



# USER MANUAL

QUAD-4Track | Position Sensing System

## **WARRANTY**

### **First Year Warranty**

The Gentec-EO QUAD-4TRACK meter and QUAD detectors carry 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 recalibration, or damages related to misuse.

Gentec-EO will repair or replace at our option any QUAD which proves to be defective during the warranty period; except in the case of product misuse.

Any unauthorized alteration or repair of the product is also not covered by the warranty.

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

In the case of a malfunction, contact your local Gentec-EO distributor or the nearest Gentec-EO office to obtain a return authorization number. Return the material to the appropriate address below.

### **Contacting Gentec Electro-Optics Inc.**

To help us answer your calls more efficiently please have the model number of the detector you are using ready before calling Customer Support.

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](mailto:service@gentec-eo.com)  
Website: [gentec-eo.com](http://gentec-eo.com)

## **SAFETY INFORMATION**

Do not use the QUAD-4TRACK if the device or the detector looks damaged, or if you suspect that the QUAD-4TRACK is not operating properly.

The user must wait for a while before handling these detectors after power is applied. Surfaces of the detector 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 A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

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## 1. INTRODUCTION

The QUAD-4TRACK is an advanced Beam Position Measurement system. It is used with the Pulse Track Applications Software, which creates a full featured data acquisition system for measuring and displaying laser energy and beam Position.

The QUAD-4TRACK is used with compatible Gentec-EO “QUAD” probes. The E series probes are used for pulsed laser applications, and the P series are used for continuous light sources. The QUAD-4TRACK can measure pulsed lasers up to 1000pps on each channel when using the E series probes. When using the P series probes the beam modulation rate can be set from 5Hz to 50Hz

Figure 1 shows the QUAD-4TRACK front panel. Figure 2 shows the QUAD-4TRACK back panel.



Figure 1, QUAD-4TRACK Front Panel



Figure 2, QUAD-4TRACK Back Panel

## 2. SPECIFICATIONS

The following specifications are based on an operating temperature of 15 to 28°C (59 to 82°F) and a relative humidity not exceeding 80%. Instruments must be stored in an environment between 10°C to 60°C (50 to 140°F) and a relative humidity not exceeding 90%.

### 2.1. QUAD-4TRACK SPECIFICATIONS

	QUAD-4TRACK
Compatible Heads	QUAD-E and QUAD-P series
Full Scale Ranges Power Mode (QUAD-P series) Energy Mode (QUAD-E series)	200 $\mu$ W to 200 mW 20 $\mu$ J to 20 mJ
Number of channels	4
Connection to computer	USB 2.0
Analog Output	BNC connector, 0 – 2.0 V
External Trigger Input	TTL BNC connector with LED indicator
Detector Input	DB-25 connector
Power Supply	9 VDC
Dimensions	152W x 51H x 293D mm
Weight	944 g

Specifications are subject to change without notice

### 2.2. QUAD-P DETECTORS SPECIFICATIONS

	QUAD-9-MT-P	QUAD-20-MT-P
	Measurement Capability	
Aperture	9 x 9 mm	20 x 20 mm
Minimum Beam Size	4.5 mm $\varnothing$	
Spectral Range	0.1 - 3000 $\mu$ m	
Power Noise Level	1 $\mu$ W	2 $\mu$ W
Maximum Measurable Power	200 mW	
Maximum Chopping Frequency	50 Hz	
Typical Sensitivity	2000 V/W	
Minimum Position Resolution	10 $\mu$ m	
Typical Rise Time (0-100%)	< 0.02 s	
	Damage Thresholds	
Maximum Average Power Density (at 1064 nm)	100 mW/cm <sup>2</sup>	
Pulsed Laser Damage Thresholds : Maximum Energy Density 1064 nm, 10 ns	50 mJ/cm <sup>2</sup>	
	Physical Characteristics	
Dimensions	63.5 $\varnothing$ x 40.6D mm	
Weight	181 g	

Specifications are subject to change without notice

### 2.3. QUAD-E DETECTORS SPECIFICATIONS

	QUAD-9-MT-E	QUAD-20-MT-E
	<b>Measurement Capability</b>	
Aperture	9 x 9 mm	20 x 20 mm
Minimum Beam Size	4.5 mm Ø	
Spectral Range	0.1 - 3000 µm	
Energy Noise Level	0.5 µJ	1.0 µJ
Maximum Measurable Energy	20 mJ / channel	
Maximum Repetition Rate	1000 Hz	
Maximum Pulse Width	2.5 µs	
Typical Sensitivity	1000 V/J	
Minimum Position Resolution	1 µm	
Typical Rise Time (0-100%)	150 µs	
	<b>Damage Thresholds</b>	
Maximum Average Power Density (at 1064 nm)	100 mW/cm <sup>2</sup>	
Pulsed Laser Damage Thresholds : Maximum Energy Density 1064 nm, 10 ns	50 mJ/cm <sup>2</sup>	
	<b>Physical Characteristics</b>	
Dimensions	63.5 Ø x 40.6D mm	
Weight	181 g	

Specifications are subject to change without notice

### 3. INSTALLING THE SOFTWARE

The Gentec-EO QUAD-4TRACK instrument is a PC-based design. As such it comes with a software application written in Lab View 8.6 designed to handle the control and display tasks. The QUAD-4TRACK communicates with the host PC via a USB port. The device supports full speed USB 2.0. The implementation of the port in the host PC is accomplished via a Virtual Com Port, or VCP. This in effect mimics a standard serial port so that the user can take advantage of the ease of developing custom applications with existing terminal emulators. Any programming environment that can use an RS232 serial port can communicate with the instrument.

Two downloads are available on the website: the USB drivers, and the application software. Download and install the drivers, followed by the software.

#### Installing the USB driver

#### Do not plug the QUAD-4TRACK into your PC yet.

The USB drivers for the QUAD-4TRACK can be downloaded from the Gentec-EO website.

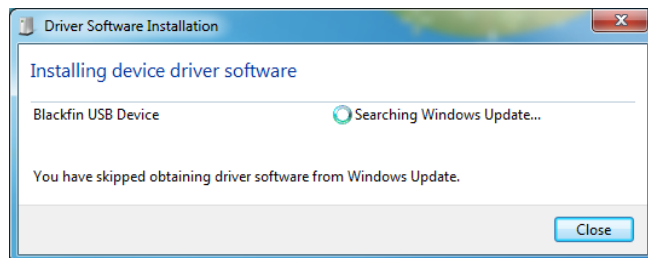
<https://www.gentec-eo.com/downloads>

This will download folders for both 32-bit and 64-bit USB drivers. To find which Windows version your PC has, press the Windows key, select Settings > System > About

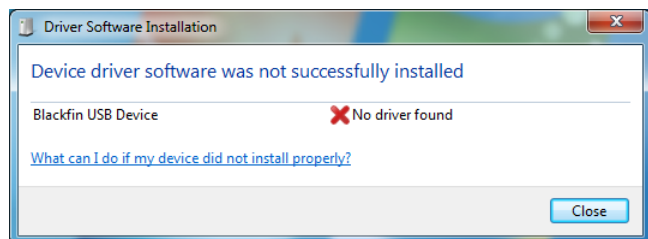
Run the correct installer to install the USB drivers.

