NIRQuest

Scientific-grade Spectrometer

Installation and Operation Manual

For Products: NIRQuest512, NIRQuest512-1.9, NIRQuest512-2.2, NIRQuest512-2.5, NIRQuest256-2.1

Locations

Americas

Ocean Insight, Inc.
8060 Bryan Dairy Rd., Largo, FL 33777, USA

Manufacturing & Logistics
4301 Metric Dr., Winter Park, FL 32792, USA

Sales: info@oceaninsight.com
Orders: orders@oceaninsight.com
Support: techsupport@oceaninsight.com

Phone: +1 727.733.2447
Fax: +1 727.733.3962

Europe, Middle East & Africa

Sales & Support
Geograaf 24, 6921 EW Duiven, The Netherlands

Manufacturing & Logistics
Maybaachstrasse 11, 73760 Ostfildern, Germany

Email: info@oceaninsight.eu

Netherlands: +31 26-319-0500
Netherlands Fax: +31 26-319-0505
Germany: +49 711-341696-0
UK: +44 1865-819922
France: +33 442-386-588
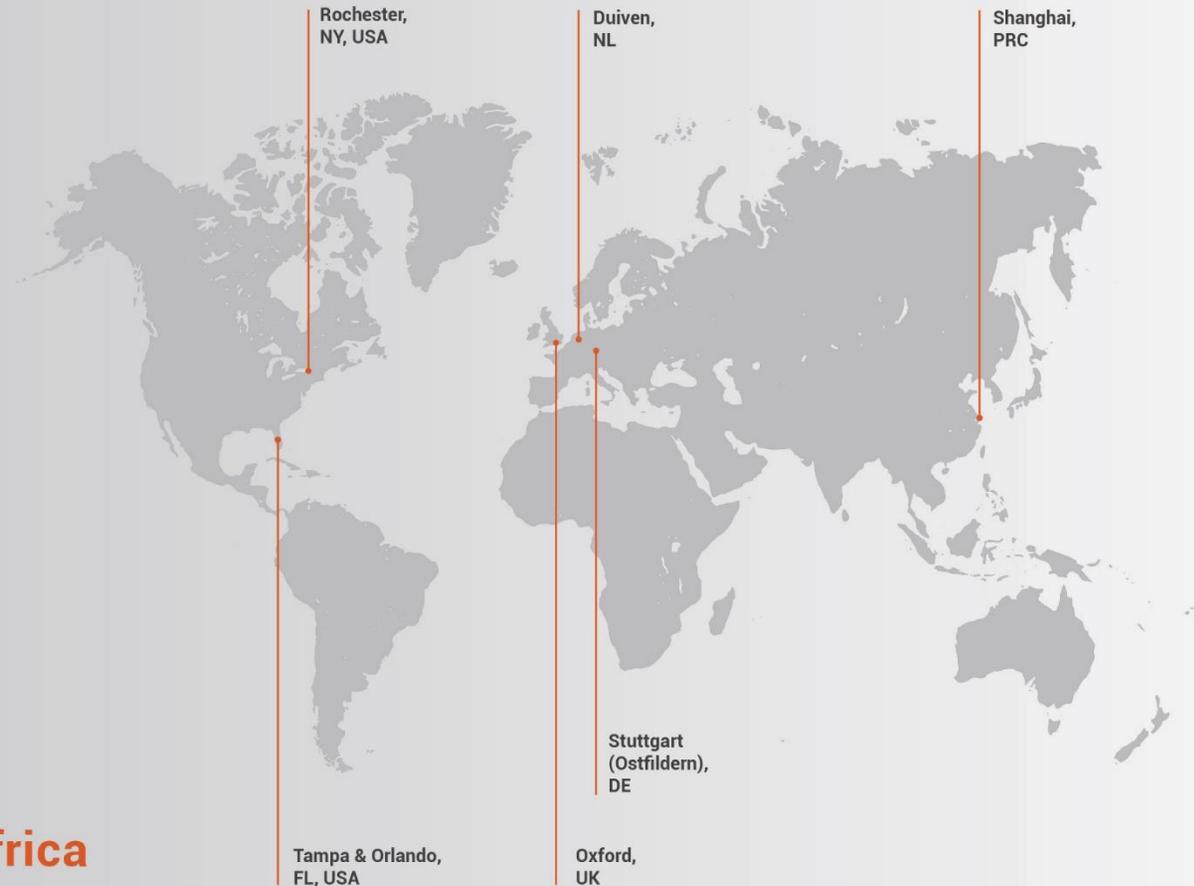
Asia

