquisition. 1 starts a raw data acquisition.

The Logging starts when the command is issued.

*CAU

Download data

This command is used to send data to the serial port according to the data sampling setting.

Text Command	Parameters	Return
CAU	None	Data in ASCII

*ANO

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	Parameters	Return
ANO	**1** to Enable, **0** to Disable	ACK

*CSU

Stop the CAU Command

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

Text Command	Parameters	Return
CSU	None	N/A

*SWA

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 in 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	Parameters	Return
SWA	Wavelength	ACK

Default: Calibration wavelength, (typically 1064 nm)

*SMU

Set Multiplier

This command is used to set the multiplier's value. Note that the MAESTRO only allows one multiplier instead of 2 unlike the SOLO2. This means that only Multiplier 1 can be set.

Text Command	Parameters	Return
SMU	Multiplier **1** +, <Multiplier value>	ACK

The following example sets multiplier 1 to 3.3.

Example		Response from MAESTRO
Text Command:	*SMU <space> 1<space> 3.3 <enter>	ACK <CR> <LF>

*SOU

Set Offsets

This command is used to set the offset's value. . Note that the MAESTRO only allows one offset instead of 2 unlike the SOLO2. This means that only Offset 1 can be set.

Text Command	Parameters	Return
SOU	Offset **1** + <Offset value>	ACK

The following example sets offset 1 to 1.5 milli.

Example		Response from MAESTRO
Text Command:	*SOU <sapce> 1 <space> 0.0015 <enter>	ACK <CR> <LF>

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

*TLA

Set Trigger Level

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

Text Command	Parameters	Return
TLA	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.

Example		Response from MAESTRO
Text Command:	*TLA <space> 15.4% <enter>	ACK <CR> <LF>

*ESU

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	Parameters	Return
ESU	**0**, **1** (to Stop, PLAY)	ACK

Default: stop

*SCA

Set Energy Mode

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

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

Default: Off

*EAA

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	Parameters	Return
EAA	**1** to turn On, **0** to turn Off	ACK

Default: On

*EOA

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	Parameters	Return
EOA	**0** to turn Off, **1** to turn On.	ACK

Default: Off

*VER

Query Version

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

Text Command	Parameters	Return
VER		Version number and device type.

Example		Response from MAESTRO
Text Command:	*VER <enter>	MAESTRO Version 1.03.02

*HEA

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

Text Command	Parameters	Return
HEA		Name of the current heads

Example		Response from MAESTRO
Text Command:	*HEA <enter>	QE-25-SP-MB <CR> <LF>

*BAT

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 or high:

Text Command	Parameters	Return
BAT		Low, High

Example		Response from MAESTRO
Text Command:	*BAT <enter>	The battery power is High

*BKL

Set Backlight

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

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

Default: Off

*KPA

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	Parameters	Return
KPA		ACK

3.4.4.2 Error Messages for SOLO2 Serial mode

#	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.
5	Scale setting not available for specified head	Refer to the Scale table in the Set Scale command.
6	Anticipation is not available	Make sure that the detector is in power-reading mode.
7	PWC is not available	Make sure that the detector head version supports Personal Wavelength Correction
8	Invalid Command: Too long.	The command must not be over 255 characters long.
9	Too many Parameters	The correct number of parameters must be sent to the device.
10	Energy mode is not available with current head	Energy Mode works only with 818P Series High Power Detectors.
11	Option only available with photodiode	Make sure the head is a photodiode.
12	Attenuator not available with current head	Make sure the head support attenuator.

4 MAINTENANCE

4.1 USB installation for the MAESTRO

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

4.2 Free Software Upgrade

Keep up to date with the latest versions of MAESTRO 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 MAESTRO. 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. Find the file that corresponds to your MAESTRO in the Downloads section and follow our simple, easy to use instructions.

In summary you will download a .BIN file that you will have to copy to a USB key. Remove any old .bin files on the USB key. Insert the USB key and touch the update button in the about menu. This should take a few minutes; after which you will need to turn off and restart the MAESTRO.

4.3 Battery Charging

As mentioned previously, the MAESTRO meter is operated using four standard rechargeable Ni-MH batteries. When the **low battery** window pops up, recharge the batteries by connecting the external power supply for four hours. The MAESTRO can be either on or off during this procedure. One battery charge provides up to 6.5 hours of operation autonomy.

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

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

4.4 Troubleshooting

If your MAESTRO does not turn on or off, remove all power supplies including the battery, and reconnect them.

Measuring all energy points.

For Energy acquisition of 100Hz and higher, use the full size real time display to log data on the USB key, the graphic display needs a lot of computing and you may lose some points, do not surf in other menus or resize the display, avoid using the PC-MAESTRO.

When using the external trigger, avoid sending voltage pulses while the MAESTRO boots up as it may hang (cause the MAESTRO to crash) the MAESTRO. Contact Gentec-EO for a special external trigger cable if this solution is not acceptable.

5 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's 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.: MAESTRO
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 61000-3-2:2006 +A2:2009	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤16 A per phase)	Class A
EN 61000-3-3:2008	Electromagnetic compatibility (EMC) - Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems (for equipment with rated current ≤16 A per phase and not subject to conditional connection.)	Class A
EN 61000-4-2:2009	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques- Electrostatic discharge.	Class B
EN 61000-4-3:2006 +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 4-6: Testing and measurements techniques- Immunity to conducted Radio Frequency.	Class A
EN 61000-4-11:2004	Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques- Voltage dips, short interruptions and voltage variations immunity tests	Class B Class B Class C Class C

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

Place: Québec (Québec)
Date : December 13, 2011

(President)

6 APPENDIX A

6.1 QED/12/25/50/65/95

Attenuator/Diffuser Calibration Procedure

Introduction;

These "Attenuator/Diffusers" must be **user** calibrated. The calibration procedure is relatively simple. First make measurement without the attenuator, then with the attenuator. The ratio of these measurements 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 MAESTRO:

The *Attenuator* setting in the *Measure mode* **must not be check marked**. That is, it must be off, otherwise you cannot access the wavelength menu window. You need this window 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 as 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 MAESTRO,* above. Make sure that the energy level is below the detector's damage threshold and your laser still has 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 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 MAESTRO 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 in the correction menu for the "Attenuator/Diffuser" when using it at the wavelength established in Step 1.

7 APPENDIX B

7.1 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 MAESTRO 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

7.2 Separation:

Paper : Manual and certificate.

Plastic: Bottom monitor enclosure, LCD enclosure.

Plastic and rubber: Top monitor Enclosure.

Wires: USB cable and power supply plug.

NimH batteries: in the Battery compartment at the back.

Liquid crystal display.

Printed circuit board: inside the monitor.

7.3 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.

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