#### Windows 7 driver installation

Plug in the QUAD-4TRACK and connect the USB cable. Turn the instrument on. Windows 7 will run the driver installer and show a message similar to this:



This will take some time, so wait until it is complete. If the driver fails to install, you will get a message similar to this:



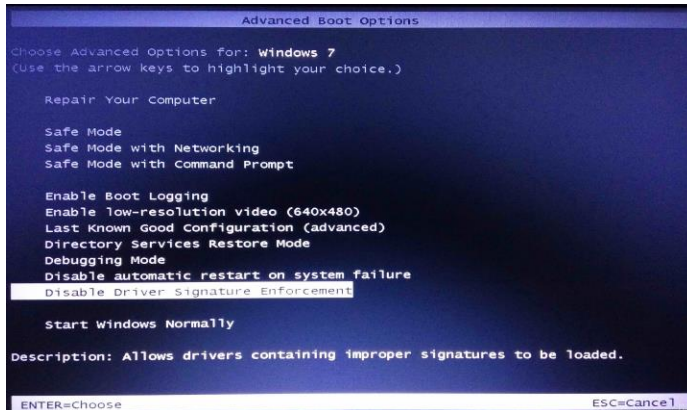
Windows 7 USB Driver file error message.



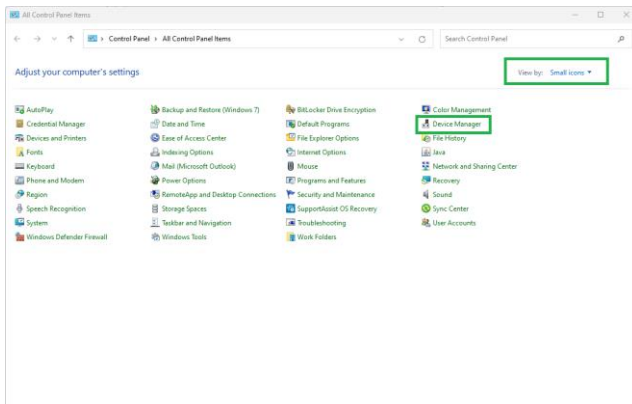
This is because the USB drivers are not certified by Microsoft. They will need to be installed with driver signing enforcement turned off.

## How to disable driver signature verification on Windows 7

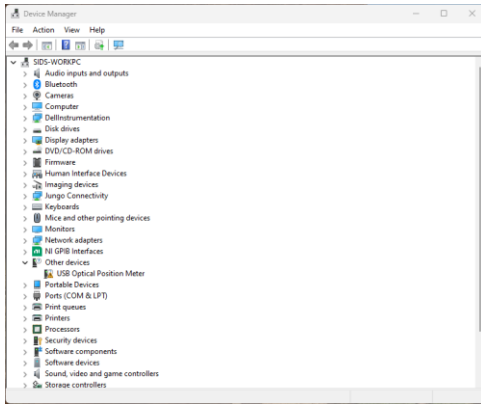
1. Turn off the PC, then turn it back on.
2. During boot-up, press "F8" key continuously (do not hold it down, press and release it repeatedly) to access the "Advanced Boot Options"
3. Use the "Down" arrow key to scroll down to "Disable Driver Signature Enforcement"
4. Press "Enter" to choose



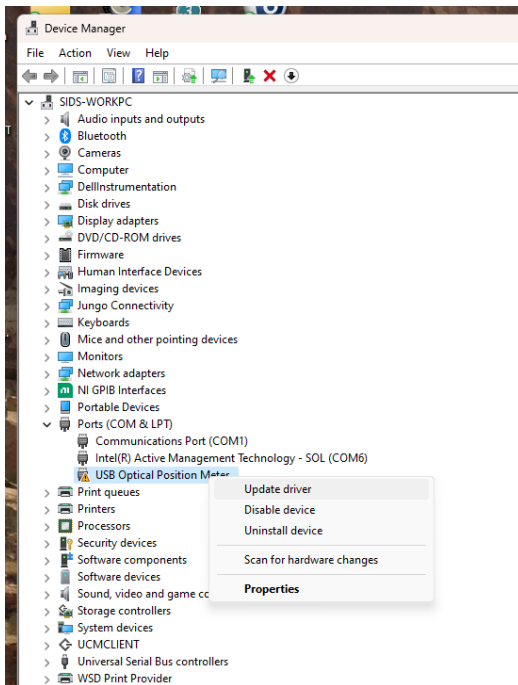
The PC will reboot disabling the enforcement. Wait for your PC to restart, then open the Device Manager. (Open the Control Panel, select View by: Small Icons, Select Device Manager)



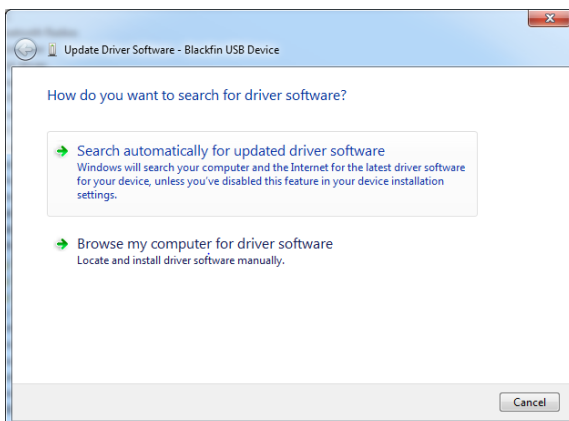
You will see the QUAD-4TRACK shown as a USB Optical Position Meter under Other devices or Ports and have a yellow triangle with a black explanation point:



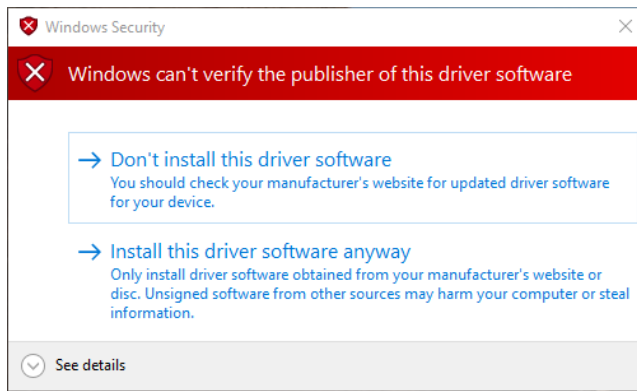
Right-click on the Optical USB Position Meter and select Update Driver.



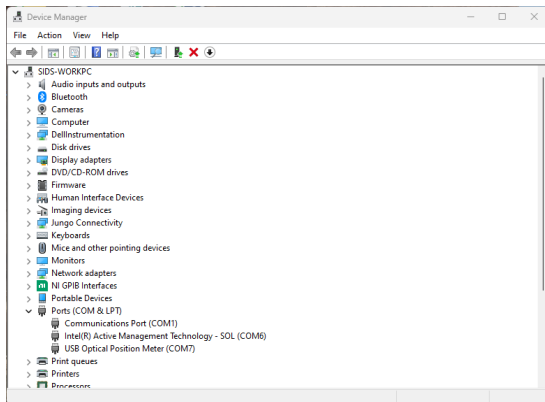
The following message will appear:



Select Browse my computer for driver software. When the file dialog box opens, select the Gentec-EO USB-Drivers folder you downloaded. Windows will display this message:



Select **Install this driver software anyway**. Windows 7 will install the drivers. In the Device Manager, the QUAD-4TRACK will now be in the ports list with no error triangle.



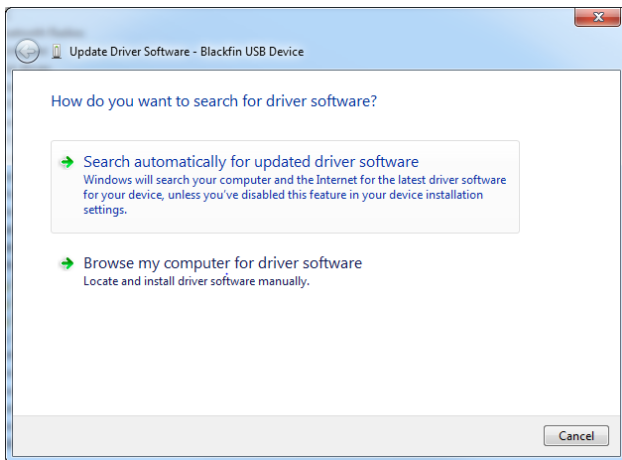
Driver signing verification will turn back on with the next reboot of the PC, but the USB drivers will still be loaded and operate correctly.

