



OceanOptics



# OCEAN QE *PRO* SERIES

**Scientific-Grade Spectrometer**

Installation and Operation Manual

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# About This Manual

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## Warnings & Cautions

**Caution:** Read this manual thoroughly before using and operating this equipment.

**Caution:** Do not let contaminants get into the bench. Keep the protective cap on the slit aperture when not connected to an accessory, probe or fiber.

**Caution:** Only change the slit aperture in a clean environment where contaminants including dust cannot enter the bench during the procedure.

**Caution:** Substitution of a component or accessory different from that supplied may result in measurement error, equipment damage, increased radio-frequency emissions or decreased immunity from electrical disturbances.

**Caution:** Repairs should be undertaken only by personnel trained or authorized by Ocean Optics. The device does not contain any user serviceable parts.

**Caution:** Do not immerse the device in any fluid, place fluids on top of or attempt to clean with liquid detergents or cleaning agents. This may cause an electrical hazard. Use a clean linen cloth to wipe the equipment. Do not use if accidental wetting occurs.

**Caution:** Do not remove any covers. Doing so may increase the risk of electrical shock or compromise the integrity of the optical components.

**Caution:** Do not gas sterilize or autoclave this device.

**Caution:** Consult local codes and ordinances for proper disposal of equipment and other consumable goods.

**Caution:** The device and/or accessories may not operate correctly if used or stored outside the relevant temperature and humidity ranges described in the Technical Specifications.

**Caution:** Do not use if device is dropped and/or damaged. Have an authorized service representative check the device before using again.

**Caution:** Be sure to install any software BEFORE connecting the spectrometer to your PC or host system. The software installs the drivers required for spectrometer installation. If you do not install the software first, the system may not properly recognize the spectrometer.

**Caution:** The user of this spectrometer shall have the sole responsibility for any malfunction that results from improper use, faulty maintenance, improper repair, damage or alteration by anyone other than Ocean Optics or their authorized service personnel.

# About This Manual

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## Warnings & Cautions



**Warning**

Do not let contaminants get into the bench. Keep the protective cap on the slit aperture when not connected to an accessory, probe or fiber.



**Warning**

Repairs should be undertaken only by personnel trained or authorized by Ocean Insight. The device does not contain any user serviceable parts.



**Warning**

Only change the slit aperture in a clean environment where contaminants including dust cannot enter the bench during the procedure.



**Warning**

Do not immerse the device in any fluid, place fluids on top of or attempt to clean with liquid detergents or cleaning agents. This may cause an electrical hazard. Do not use if accidental wetting occurs.



**Warning**

Substitution of a component or accessory different from that supplied may result in measurement error, equipment damage, increased emissions or decreased immunity.

## Certifications and Compliance



**Warning**

This is an FCC Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.



**Warning**

The authority to operate this equipment is conditioned by the requirement that no modifications will be made to the equipment unless the changes or modifications are expressly approved by the manufacturer.



**FCC  
Compliance**

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 the user will be required to correct the interference at his own expense.



**WEEE  
Compliance**

The WEEE symbol on the product indicates that the product must not be disposed of with normal household waste. Instead, such marked waste equipment must be disposed of by arranging to return to a designated collection point for the recycling of waste electrical and electronic equipment. Separating and recycling this waste equipment at the time of disposal will help to conserve natural resources and ensure that the equipment is recycled in a manner that protects human health and the environment.

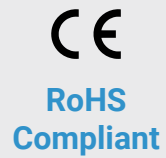


This device has been tested and complies with the following standards:

Electromagnetic Compatibility Directive – 2004/108/EC

EN 61326-1:2013

EN 55011:2009 w/A1:2010



This device complies with RoHS materials standards.



Ocean Optics, the applied spectral knowledge company, has been certified for ISO 9001:2015 certification applicable to the design and manufacture of electro-optical equipment.

## Warranty

For the most current warranty information, please visit [OceanInsight.com](http://OceanInsight.com).

# Introduction

The Ocean Insight QE *Pro* Spectrometer is a scientific-grade spectrometer with broadband sensitivity, from UV to NIR, making it suitable for a wide range of applications. Its high sensitivity and thermoelectric cooler enable effective measurements at very low light levels.