Ocean Insight Asia
666 Gubei Rd., Kirin Tower Suite 601B
Changning District, Shanghai, PRC, 200336

Email: asiasales@oceaninsight.com

China: +86 21-6295-6600
China Fax: +86 21-6295-6708
Japan & Korea: +82 10-8514-3797

Rochester, NY, USA

Duiven, NL

Shanghai, PRC

Stuttgart (Ostfildern), DE

Tampa & Orlando, FL, USA

Oxford, UK

www.oceaninsight.com

Table of Contents

About This Manual

Warnings & Cautions

 This device may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures such as re-orienting, relocating or shielding the location.

Cautions

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 emissions or decreased immunity.

Caution: Repairs should be undertaken only by personnel trained or authorized by Ocean Insight. 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. 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: To ensure reliable operation, it is recommended that the power supply be attached prior to inserting the USB connector.

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

Warranty

For the most current warranty information, please visit OceanInsight.com.

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.**

FC

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.

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.

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:

> **CAN ICES-003, class A**
>
> **EN 55011:2009/A1:2010 Group 1 Class A**
>
> **EN 61326-1:2013 Basic Level**

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ISO Certification

Ocean Insight, the industry leader in miniature photonics, has been certified for ISO 9001:2015 certification applicable to the design and manufacture of electro-optical equipment.

Introduction

Product Description

A high-performance optical bench, low-noise electronics and various grating options make NIRQuest Spectrometers the best choice for modular NIR spectroscopy. This small footprint, near infrared spectrometer is available in several different models that cover various wavelength ranges between 900 nm and 2500 nm and as with most Ocean Insight designs can be customized for your specific application with various grating, slit and mirror options.

> **NOTE**
>
> High Gain Mode is not recommended for NIRQuest512-2.2 and NIRQuest512-2.5 spectrometers but can be used. An additional 30 minute warm up time is necessary to stabilize the detector response.

An optional internal shutter is available on custom-configured spectrometers (INTERNAL-SHUTTER-LRG-BENCH). This makes it easier to take dark measurements and when you need fast integration times with the best possible signal. This optional feature is also recommended for probe-based or emissive measurements where it is difficult to introduce a shutter into the optical path. The shutter can be added to an existing NIRQuest for an extra charge.

Replaceable slits are offered for added convenience.

Breakout Box

Ocean Insight also offers the Breakout Box (HR4-BREAKOUT), a passive module that separates the signals from their 30-pin port to an array of standard connectors and headers, enabling easy access to a variety of features found in Ocean Insight's NIRQuest 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 on the board itself.

Features

- High signal-to-noise ratio: 15,000:1 to 7500:1, depending on model. Combined with high dynamic range this means that you can achieve the highest accuracy and precision.
- Deep Thermoelectric cooling (TEC) cooling down from 35°C to 50°C below ambient. This means lower dark current and improved signal to noise.
- High Resolution: 2nm - 12nm (slit and detector dependent) to suit your application.
- Small and lightweight: 182 x 110 x 47 mm and 1.2 kg.
- Fast data transfer via USB and optional RS-232. GPIO pins support I2C peripherals.
  - Integration times from 1 ms to 120 seconds (depending on spectrometer model)
- Embedded microcontroller allows programmatic control of all operating parameters and standalone operation
  - USB 2.0 480Mbps
  - Communication standards for digital accessories (I2C)
- Onboard Pulse Generator
  - 3 programmable strobe signals for triggering other devices
  - Software control of nearly all pulse parameters
- Onboard GPIO
  - 10 user-programmable digital I/Os
- EEPROM storage for
  - Wavelength Calibration Coefficients
  - Linearity Correction Coefficients
  - Absolute Irradiance Calibration (optional)
- 30-pin connector for interfacing to external products
- Kensington® security slot
- Optional shutter for dark measurements requiring a fast integration time and good throughput – Specify when ordering

Interface Options

The NIRQuest Spectrometer has 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. However, you must create custom software if using the serial port. OceanView software is available if you are connecting via the USB port.