## Windows 8, Windows 10, and Windows 11 driver installation

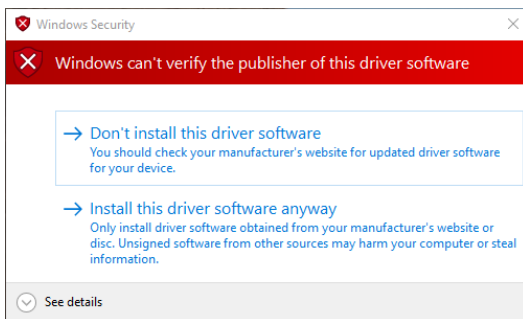
The initial steps are the same as Windows 7, but the error messages are not the same and the method of disabling driver enforcement is different.

To install the driver, right-click on the Optical USB Position Meter in the Device Manager and select **Update Driver**.

The following message will appear:

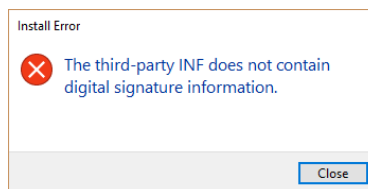


When the file dialog box opens, select the Gentec-EO USB-Drivers folder you downloaded. Windows will display this message:

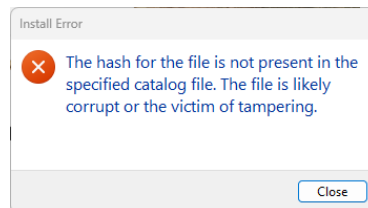


Select Install this driver software anyway. Windows will install the drivers.

If you get one of these messages:



Windows 8 USB driver file error message



Windows 10 and Windows11 USB Driver file error message.

It is because the USB drivers are not certified by Microsoft. They will need to be installed with driver signing enforcement turned off.

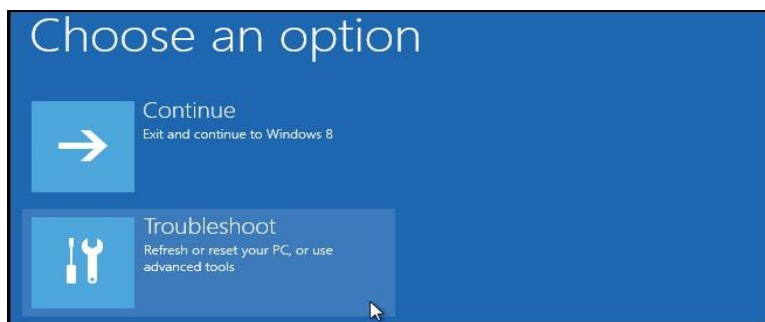
### How to disable driver signature verification on Windows 8, 10 or 11

To disable driver signature verification, you need to get into the Troubleshooting options from the boot manager. Simply select Restart from the power options menu (on Windows 8 that's under Charms or on the login screen, and in Windows 10 and Windows 11 it's on the Start Menu).

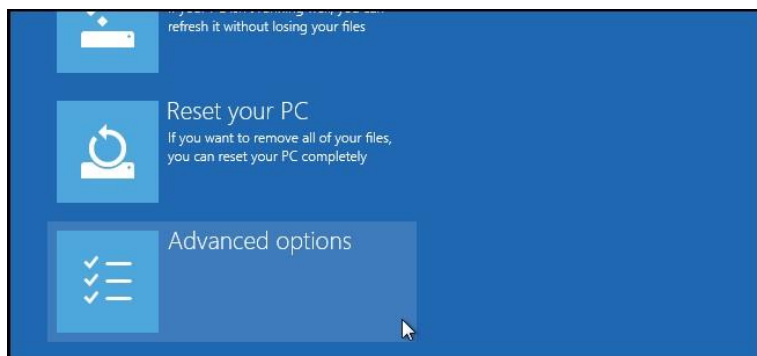
Hold down the SHIFT key while you click Restart.



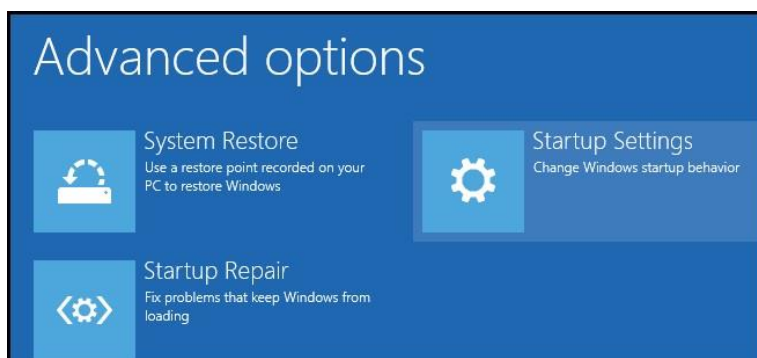
Once your computer has rebooted you will be able to choose the Troubleshoot option.



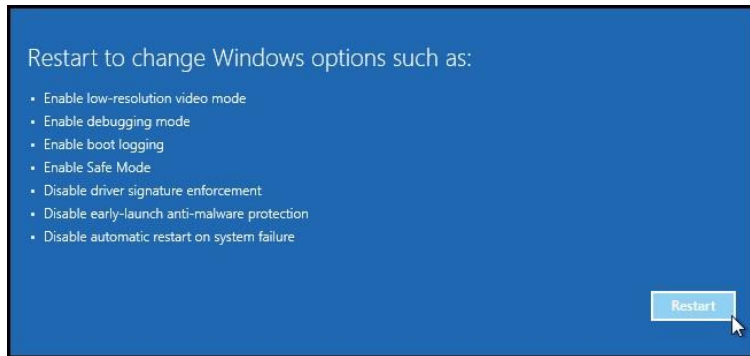
Next select Advanced options.



Next select Startup Settings.

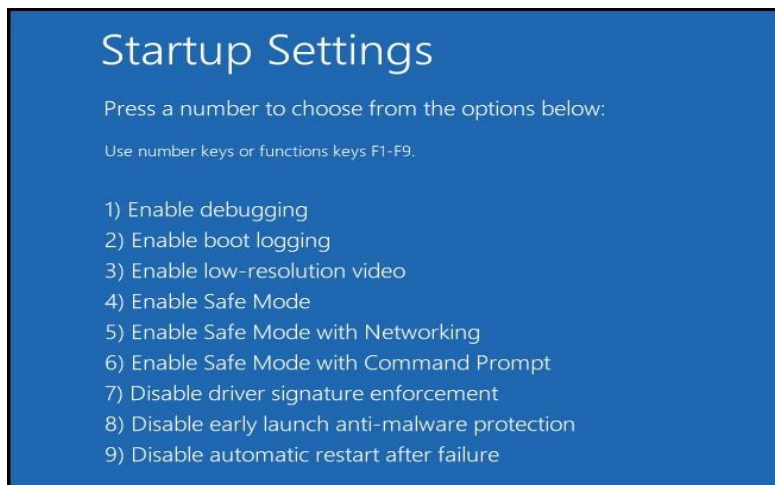


Since we are modifying boot time configuration settings, you will need to restart your computer one last time.