## Product Features

<b>Purge Port with Deep UV Option</b>		<b>Interchangeable Slits</b>	<b>2 Indicator Lights for Spectrometer and Thermoelectric Cooling Status</b>
<b>Optional Internal Shutter</b>	<b>Multi Scan Data Buffering</b>		<b>10 User Programmable Digital I/O Pins</b>
<b>Thermoelectrically Cooled</b>		<b>4 Modes of Triggering</b>	<b>SPI/I2C for Controlling Peripherals</b>
<b>Communications</b> <ul style="list-style-type: none"> <li>• <b>USB 2.0 Full Speed</b></li> <li>• <b>RS232 up to 460k Baud</b></li> </ul>	<b>Nonvolatile Storage</b> <ul style="list-style-type: none"> <li>• <b>Wavelength Cal. Coef.</b></li> <li>• <b>Linearity Corr. Coef.</b></li> <li>• <b>Optional Absolute Irradiance Cal.</b></li> </ul>		

## System Requirements

You can use the QE *Pro*'s USB connectivity with any computer that meets the requirements for the spectroscopy application being used.

Alternately, the QE *Pro* has a serial port for connecting to PCs and PLCs.

However, this connection method requires an external power supply to power the QE *Pro*, called the Breakout Box, and a serial cable.

## EEPROM Utilization

Nonvolatile memory in each QE *Pro* contains wavelength calibration coefficients, linearity coefficients, and a serial number unique to each individual spectrometer. Ocean Insight's spectroscopy application reads these values directly from the spectrometer, enabling the ability to "hot-swap" spectrometers between computers without entering the spectrometer coefficients manually on each computer.



## About Ocean Insight Software

For the most up to date software, please refer to [OceanInsight.com](https://OceanInsight.com). OceanView is the general-purpose spectroscopy software for all Ocean Insight spectrometers. It is a completely modular, Java-based spectroscopy software platform that operates on Windows, Macintosh and Linux operating systems. The software can control any Ocean Insight spectrometer and device.

OceanView is a user-customizable, advanced acquisition and display program that provides a real-time interface to a variety of signal-processing functions. With OceanView, you can perform spectroscopic measurements (such as absorbance, reflectance, and emission), control all system parameters, collect and display data in real time, and perform reference monitoring and time acquisition experiments. Consult the OceanView manual for hardware requirements when using OceanView.

## Interface Options

The QE *Pro* has both USB and serial port connectors (with the use of an adapter), enabling you to connect the spectrometer to a desktop or notebook computer via a USB port or serial port.

Computer Interface	Operating System Requirements	Part Needed	Description of Part
USB Port	For the most current software, visit <a href="https://OceanInsight.com">https://OceanInsight.com</a> *	USB-CBL-1 (included)	Cable that connects from USB port on QE <i>Pro</i> to USB port on desktop or notebook PC
Serial Port	Any 32-bit or 64-bit Windows operating system	HR4-BREAKOUT (not included)	Adapter block that enables connection from serial port on QE <i>Pro</i> to serial port on desktop or notebook PC; comes with 5 VDC power supply (required when connecting to serial port)

\*OceanView may run with previous operating systems but Ocean Insight does not actively support these installations.

## Shipment Components

- QE *Pro* Spectrometer
- USB Cable
- + 5VDC power supply
- Wavelength Calibration Data Sheet (please save for future reference)

## Optional Breakout Box

Ocean Insight also offers the Breakout Box (HR4-BREAKOUT), a passive module that separates the signals from their 22-pin port to an array of standard connectors and headers, enabling easy access to a variety of features found in Ocean Insight's QE *Pro* Spectrometer. In addition to the accessory connector, the breakout box features a circuit board based on a neutral breadboard pattern that allows custom circuitry to be prototyped.

### NOTE

Be aware when using the Breakout Box that the signals for hardware flow control (handshaking) are not connected in the QE *Pro*.

# Installing the QE Pro

You must install the spectroscopy application prior to connecting the QE Pro Spectrometer to the computer. The Ocean Insight spectroscopy application installs the drivers required for the QE Pro spectrometer installation. If you do not install the application first, the system will not properly recognize the QE Pro.