Computer Interface	Operating System Requirements	Cable Needed	Description of Cable
USB Port	For the most current software, visit OceanInsight.com*	USB-CBL-1 (included)	Cable connects from USB port on NIRQuest Spectrometer to USB port on desktop or notebook PC
Serial Port	Any 32 or 64-bit Windows operating system	HR4-BREAKOUT (not included)	Adapter block that enables connection from serial port on NIRQuest 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.

Items Included with Shipment

- ❑ NIRQuest Spectrometer
- ❑ + 5VDC power supply
- ❑ 15-Pin Accessory Cable (see NIRQuest 15-Pin Accessory Cable Printout)
- ❑ USB Cable
- ❑ Wavelength Calibration Data Sheet – Each spectrometer is shipped with a Wavelength Calibration Data Sheet that contains information unique to your spectrometer.

NOTE

Please save the Wavelength Calibration Data Sheet for future reference.

Installation

You must install the spectroscopy application prior to connecting the NIRQuest Spectrometer to the PC. The spectroscopy application installs the drivers required for spectrometer installation. If you do not install the software first, the system will not properly recognize the NIRQuest Spectrometer.

If you have already connected the NIRQuest Spectrometer to the PC prior to installing the software, consult *Troubleshooting* for information on correcting a corrupt NIRQuest Spectrometer installation.

> **CAUTION**
>
> Ensure that TEC power is always applied (using OceanView software) before USB power.

USB Mode

To connect the NIRQuest Spectrometer to a PC via the USB port, the PC must be running the Windows operating system.

1. Install the spectroscopy application on the destination computer, and then reboot the system.

2. Plug the +5VDC wall adapter into an electrical outlet, then connect the power cord to the 2.5 mm power jack (older versions may have a 1.3 mm power jack) on the rear of the NIRQuest Spectrometer.

3. Locate the USB cable that came with the NIRQuest Spectrometer.

4. Insert the square end of the cable into the rear of the NIRQuest Spectrometer, and then insert the rectangular end into the USB port of the computer.

If the software was installed prior to connecting the NIRQuest Spectrometer, the **Add New Hardware Wizard** appears and installs the NIRQuest Spectrometer drivers. If the drivers do not successfully install, or if you connected the NIRQuest Spectrometer to the computer before installing the software, consult *Troubleshooting*.

Serial Port Mode

To use the serial port capacity of the NIRQuest Spectrometer, the PC must be running a 32 or 64-bit version of the Windows operating system.

1. Plug the +5VDC wall adapter into an electrical outlet, then connect the power cord to the 2.5 mm power jack (older versions may have a 1.3 mm power jack) on the rear of the NIRQuest Spectrometer.

2. Connect one end of the serial cable to the RS-232 connector on the rear of the NIRQuest Spectrometer, and then connect the other end to a serial port on the PC.

3. Note the serial port number (also called COM Port) on the PC to which the NIRQuest Spectrometer is connected (some PCs may not have numbered ports).

Configuring the NIRQuest Spectrometer

If you have followed the previous steps for connecting NIRQuest in USB mode and started OceanView, 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.

Note the spectrometer that you have installed is listed in the **Data Sources** pane.

OceanView Acquisition Controls

In OceanView, the Acquisition Parameter Controls allow you to set the desired parameters for the NIRQuest.
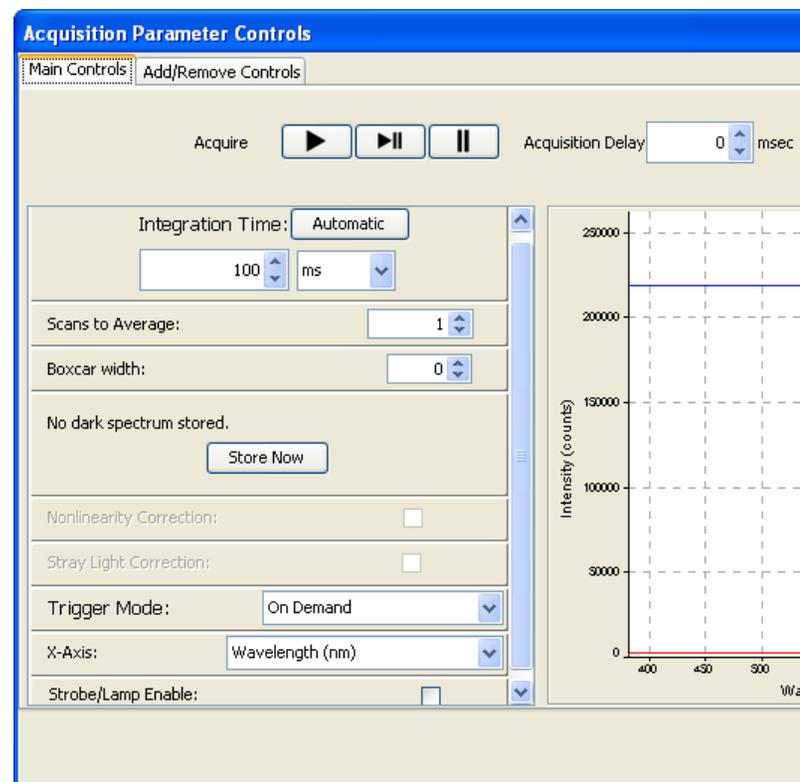
TE Cooler