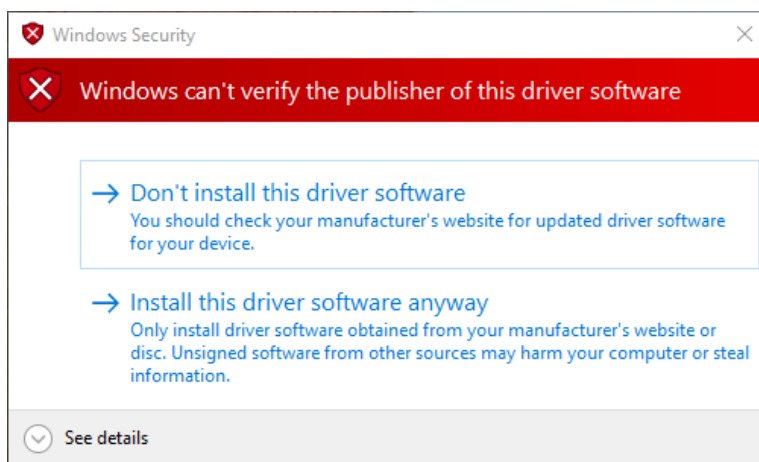


After the restart you will be given a list of startup settings that you can change. The one we are looking for is "Disable driver signature enforcement". The instructions displayed in Windows 10 and Windows 11 say to use the F7 function key, but it does not reliably work.

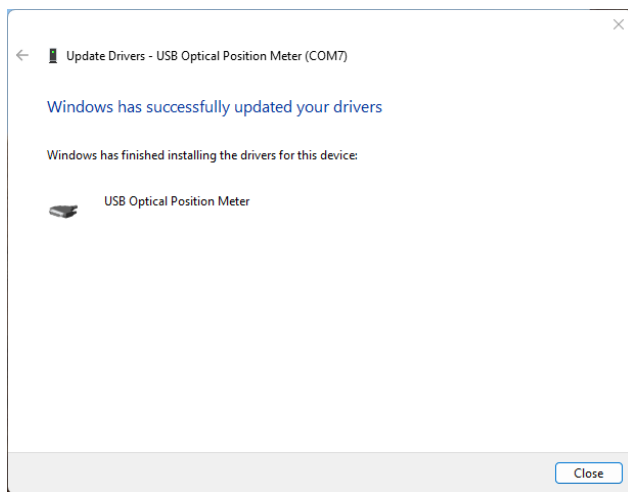
Press the number 7 key.



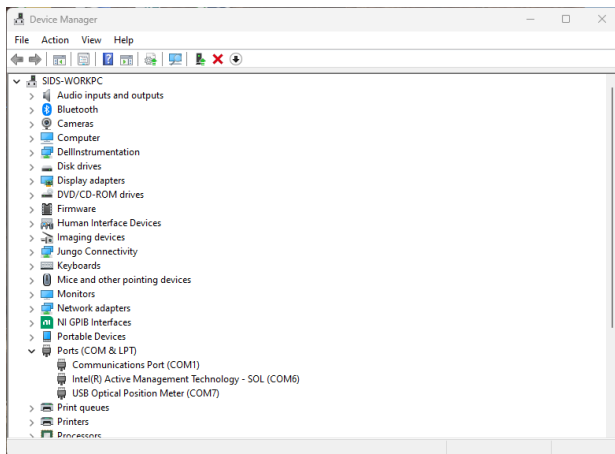
Your PC will reboot and you will be able to install unsigned drivers in the same manner as described above. You will get this warning again:



Select Install this driver software anyway. Since the driver signing verification is off Windows will install the drivers and display this message:



In the Device Manager, the QUAD-4TRACK will now show in the ports list with no error triangle.



Driver signing verification will turn back on with the next reboot of the PC, but the USB drivers will still be loaded and operate correctly.

The driver installation is now complete. You may now continue with the application software.

## 4. INSTRUMENT HARDWARE

### 4.1. POWER SOURCE

The QUAD-4TRACK system is supplied with a 10V, 1.5A universal power module. It will accept voltages from +9V to +15V provided they supply at least 1A and the plug is 5.5mm outer diameter, 2.1 mm inner diameter, and 11mm in length, with the center being positive. Plug the supply into the DC power jack located on the front panel.

### 4.2. PROBE CONNECTION

The QUAD-4TRACK probes use a DB25 connector. See figure 1. To remove the probe, power down the unit first and remove the connector.

### 4.3. INDICATOR LED'S

There are 2 LED's on the QUAD-4TRACK back panel as shown in figure 2.

The Power LED is illuminated whenever an external supply is plugged into the DC power jack.

The Trigger LED illuminated when the QUAD-4TRACK is triggered. This LED functions at all times, whether the QUAD-4TRACK is sending data to the application software or not.

### 4.4. USB

The QUAD-4TRACK communicates with the host PC via a USB port. The device supports full speed USB 2.0. The host P.C must have the QUAD-4TRACK USB drivers installed. These drivers are on the disc supplied with the QUAD-4TRACK instrument. The Application Software is written in LabView and uses the NI-VISA software from National Instruments to affect a communication link with the QUAD-4TRACK. The USB cable cannot be unplugged from the QUAD-4TRACK during operation.

### 4.5. ANALOG OUT

The Analog Output provides an amplified, buffered signal from the probe. A Full Scale Reading will correspond to a 1.5V Signal at the analog out when set to a channel.

The 5th choice is a Bar Graph representing each of the 4 channels. A value of 2.000V is a full scale representation. Each bar in the graph is approximately 50us wide.

### 4.6. EXTERNAL TRIGGER

QUAD-4TRACK supports internal and external triggering. Connect a TTL trigger signal to this input to use external triggering.

### 4.7. TURNING THE UNIT ON

Before turning the QUAD-4TRACK on, be sure that the probe in use is plugged in. When the QUAD-4TRACK powers up, it reads the probe memory to obtain required information for correct operation. QUAD-4TRACK cannot detect a probe removal, so hot swapping the probe is not permitted. Doing so will not cause damage, but the probe information will not be updated. Once the probe and power supply are connected, turn the unit on by setting the Power Switch to ON. The Power LED will illuminate. The QUAD-4TRACK is now ready to use.

### 4.8. POWER ON TESTS

When powered on, the QUAD-4TRACK tests its internal memory and its control circuitry to ensure it can accurately measure data. If the internal memory fails its test, the QUAD-4TRACK will not turn on the Power LED. Should this condition occur, contact Gentec-EO at 503-697-1870 for service of the unit.



## 5. THE APPLICATIONS SOFTWARE

Welcome to the QUAD-4TRACK Pulse Track Software Application Software. This software, when coupled with a Gentec-EO QUAD-4TRACK Instrument, provides the user with a versatile measurement system.

The Applications Software communicates with the host PC via a USB port. The system uses the QUAD-4TRACK Command Set to do this.

The QUAD-4TRACK sends the measured data to the Applications Software when requested to do so. The software will then display the data from each of the 4 channels.

### 5.1. COMMUNICATIONS WITH HOST PC

The QUAD-4TRACK Instrument communicates with the host PC via a USB port. The device supports full speed USB 2.0. The host P.C must have the QUAD-4TRACK Instrument USB drivers installed. These drivers are installed by the disc supplied with the QUAD-4TRACK Instrument. The Application Software is written in LabView and uses the NI-VISA software from National Instruments to affect a communication link with the QUAD-4TRACK Instrument. The implementation of the port in the host PC is accomplished via a Virtual Com Port, or VCP. This in effect mimics a standard com port so that the user can take advantage of the ease of developing custom applications with existing terminal emulators.

The Ports Settings are:

Baud Rate : 115200  
Data Bits : 8  
Stop Bits : 1  
Parity : None  
Flow Control : None

The host PC must have the QUAD-4TRACK USB drivers installed. These drivers are installed by the disc supplied with the QUAD-4TRACK instrument. The QUAD-4TRACK instrument will use the highest available PC baud rate. PC's running a language that uses an alphabet such as English generally will have a maximum baud rate of 921600. PC's using a symbol-based language such as Japanese run slower baud rates, usually with a maximum of 115200. This restriction drives the maximum rate used in the QUAD-4TRACK.