If you have already connected the QE Pro to the computer prior to installing the spectroscopy software, consult Chapter 3: Troubleshooting for information on correcting a corrupt QE Pro installation.

## QE Pro Installation

This section contains instructions for connecting the QE Pro via both USB and serial modes.

### USB Mode

QE Pro Spectrometer Device Driver Installation

If the computer is connected to the internet, the device driver installation will occur automatically. If the computer is offline, you will need to open the device manager and search for the drivers.

### Serial Port Mode

1. Plug the 5 VDC external power supply into an outlet and connect it to the QE Pro.
2. Connect the serial cable adapter block to the appropriate pins of the QE Pro's 30-Pin Accessory Connector.

Connect one end of the 9-pin serial cable to the adapter block on the QE Pro, and then connect the other end to a serial port on the PC.

Note the number of the serial port (COM Port) to which you connected the QE Pro (some PCs may not have numbered ports; handheld PCs typically have only one serial port).

### LED Operation

The QE Pro features two status LEDs:

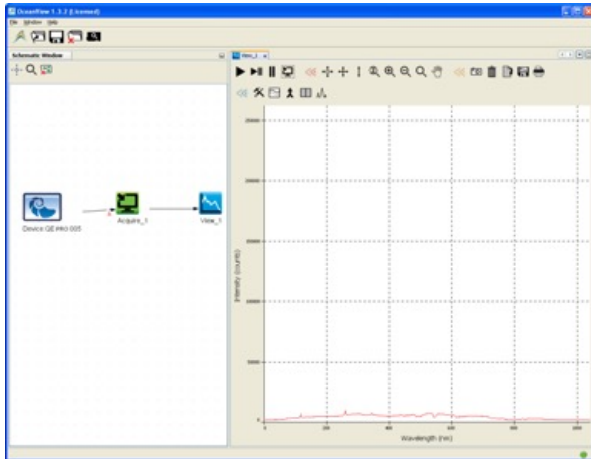
LED Position	Meaning
Top LED	<b>Monitors Spectrometer status:</b> <ul style="list-style-type: none"><li>• Off – spectrometer does not have power</li><li>• Flashing orange – spectrometer is booting</li><li>• Steady green – spectrometer is ready</li></ul>
Bottom LED	<b>Monitors Thermoelectric Cooling (TEC) status:</b> <ul style="list-style-type: none"><li>• Off: The TEC system is off.</li><li>• Orange: The TEC has not yet stabilized at its given setpoint.</li><li>• Green: The TEC is stable (has been within 1 °C of the setpoint for at least 15 seconds).</li></ul>

## Configuring the QE Pro

The QE *Pro* can be used with OceanView software when connected to the USB port. If you have followed the previous steps and started your spectroscopy application, the spectrometer is already acquiring data. Even with no light in the spectrometer, there should be a dynamic trace displayed in the bottom of the graph. If you allow light into the spectrometer, the graph trace should rise with increasing light intensity. This means the software and hardware are correctly installed.

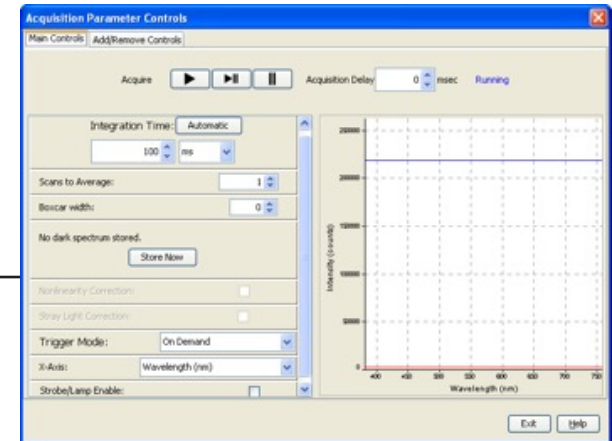
## Configuring QE Pro in OceanView

If you have followed the previous steps and started OceanView, your spectrometer appears in the Schematic and Graph Views:



## OceanView QE Pro Acquisition Controls

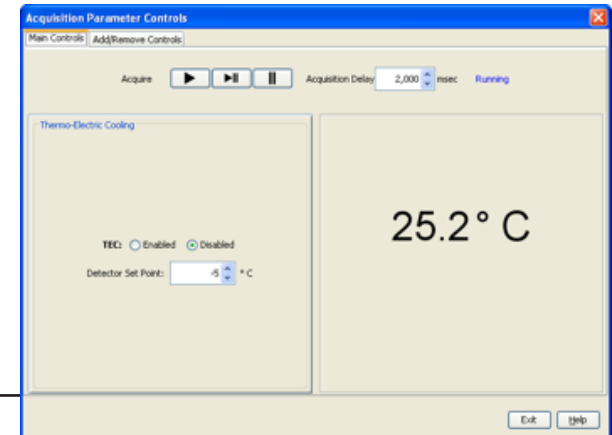
In OceanView, the Acquisition Parameter Controls allow you to set the desired parameters for QE *Pro*.



## TE Cooler

To control the TE Cooler,

1. Right-click on the QE *Pro* in the Schematic View.
2. Select New Acquisition | Thermo-Electric Cooling.



## Buffering

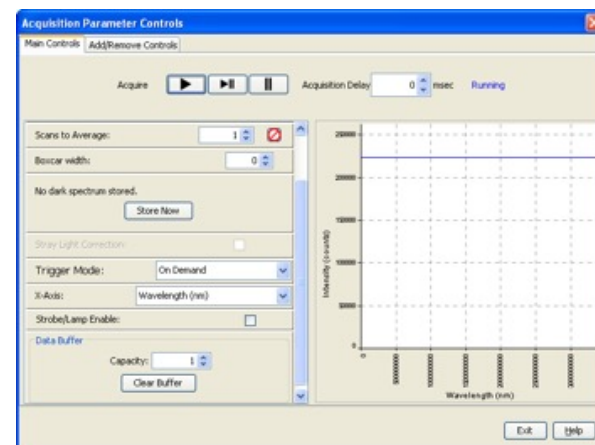
To control buffering,

1. Right-click on the QE *Pro* in the Schematic View.
2. Select **New Acquisition | Data Buffer**.

Data buffering can also be set using the Acquisition Parameter Controls.

To add data buffering controls to the Acquisition Parameter Controls,

1. Click on the **Add/Remove Controls** tab.
2. Select Data Buffer. The **Data Buffer** controls appear on the Main Controls tab.
3. Select the data buffering capacity (the total number of scans the device can store at once).
4. Click **Clear Buffer** to set the buffer to zero and start over.

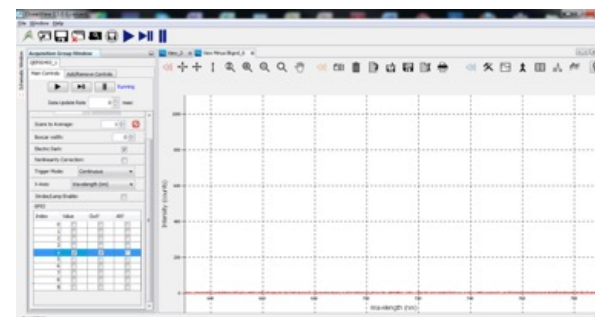
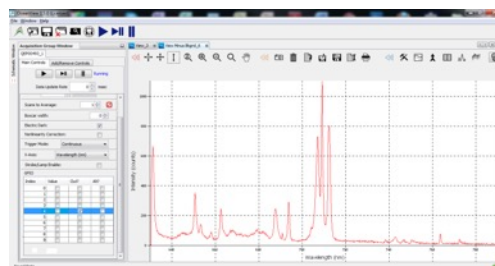


## Optional Shutter

To enable the optional shutter,

1. In the Acquisition Group window, click on the **Add/Remove Controls** tab.
2. Select **GPIO**. The GPIO controls appear on the Main Controls tab.
3. Check the Out box for Index 4. This makes the GPIO an output.

4. Check the **Value** box for Index 4 to close the shutter. You can now take your dark measurement.
5. Uncheck the Value box to open the shutter.