1. Right-click on the NIRQuest in the Schematic View.
2. Select New Acquisition | Thermo-Electric Cooling.
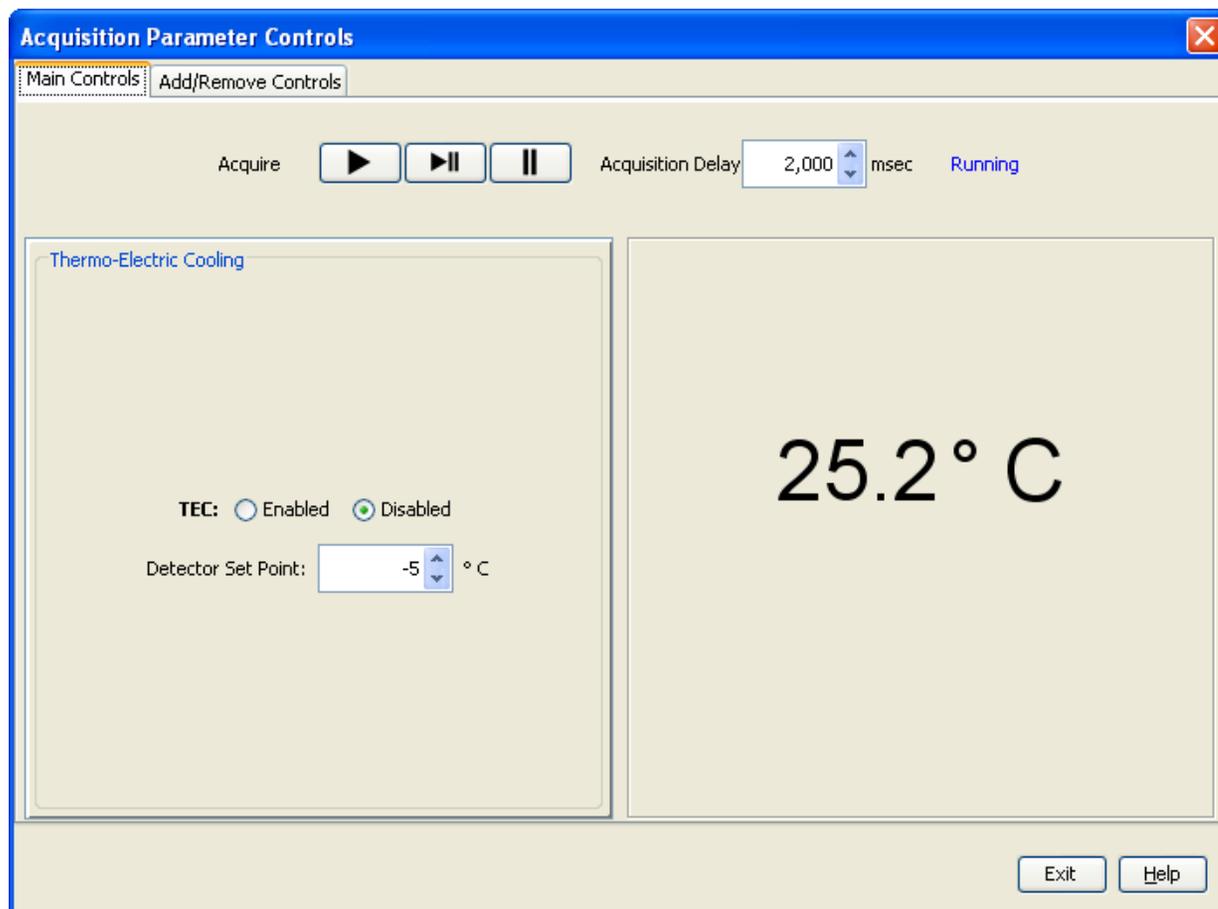
Optional Shutter