#### Data Format

Measurement Data is sent from the QUAD-4TRACK Instrument as a Hexadecimal string. The supplied LabView VIs parse this data into numeric values.

Pulse amplitude for each channel, Measurement Range, and time stamp information are sent.

The format is: AAAAAAAAAAARPPPPPPPCRLF

Where AAA is the pulse amplitude in ADC counts, for each of the 4 channels. R is the range index of the range used to measure the data. P is the pulse time stamp. The values are followed by a carriage return and a line feed.

The final byte of the pulse amplitude consists of 4 bits of data in the high nibble, followed by 0x04, the end of transmission character, in the low nibble. This is done because the data is sent over the com port, and is also sent to the secondary processor. The secondary processor uses the data to set the analog out DAC, and must know where each pulse terminates.

The range byte is 0 to 18, with 0 indicating 2 fJ and 18 indicating 2kJ. Ranges are in decades.

The period is based on a 135MHz clock, so dividing 135MHz by the period counts will yield the frequency.

A full scale reading in any range is 3072 counts. To find the value of the pulse, divide it by 3072 and multiply the result by the range.

To decode the pulse amplitudes, mask off bytes 0 to 11. Channel 1 is bytes 0, 1, and 2, on to Channel 4 at bytes 9, 10, and 11. Suppose byte 0 is 0x41, byte 1 is 0x39, and byte 2 is 0xC4. 0x41 is an 'A', and 0x39 is a '9'. The third byte has the 0x04 lower nibble to signal the end of the channel data. The character of interest is the 'C'. There for the pulse amplitude is 0xA9C, or 2716 counts. The energy measured will be 2716/ 3072 times the range.

## Data Acquisition

When the QUAD-4TRACK Instrument is powered on, it enters the data acquisition state and waits for a trigger. When a trigger event occurs, the Triggered LED will illuminate and the Instrument will measure the pulse energy and the period timer. If the instrument has been commanded by the user to send data, the results will be sent to the com port and the analog out controller.

### 5.2. COMMAND SET

All host commands and queries must consist of 3 alphabetic characters followed by an optional argument list. If there is more than one argument, they must be comma separated. All commands are terminated by a carriage return followed by a line feed. The format is:

abc<arg1,arg2,...,argN>CR LF

The 3 characters are case independent. If the command has arguments and the argument is valid, "OK\r\n" is returned unless noted below. If an error occurs, "ERR\r\n" is returned. If the command has no arguments, it is interpreted as a query if applicable and the value of the current state of the parameter the command is returned. All returned parameters are terminated with a carriage return followed by a line feed. All commands/ queries have a LabView VI to implement them. Since the communications is done via a com port, any software that supports RS232 communications can be used to develop a custom application using the command set.

### Command and Query List

VER, Version Query, causes the instrument to return the internal firmware version.

IDN, Instrument ID Query, causes the instrument to return the instrument identification.

SND, the data send command. This command uses one argument. If the command is sent with a 1, then the data stream is turned on. Sending it with a 0 turns the data stream off and the instrument responds with OK.

RNG, the range command. Sets the instrument measurement range if sent with the range index. The ranges correspond to the sent index as follows:

Range	Range Index
2fJ or 2 fW	0
20fJ or 20fW	1
200fJ or 200fW	2
2pJ or 2pW	3
20pJ or 20pW	4
200pJ or 200pW	5
2nJ or 2nW	6
20nJ or 20nW	7
200nJ or 200nW	8
2μJ or 2μW	9
20μJ or 20μW	10
200μJ or 200μW	11
2mJ or 2mW	12
20mJ or 20mW	13

200mJ or 200mW	14
2J or 2W	15

If the command is sent with no argument the current range index is returned.

MAX, the maximum range query, returns the maximum range index that can be requested. If the range command is sent with a index greater than this value, and ERR is returned.

MIN, the minimum range query, returns the minimum range index that can be requested. If the range command is sent with a index less than this value, and ERR is returned.

MRD, the maximum reading query, returns the maximum value that the instrument can measure.

TRG, the trigger level command, sets the internal trigger level in % of full scale. The allowed range is 2% to 20%. Values outside of this range will be ignored and ERR will be returned. If sent without an argument, the current level is returned.

TSC, the trigger source command, sets the trigger source to internal or external. An argument of 0 sets the trigger to internal, and argument of 1 sets it to external. The source cannot be queried.

POL, the external trigger polarity, set the external trigger edge sensitivity. An argument of 0 sets the trigger to rising edge, and argument of 1 sets it to falling edge. The polarity cannot be queried.

SRC, the analog out source command, selects which signal to send to the analog out BNC. The source cannot be queried.

Argument Sent	Analog Out Source
0	4 Channel Bar Graph
1	Channel A Pulse
2	Channel B Pulse
3	Channel C Pulse
4	Channel D Pulse

WAV, the user wavelength command, sets the wavelength in use. The argument is the wavelength in nm. No argument returns the current wavelength. This command is used in conjunction with the WCM command.

WCM, the wavelength compensation command, turns wavelength compensation on or off. An argument of 0 turns it off, and argument of 1 turns it on. No argument returns the current state. This command is used in conjunction with the WAV command.

WVQ, the wavelength response query, returns the sensor wavelength and percent response at the desired index. The instrument stores 40 response points in the sensor EEPROM. Sending the query with arguments from 0 to 39 will return each of the points respectively.

The following commands access the EEPROM used in the sensor. They should be used as queries only as they will overwrite the factory values if used as commands.

PRV, the probe responsivity query, returns the responsivity for the requested channel. The argument is the channel index.

Argument Sent	Channel Responsivity Returned
0	Channel A
1	Channel B
2	Channel C
3	Channel D

PWV, the calibration wavelength query, returns the calibration wavelength in nm.

PSZ, the element diameter query, returns the element diameter in meters.

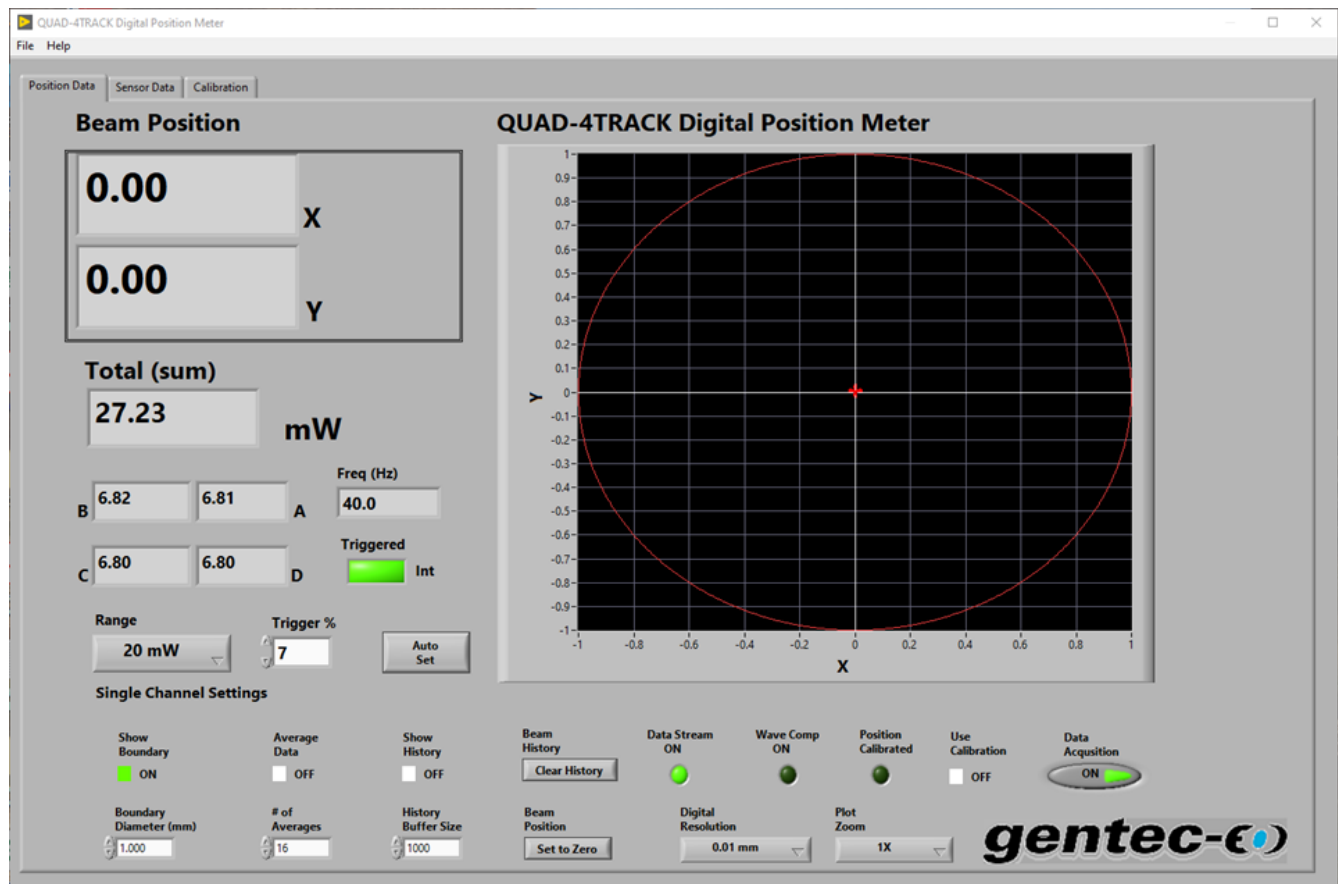
PTY, the sensor type query, returns the sensor type index. 0 is a Joulemeter, 1 is a Radiometer.