## NOTE

Make sure the ALT checkbox for the GPIO (Index 4) is not selected, which would prevent the shutter from triggering. The activation time of the internal shutter is 11 ms.

## External Triggering Options

You can trigger the QE *Pro* using a variety of External Triggering options through the 30-pin Accessory Connector on the spectrometer. See the External Triggering Options document located at <https://www.oceaninsight.com/support/documents-manuals/manuals-operating-instrs/>. The document contains instructions for configuring External Triggering options for the QE *Pro*.

## Changing the Slit

QE *Pro* has an interchangeable slit feature allow you to move rapidly between different measurement types without changing your spectrometer.

For instructions on how to change the slit on your spectrometer, visit [OceanInsight.com](https://www.oceaninsight.com).

Ocean Insight recommends that a calibration always be performed after changing the slit on a spectrometer as it will optimize the performance of the device.

## Calibrating the Wavelength of the QE *Pro*

Each spectrometer is calibrated before it leaves Ocean Insight, however the wavelength for all spectrometers will drift slightly as a function of time and environmental conditions.

For instructions on how to calibrate the QE *Pro*, visit [OceanInsight.com](https://www.oceaninsight.com).

# Troubleshooting

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## Connected to Computer Prior to Application Installation

### Windows Operating Systems

If you connected your Ocean Insight QE *Pro* device to the computer prior to installing your spectroscopy application (OceanView) on a Windows platform, you may encounter installation issues that you must correct before your Ocean Insight device will operate properly.

Follow the applicable steps below to remove the incorrectly installed device, device driver, and installation files.

#### NOTE

If these procedures do not correct your device driver problem, you must obtain the *Correcting Device Driver Issues* document from the Ocean Optics website: [www.oceanoptics.com](http://www.oceanoptics.com).

### *Remove the Unknown Device from Windows Device Manager*

1. Open Windows Device Manager. Consult the Windows operating instructions for your computer for directions, if needed.
2. Locate the **Other Devices** option and expand the **Other Devices** selection by clicking on the “+” sign to the immediate left.
3. Locate the unknown device (marked with a large question mark). Right-click on the Unknown Device listing and select the **Uninstall** or **Remove** option.
4. Click the **OK** button to continue. A warning box appears confirming the removal of the Unknown Device. Click the OK button to confirm the device removal.
5. Disconnect the QE *Pro* from your computer.
6. Re-plug the spectrometer into your computer.

The system should now be able to locate and install the correct drivers for the USB device.

#### NOTE

Improperly installed USB devices can also appear under the Universal Serial Bus Controller option. Be sure to check this location if you cannot locate the unknown device.

## Apple Mac OSX Operating Systems

Since there are no device files for the *QE Pro* Spectrometer in a Mac operating system, you should not encounter any problems if you installed the spectrometer before the operating software.

## Linux Operating Systems

For Linux operating systems, all you need to do is install the software, then unplug and re-plug in the spectrometer. Technically, the driver files for Linux simply give nonprivileged users permission to use newly connected hardware. There isn't any long-term harm to plugging in the device before installing the software.

## FPGA Firmware Upgrade

The FPGA firmware in the *QE Pro* should be upgraded using the USB bus. Upgrading the FPGA firmware in the *QE Pro* via the RS-232 serial bus produces unpredictable results.

## TEC Readback Accuracy at Temperature Extremes

The TEC temperature is read back by a thermistor embedded in the detector. As with most thermistors, the relationship between resistance and temperature is non-linear. However, the *QE Pro* uses a piecewise linear interpolation to convert from resistance to temperature. This linearization is targeted at the range from -20 °C to 40 °C. Accuracy will deteriorate beyond the edges of this range.

## TEC Readback Temperature Not Exactly at Setpoint

The settled TEC readback temperature is slightly different from the TEC setpoint temperature, typically by ~0.2 °C. However, on other Ocean Insight products (and some competitive products), the TEC temperature appears to settle exactly at the TEC setpoint (generally when the TEC control loop uses a common ADC for both control and readback). The *QE Pro* uses an ADC that is independent of the control loop, resulting in a more reliable value. Although TEC accuracy is typically not very important to users, TEC stability (outstanding on the *QE Pro*) is critical.