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.
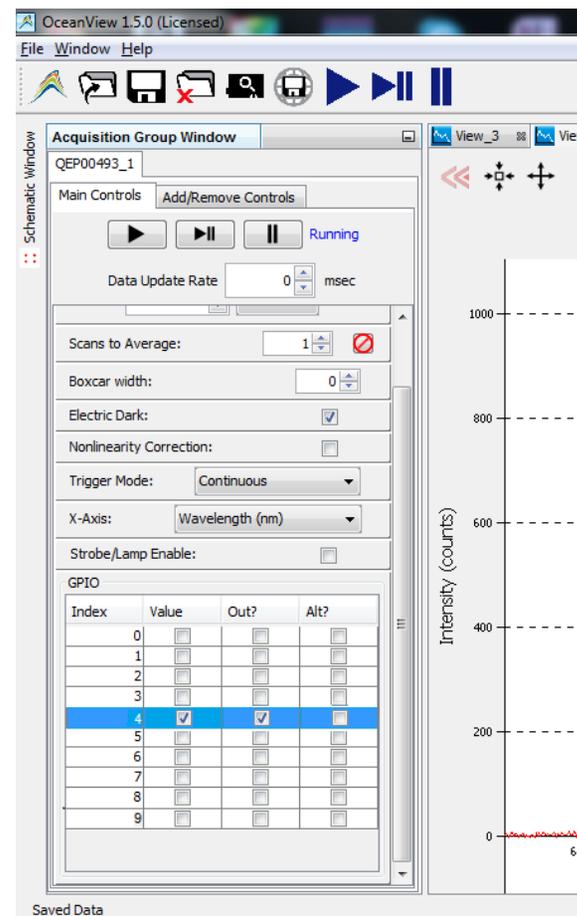
NOTES

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 11ms.

External Triggering Options

You can trigger the NIRQuest Spectrometer using the External Software Triggering option through the 30-pin accessory connector on the spectrometer. Only the External Software Trigger mode is available with the NIRQuest Spectrometer.

Changing the Slit

NIRQuest spectrometers have an interchangeable slit feature which allows 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.

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

Calibrating the Wavelength of the NIRQuest

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 NIR Quest, visit OceanInsight.com.

Troubleshooting

NIRQuest Spectrometer Connected to Computer Prior to Application Software

Windows Operating Systems

If you connected your NIRQuest Spectrometer to the computer prior to installing your Ocean Insight software application, you may encounter installation issues that you must correct before your Ocean Insight device will operate properly.

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.

NOTES

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.

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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 NIRQuest Spectrometer from your computer.

6. Replug the spectrometer into your computer. The system should now be able to locate and install the correct drivers for the USB device.

Apple Mac OSX Operating Systems

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

Linux Operating Systems

For Linux operating systems, all you need to do is install the spectrometer operating software, then unplug and replug 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.

Specifications

	NIRQuest512	NIRQuest512-1.9	NIRQuest512-2.2	NIRQuest512-2.5	NIRQuest256-2.1
PHYSICAL					
Dimensions (mm):	182 x 110 x 47				
Weight (kg):	1.18 (w/o power supply)				
DETECTOR					
Detector range:	850-1700 nm	1000-1900 nm	900-2200 nm	900-2550 nm	900-2100 nm
Useable range[1]:	900-1700 nm	1000-1900 nm	900-2200 nm	900-2500 nm	900-2050 nm
Pixels:	512				256
Pixel size:	25 μm x 500 μm	900-2200 nm			50 μm x 250 μm
Saturation charge:	30 pC (~188 Me- electrons)				
Defective pixels:	0 pixels	<20 pixels			<12 pixels
OPTICAL BENCH					
Design:	f/4, symmetrical crossed Czerny-Turner				
Optional Shutter activation time:	11 ms				