### 5.3. THE MAIN DISPLAY

The Main Display Panel has two display regions. They are:

1. The Position Data Display, which is on a user selectable tab.
2. The Sensor Data Display, which is on a user selectable tab.
3. The Calibration Display, which is on a user selectable tab.

#### The Position Data Display



The Measurement Display has Controls and Indicators related to instrument usage. It is the main display used while taking data with the QUAD-4TRACK Instrument.

#### Controls

The controls on the Position Data Display are:

Range  
 Trigger %  
 Show Boundary  
 Boundary Diameter  
 Average Data  
 # of Averages

Show History  
History Buffer Size  
Clear History  
Beam Position (Zero Beam)  
Digital Resolution  
Plot Zoom  
Use Calibration  
Auto Set  
Run

### **Range**

Sets the instrument to the desired range.

### **Trigger %**

The trigger level in percent of full scale. If the level is set to 10% and the range is set to 200uJ, then the instrument will trigger at signals greater than 20uJ.

The QUAD-4TRACK examines all 4 channels for a trigger event in sequences, so if any of the 4 channels are above the set trigger level, all 4 channels will be measured.

### **Show Boundary**

When this control is ON a circle with the set diameter is plotted on the X Y graph. When coupled with the plot history, this can be used for limit testing.

### **Boundary Diameter**

The diameter of the Boundary Circle plotted on the X Y graph. When coupled with the plot history, this can be used for limit testing.

### **Average Data**

When turned on the data is averaged using a moving average, also known as a Box Car filter.

This means that the average will not be complete until all the samples are taken, but the displays will reflect the current averaged value until this happens. Suppose that a batch size of 5 is selected, and then Average Data is selected. The samples will be averaged as follows:

Sample Number	Number Averaged
1	1 sample summed, divided by 1
2	2 samples summed, divided by 2
3	3 samples summed, divided by 3
4	4 samples summed, divided by 4
5	5 samples summed, divided by 5

The averaging filter is now full. As each new sample is taken, it will replace the oldest sample and a new average will be computed based on the new data set, that is sample 6 will replace sample 1, the and the new set will be averaged.

### **# of Averages**

The number of averages to use in the moving average.

### **Show History**

When this control is ON the red beam position indicator will draw a dashed green line on the graphic display to

show where the beam has been. The number of history points to keep is set by the History Buffer Size control. When the beam position history reaches the History Buffer Size, the history will be cleared and will start over. The plot update rate is 330 ms, so a History Buffer size of 1000 points will trace out 330 seconds of beam history, or 5 ½ minutes.

### **History Buffer Size**

The number of points to keep in the Beam History plot.

### **Clear History**

Clears the Beam Position History plot. If Show History is active, a new history plot will start.

### **Beam Position (Zero Beam)**

Forces the Beam Position to 0, 0. This can be used to measure displacement of the beam.

### **Digital Resolution**

Sets the resolution of the X and Y indicators. This control has no effect on the energy indicators.

### **Plot Zoom**

Zooms in the graphic display by the selected factor. Zoom factors are set in powers of 2 from 1X to 128X.

### **Use Calibration**

When this control is ON the beam position indicator will be corrected for the non linear response of the detector. If the beam position has not been calibrated, then the control will be turned off and an error message will be displayed.

If the control is OFF, then no correction will be done.

### **Auto Set**

Calls the Autoset VI. This VI attempts to find the best range and trigger level for the signal being measured. The flow is:

1. Set trigger level to 7%
2. Set Range to top Range.
3. Test for triggering.

If no triggers are present, the VI reduces the range to the next lowest and tests for triggering. It repeats this process until the lowest range is reached. If no triggers are present, it then reduces the trigger level 1% at a time until either triggering occurs or the minimum trigger level is reached.

When a trigger is found, the VI returns the discovered setup to the Position Data Display.

### **Run**

Data Collection Control. When active the data is collected for display if the device is triggered. Data Collection is suspended if another control is activated, and then resumed when the other control is released.

### **Indicators**

The indicators on the Position Data Display are:

X (mm)  
Y (mm)  
Total  
Quad Energy A  
Quad Energy B  
Quad Energy C

Quad Energy D  
Frequency (Hz)  
Triggered  
Data Stream On  
Wave Comp On  
Position Calibrated  
Pulse Track Plot

**X (mm)**

The X position of the beam on the detector surface in millimeters. The units are only visible when the Beam Position has been calibrated.

**Y (mm)**

The Y position of the beam on the detector surface in millimeters. The units are only visible when the Beam Position has been calibrated.

**Pulse Energy**

The total energy in the beam. This is the sum of each of the energies measured by the quadrants.

If any of the 4 channels is over ranged, this indicator's background will turn red.

**Quad Energy A**

The energy in the portion of the beam incident on quadrant A, the upper right quadrant.

If the channel is over ranged, this indicator's background will turn red.

**Quad Energy B**

The energy in the portion of the beam incident on quadrant B, the upper left quadrant.

If the channel is over ranged, this indicator's background will turn red.

**Quad Energy C**

The energy in the portion of the beam incident on quadrant C, the lower left quadrant.

If the channel is over ranged, this indicator's background will turn red.

**Quad Energy D**

The energy in the portion of the beam incident on quadrant C, the lower right quadrant.

If the channel is over ranged, this indicator's background will turn red.

**Frequency (Hz)**

The frequency (pulse repetition rate) of the pulses being measured.

**Triggered**

Illuminates when the instrument is triggered and sending data to the VI. If triggers stop, the trigger timer must expire before the LED will go out.

**Data Stream On**

Illuminates when the Data stream is on. Note that if the instrument is not triggered, no data will be sent.

### Wave Comp On

Illuminates when Wavelength Compensation is on.