## Baseline Drifts Downward

The baseline has been measured to drift downward at a rate of 6.5 counts over 45 minutes, even after the TEC is considered to be stable. This issue can be mitigated by electric dark correction. See the Engineering Note *QE Pro* Baseline Drift with TEC On for more information.

## The Timing of Acquiring Spectra

With other Ocean Insight spectrometers, a request to get the spectrum retrieves the current spectrum in the process of completing. With the *QE Pro*, the most recently completed spectrum is retrieved. This issue is discussed more fully in the *QE Pro* Data Sheet in the Acquire Spectra Into Buffer Timing section.

## HR4000 Breakout Board DC Power Input

The HR4000 breakout board contains a DC power input. This is typically used on other Ocean Insight devices to power the device when it is being controlled via RS232 instead of USB. However, the *QE Pro* does not support the GPIO power inputs as of this writing; instead, use the DC power jack input on the *QE Pro* itself. Plugging in a DC power input to the HR4000 breakout board may damage the internal circuitry on the *QE Pro* or the power supply itself.

## HR4000 Breakout Board RTS and CTS Signals

The HR4000 breakout board also does not connect the RTS and CTS signals from the *QE Pro* to its RS-232 connector

Please contact us for any issues or concerns. Our contact information is located on our website at: [OceanInsight.com](http://OceanInsight.com)



# Technical Specifications

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## QE Pro Specifications

### CCD Detector Specifications

Specification	Value
Detector range	185-1100 nm
Pixels	1024 active
Pixel size	24 $\mu\text{m}^2$
Quantum efficiency	90% peak; 65% at 250 nm.

### QE Pro Spectrometer Specifications

Specification	Value
Integration time	8 ms to 60 minutes
Typical dynamic range	~85,000:1
Signal-to-noise ratio	1000:1 (single acquisition)
Readout Noise	2.5 counts RMS (typical)

# Technical Specifications

Specification	Value
Linearity Corrected	0.5% nonlinearity (max)
f number	f/4
Activation time of optional internal shutter	11 ms
Trigger jitter	10 ns
Fiber optic connector	SMA 905
Gratings	14 gratings available (H1--H14), HC1 grating
Entrance aperture	5, 10, 25, 50, 100 or 200 $\mu\text{m}$ wide slits (or SMA/FC bulkhead with no slit)
Optical resolution (FWHM)	Depends on grating and size of entrance aperture
OFLV filters	OFLV-QE (200-950 nm); OFLV-QE-250 (250-1000 nm); OFLV-QE-300 (300-1050 nm); OFLV-QE-350 (350-1100 nm); OFLV-QE-400 (400-1150 nm)
Temperature Operation	TE Cooler can only cool 15 to 20 $^{\circ}\text{C}$ below ambient temperature 0 $^{\circ}\text{C}$ to 50 $^{\circ}\text{C}$
Humidity	$\leq$ 90% noncondensing

# Technical Specifications

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Specification	Value
Power consumption TEC On @ 40° below ambient TEC Off	15W (Max) 2.5W (Max, Typical)
Supply Voltage	4.5 – 5.5 V
Power-up Time	7 seconds
Interfaces	USB 2.0, 480 Mbps (USB 1.1 compatible); RS-232 (5 wire)
Dimensions (LWH)	182 mm (7.16 in.) x 110 mm (4.33 in.) x 47 mm (1.85 in.)
QE <i>Pro</i> Weight	1.15 kg (2.6 lb.)
Power Supply Weight	0.45 kg (1 lb.)

## System Compatibility

You can use the QE *Pro*'s USB connectivity with any computer that meets the requirements for the spectroscopy application being used. See About Ocean Insight Software.

Alternately, the QE *Pro* has a serial port for connecting to PCs, PLCs, and other devices with a Windows 32-bit operating system that support the RS-232 communication protocol. However, this connection method requires an external power supply to power the QE *Pro*, the HR4000 Breakout Box, and a serial cable.