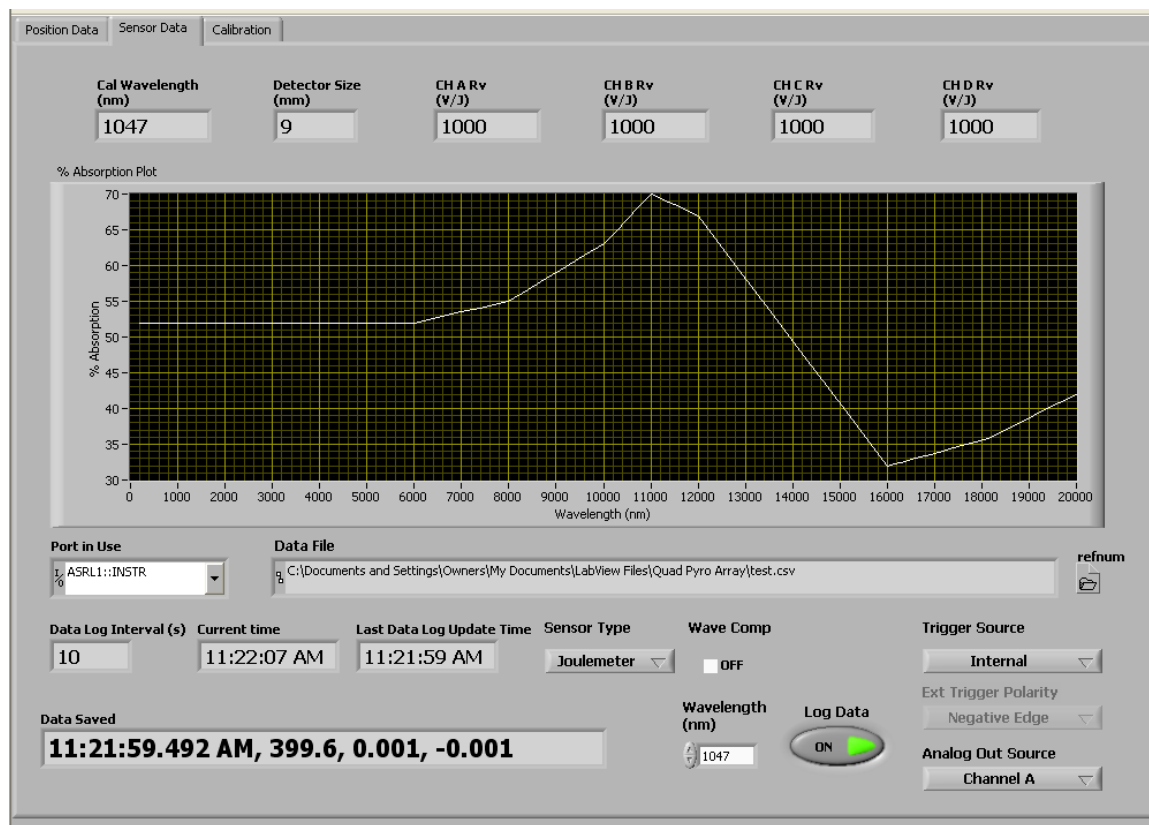
### Position Calibrated

Illuminates when the Beam Position has been calibrated.

### Pulse Track Plot

Graphic plot of the beam position and position history if active.

## 5.4. SENSOR DATA DISPLAY



The Sensor Data Display has Controls and Indicators related to the sensor. The sensor information is read from the sensor memory on program startup.

### Controls

The Controls are:

Trigger Source  
 Trigger Polarity  
 Log Data  
 Wavelength (nm)  
 Analog Out Source



**Trigger Source**

Selects the Trigger Source, External or Internal. If External is selected, a trigger source must be connected to the External Trigger BNC.

**Trigger Polarity**

Selects the External Trigger Polarity, Positive (rising) or Negative (falling) edge.

**Log Data**

Log data to selected file. if no file is currently open, a prompt will request the file to log data to. Data files can be opened and closed via the File menu.

**Wavelength (nm)**

Sets the wavelength of the laser in use.

Since the sensor responsivity varies with wavelength, turning Wavelength Compensation on with the wavelength set to any value other than the calibration wavelength may cause a rescale of the available ranges. If this occurs, the instrument will set itself to the same currently set range if it is still available. If it is not, the instrument will set itself to the next available range.

**Analog Out Source**

Selects what is sent to the Analog Out BNC of the QUAD-4TRACK. The Analog Output provides an amplified, buffered signal from the probe. A Full Scale Reading will correspond to a 1.5V Signal at the analog out when set to a channel.

The 5th choice is a Bar Graph representing each of the 4 channels. A value of 2.000V is a full scale representation. Each bar in the graph is approximately 50us wide.

**Indicators**

The Indicators are:

Cal Wavelength  
Wave Comp  
Detector Size  
Responsivity  
% Absorption Plot  
Port in Use  
Data File  
Data Log Interval  
Current Time  
Last Data Log Update Time  
Data Saved

**Cal Wavelength**

The wavelength of the laser used to calibrate the sensor.

**Wave Comp**

Turns Wavelength Compensation On. The sensor responsivity is wavelength dependent. Turning Wavelength Compensation On causes the instrument to restructure its internal gains to compensate for the variation in responsivity.

**Detector Size**

The size of the detector used in the sensor. This is not the size of an individual quadrant, but rather the total detector.

**Sensor Responsivity**

The responsivity, in V/J, of each of the 4 sensors in the quad. This data is stored in the array memory and read by the instrument to be used for responsivity normalization.

**% Absorption**

The wavelength response, in % Absorption, of sensors in the array. This data is stored in the array memory and read by the instrument to be used for responsivity normalization when the sensor is used at a wavelength other than the calibration wavelength.

**Port in Use**

The Virtual Com Port in Use.

**Data File**

The path of the currently open data file. If the indicator is empty, no file is currently open to log data.

**Data Log Interval**

Sets the time interval to use when saving data to a file. Do not set this interval to less than 1 second or invalid data may be saved.

**Current Time**

The current time. This is used to determine when the data log interval has been reached.

**Last Data Log Update Time**

Displays the last data log time stamp. This value is written to the data file.

**Data Saved**

Displays the saved. This value is written to the data file.

## 5.5. CALIBRATION DISPLAY

Position Data   Sensor Data   Calibration

**Calibrate Beam Position**

Calibrated = A x Measured<sup>7</sup> + B x Measured<sup>6</sup> + C x Measured<sup>5</sup> + D x Measured<sup>4</sup> + E x Measured<sup>3</sup> + F x Measured<sup>2</sup> + G x Measured + G

Set Postions	Measured Postions	Corrected Postions	Coefficients
-2.00E+0	-3.86E+0	-2.00E+0	2.61E-2
-1.50E+0	-3.33E+0	-1.50E+0	5.04E-1
-1.00E+0	-1.96E+0	-9.92E-1	-5.63E-2
-5.00E-1	-1.01E+0	-5.18E-1	-1.19E-2
0.00E+0	-1.20E-2	2.00E-2	8.31E-3
5.00E-1	1.04E+0	4.87E-1	-1.23E-5
1.00E+0	2.44E+0	1.01E+0	-3.14E-4
1.50E+0	3.33E+0	1.50E+0	5.89E-5
2.00E+0	3.86E+0	2.00E+0	

Save Coefficients  
Recall Coefficients

The Calibration Display has Controls and Indicators related to calibrating the beam position.

To use the Beam Position Calibration, first make sure that the instrument is triggered and measuring. Press the Calibrate Beam Position button. The software will request you to place the beam at a series of five positions on the X axis. A measurement will be taken at each position and the resulting data will be used to fit a 7th order polynomial. The results of the curve fit will then be used to correct the Beam Position display if the Use Calibration control is active.

### Controls

The controls are Calibrate Beam Position, Save Coefficients, and Recall Coefficients.

### Calibrate Beam Position

Pressing this button calls the Beam Position Calibration routine. The user will be asked to set the beam position to a set of X axis values determined by the sensor radius. At each position the measured displacement and the set displacement will be recorded. When all measurements are taken, a 7th order polynomial curve fit will be done to determine the correction coefficients. The results of the correction will be displayed to show the accuracy of the corrections.

Note that each measurement taken is the average of 16 pulses. This means that the time to finish the calibration is pulse rep rate dependent.

The measured data from the instrument is nonlinear in response and is also dependent on the beam shape. The quadrants are symmetric about the center and have excellent spatial uniformity and matching responsivity, so calibration can be performed in one axis only. The system calibrates the sensor in the X axis by measuring the data at 9 positions. These positions are found using the sensor radius. A 9mm sensor has a radius of 4.5mm. The software will use the closed even value, which is 4mm, then divide it into 8 intervals, or 9 steps or -2.00, -

1.50, -1.0, -0.5, 0, +0.5, +1.0, +1.5, and +2.0. It then uses the known positions and the measured data to calculate the correction coefficients.

The beam must be at the 0,0 position before performing the calibration, and the Beam Position must not be Set to Zero by using the Zero Beam control.

### **Save Coefficients**

Saves the Displayed Calibration Coefficients to a user specified file.

### **Recall Coefficients**

Recalls the Calibration Coefficients from a user specified file. These values will then be used for beam position correction.

### **Indicators**

The indicators are:

Set Position  
Measured Position  
Coefficient  
Calibrated Position

### **Set Positions**

The requested Set Position for each measurement during the calibration.

The Set Positions are determined by computing the closest even integer radius of the Sensor and then dividing that value by 8. The positive X axis 4 steps plus zero are used to fit a 7th order polynomial.

As an example, suppose the Sensor has a diameter of 9mm. The radius will then be 4.5mm, so the algorithm will set this to 4mm. Division by 8 gives 0.5mm. The 9 Set Positions will then be:

(-2.0,0) , (-1.5,0) , (-1.0,0) , (-0.5,0) , (0,0) , (0.5,0) , (1.0,0) , (1.5,0) , (2.0,0)

### **Measured Positions**

The Measured Position by the DPQ-4 for each Set Position used during the calibration.

### **Coefficients**

The 8 coefficients used in the correction equation.

$$y(x) = Ax^7 + Bx^6 + Cx^5 + Dx^4 + Ex^3 + Fx^2 + Gx + H$$

where x is the measured position and y is the calibrated measurement.

### **Calibrated Positions**

The Corrected Position for each measurement

## 6. OPERATING QUAD-4TRACK WITH THE APPLICATIONS SOFTWARE

Plug the power supply and probe into the QUAD-4TRACK instrument. Start the application software. The software will set itself to the Position Measurement Tab and initialize contact with the instrument. It will then set itself to the Probe Data tab and read the required information from the probe. The software will then configure itself for the ranges appropriate to the probe and set itself to the Position Measurement tab. The system is now ready for use.

### 6.1. GETTING READY TO MEASURE DATA

The QUAD-4TRACK instrument and applications software provide a versatile high speed measurement system. It must be properly set up to work well. The following sections discuss the controls that set up the instrument for measuring data.

### 6.2. RANGE SETTING

The available ranges are dictated by the probe in use. Use the range control to set the range to a value appropriate for the expected energy. Note that energy values above the range value can be measured, but accuracy may be reduced. In general, the smallest range that will contain the expected energy should be used, i.e., if the maximum energy to be measure is 189 $\mu$ J, the use the 200 $\mu$ J range. Note that this energy can be measured in the 2mJ range with a trigger level below 9%, or an external trigger, but more accurate results will be obtained in the 200 $\mu$ J range.

### 6.3. TRIGGER LEVEL SETTING

If internal trigger is used, then the trigger level is set to a value that is less than the lowest expected energy. For example, energies from 1.8mJ to 15mJ are expected. Select the 20mJ range, and set the trigger level to less than  $1.8 / 20 \times 100 = 9\%$ . You may have to experiment with the trigger level until the trigger LED illuminates.

### 6.4. TRIGGER SOURCE SETTING

The trigger source can be set to internal or external. Internal trigger generates a trigger event whenever the pulse exceeds the trigger level. External triggering generates a trigger even whenever a TTL pulse is received on the external trigger input. A measurement is taken when a trigger even is generated, so with external triggering missing or runt pulses can be discovered.

### 6.5. TRIGGER POLARITY (SLOPE) SETTING

In external trigger mode, the rising or falling edge of the TTL pulse may be selected as the trigger event. If the trigger is set to external, with edge polarity, then the temporal relationship between the edge of the trigger and the rising edge of the pulse must be in a window not to exceed  $\pm 10\mu$ s.

### 6.6. AUTOSET

This button calls the Autoset VI. This VI attempts to find the best range and trigger level for the signal being measured. The flow is:

1. Set the trigger source to internal.
2. Set trigger level to 7%
4. Set the Range to Top Range.
5. Test for triggering.

If no triggers are present, the VI reduces the range to the next lowest and tests for triggering. It repeats this process until the lowest range is reached. If no triggers are present, it then reduces the trigger level 1% at a time until either triggering occurs or the minimum trigger level is reached.

When a trigger is found, the VI returns the discovered setup to the Instrument Controls Display.

## **6.7. MEASURING DATA**

Once range and trigger setting have been made, and the trigger LED is illuminated, then data can be acquired by pressing the Acquire Data button

## **6.8. DATA CORRECTION**

The QUAD-4TRACK system is capable of correcting data for wavelength variation from the calibration values. This correction can be disabled if so desired.

## **6.9. WAVELENGTH CORRECTION**

Wavelength correction is done in the QUAD-4TRACK instrument. When a wavelength different from the calibration value is selected, the internal gains of the instrument are changed to normalize the response of the probe to the calibration wavelength. Since the sensor responsivity can vary significantly with wavelength, turning Wavelength Compensation on may cause a rescale of the available ranges. If this occurs, the instrument will set itself to the currently set range if it is still available. If it is not, the instrument will set itself to the next available range.

The response of the probe is stored in the probe memory and is read when the QUAD-4TRACK is powered on. It is plotted on the Probe Data display

## **6.10. FILE MANAGEMENT**

As data is being acquired, it may be saved to an external file for later analysis, either by the Applications Software or some other software package of the users' choice. The Applications Software can open, close, and copy an open file to the Applications Software displays.

## **6.11. OBTAINING HELP**

There is context sensitive help available by selecting the Show Context Help item in the help menu. A help window will appear when the mouse cursor is placed over a control or indicator.

There is a compiled help file that can be called by selecting the Help item in the help menu.

## 7. RECYCLING AND SEPARATION PROCEDURE FOR WEEE DIRECTIVE

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

The complete Monitor contains

- 1 Monitor
- 1 USB cable
- 1 Instruction manual
- 1 Calibration certificate

### 7.1. SEPARATION:

Paper: Manual and certificate

Aluminum: Monitor enclosure.

Printed circuit board: inside the monitor.

### 7.2. DISMANTLING PROCEDURE:

To open the monitor:

Remove all the screws on both sides of the monitor:

Remove the PCB by sliding it out of the enclosure.

## 8. DECLARATION OF CONFORMITY



Application of Council Directive(s): 2014/30/EU 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.: QUAD-4TRACK  
 Year of test & manufacture: 2012

**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 61000-4-4:2012	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 61000-4-6:2013	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 : July 14, 2016

(President)



## 9. UKCA DECLARATION OF CONFORMITY



Application of Council Directive(s): 2014/30/EU 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.: QUAD-4TRACK  
 Year of test & manufacture: 2012

**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 61000-4-4:2012	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 61000-4-6:2013	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 01, 2021

(President)



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### CALIBRATION CENTERS

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