## 30-Pin Accessory Connector Pinout

The QE *Pro* features a 30-pin Accessory Connector, located on the side of the unit as shown:



Pin #	Function	Input/Output	Description
1	RS232 Rx	Input	RS232 receive signal – Communicates with a PC over DB9 Pin 3
2	RS232 Tx	Output	RS232 transmit signal – Communicates with a PC over DB9 Pin 2
3	GPIO (2)	Input/Output	General Purpose Input Output
4	-	-	Unused

5	Ground	Input/Output	Ground
6	I2C SCL	Input/Output	I2C clock signal for communication to other I2C peripherals
7	GPIO (0)	Input/Output	General Purpose Input Output
8	I2C SDA	Input/Output	I2C data signal for communication to other I2C peripherals
9	GPIO (1)	Input/Output	General Purpose Input Output
10	Ext. Trigger In	Input	CMOS input trigger tolerant from 3-5V
11	GPIO (3)	Input/Output	General Purpose Input Output
12	VOUT	Output	Output power pin for QE <i>Pro</i>
13	SPI_MOSI	Output	SPI Master Out Slave In (MOSI) signal for communication to other SPI peripherals
14	VOUT	Output	Output power pin for QE <i>Pro</i>
15	SPI MISO	Input	SPI Master In Slave Out (MISO) signal for communication to the other SPI peripherals
16	GPIO (4)	Input /Output	General Purpose Input Output
17	Single Strobe	Output	CMOS (3.3V) output pulse used as a strobe signal – Has a programmable delay relative to the beginning of the spectrometer integration period
18	GPIO (5)	Input/Output	General Purpose Input Output
19	SPI Clock	Output	SPI clock signal for communication to other SPI peripherals
20	Continuous Strobe	Output	CMOS output signal used to pulse a strobe – Divided down from the master clock signal
21	SPI CS	Output	External SPI chip select (active low)
22	GPIO (6)	Input/Output	General Purpose Input Output
23	RESET	Input	This pin is pulled up to 5V by a 10K internal resistor. Pull down to ground to reset. Leave open for normal operation.
24	RS-232 CTS	Output	RS-232 Clear to Send control logic signal – used to enable or suspend host transmission to the QE <i>Pro</i>

25	Lamp Enable	Output	CMOS signal driven Active HIGH when the Lamp Enable command is sent to the spectrometer
26	GPIO (7)	Input/Output	General Purpose Input Output
27	RS-232 RTS	Input	RS-232 Request To Send control logic signal -- used to enable QE <i>Pro</i> transmission to the host
28	GPIO (8)	Input/Output	General Purpose Input Output
29	Ground	Input/Output	Ground
30	GPIO (9)	Input/Output	General Purpose Input Output

### 30-Pin Accessory Connector Pinout Diagram

When facing the 30-pin Accessory Connector on the front of the vertical wall of the QE *Pro*, pin numbering is as follows:

USB Port	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29

**30-Pin Accessory Connector Pinout Diagram**

### 30-Pin Accessory Connector Pinout Diagram

30-Pin Accessory Connector – Pin Definitions and Descriptions  
The following table contains information regarding the function of each pin in the QE *Pro*'s 30-Pin Accessory Connector:

#### 30-Pin J2 Accessory Connector - Part Numbers

- The part numbers for the 30-pin accessory connector on the QE *Pro* Spectrometer are as follows:

- The connector is Pak50™ model from 3M Corp. Headed Connector – Part Number **P50-030P1-RR1-TG**.
- The mating connector is Part Number **P50-030S-TGF**.
- Mating the two components requires two 1.27 mm (50 mil) flat ribbon cables (3M 3365 Series is recommended, HR4-CBL-DB15).

## HR4-CBL-DB15 Accessory Cable Pinout

Pin #	Description	Pin #	Description	Pin #	Description
1	Single_strobe	6	GPIO-8	11	SDA
2	ContStrobe	7	A_OUT	12	SCL
3	V5_SW	8	ExtTrigIn	13	LampEnable
4	ExtTrigIn	9	GPIO-9	14	A_IN
5	ExtTrigIn	10	GND_SIGNAL	15	GPIO-7

## Questions?

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