	NIRQuest512	NIRQuest512-1.9	NIRQuest512-2.2	NIRQuest512-2.5	NIRQuest256-2.1
Entrance aperture standard (custom):	25 µm (10 µm, 50 µm, 100 µm and 200 µm [or no slit])				
Grating options (standard):	Grating NIR3, 150 l/mm, 900-1700 nm	Grating NIR3, 100 l/mm, 150 l/mm, 900-1700 nm	Grating NIR2, 100 l/mm, 900-2050 nm	Grating NIR1, 75 l/mm, 1075-2500 nm	Grating NIR2, 100 l/mm, 900-2050 nm
Grating options (custom):	NIR10, NIR11, NIR13 and NIR14		NIR2, NIR3, NIR10, NIR11, and NIR13		
Longpass filter[2]:	OF1-RG830 longpass NIR filter (optional)	OF1-CGA1000 longpass NIR filter (standard)	OF1-RG830 longpass NIR filter (optional)		
2nd Order filter[2]:	N/A	Standard			
Fiber optic connector:	SMA 905 to 0.22 numerical aperture single-strand optical fiber				
SPECTROSCOPIC					
Wavelength range:	900-1700 nm w/Grating NIR3	1100-1900nm w/Grating NIR3	900-2200nm w/Grating NIR2	900-2500nm w/Grating NIR1	900-20500nm w/Grating NIR2
Optical resolution (FWHM)[3]:	~3.1 nm w/25 µm slit		~5 nm w/25 µm slit	~6.3 nm w/25 µm slit	~7.6 nm w/25 µm slit
Signal-to-noise ratio at full signal[4]:	>15000:1 @ 100 ms integration	>8000:1 @ 100 ms integration;	10000:1 @ 100 ms integration		
	>13000:1 @ 1000 ms integration				
A/D resolution:	16-bit				
Dark noise:	6 RMS counts @ 100 ms			16 RMS counts @ 10	6 RMS counts @ 100

Ocean Insight

	NIRQuest512	NIRQuest512-1.9	NIRQuest512-2.2	NIRQuest512-2.5	NIRQuest256-2.1
				ms	ms
	12 RMS counts @ 1000 ms	12 RMS counts @ 250 ms		24 RMS counts @ 30 ms	12 RMS counts @ 250 ms
Dynamic range:	150×10^6 (system); 15K:1 for a single acquisition	7.5M (system); 10K:1 for a single acquisition		100K (system); 7.5K:1 for a single acquisition	715M (system); 10K:1 for a single acquisition
Integration time[5]:	1 ms − 120 s	1 ms − 2 s	1 ms − 1 s	1 ms − 200 ms	1 ms − 2 s
Corrected linearity:	>99.8%			>99.6%	>99.8%
ELECTRONICS					
Power consumption	DC input jack +5V, 3 A maximum				
Data transfer speed:	Full scan to memory every 5 ms with USB 2.0 port				
Inputs/ Outputs:	External trigger input + single strobe output				
Breakout box compatibility:	Yes				
Trigger modes:	2 modes (Normal/Free Run + External Hardware Edge Trigger)				
Strobe functions:	Yes				
Gated delay:	Yes, with external hardware trigger delay				
Connector:	30-pin connector				
TEMPERATURE & THERMOELECTRIC COOLING					
Temperature limits	10-35 ºC (0-90% non-condensing)				

	NIRQuest512	NIRQuest512-1.9	NIRQuest512-2.2	NIRQuest512-2.5	NIRQuest256-2.1
(environmental):					
TEC range:	20 -- 35ºC below ambient	30 -- 50ºC below ambient			
TEC stability:	+/-0.5 ºC of set temperature in <1 minute; typical long-term stability +/-0.1 ºC				
COMPUTER					
Computer interfaces:	USB 2.0 @ 480 Mbps; RS-232 (2-wire) @ 115.2 K baud (custom configuration)				
Peripheral interfaces:	I2C inter-integrated circuit				

[1] "Useable range" is defined in the context of the NIRQuest model's detector response and its typical grating response. For example, the 512-element detector has response at 850 nm, but grating response begins at 900 nm. The G9206 256-element detector response is sensitive to TEC temperature, and has response only to 2050 nm when the TEC is set to -20 ºC. The G9208 256-element and 512-element detector has response to 2550 nm, but the grating efficiency drops off at 2500 nm.

[2] Other filter options are available for order-sorting in the NIRQuest 512-2.5. NIRQuest 512-2.5 ships with a 2nd-order filter. See an Applications Scientist for details.

[3] Optical resolution (FWHM) depends on grating and slit selection.

[4] SNR will decrease at longer integration times.

[5] Maximum integration times are defined as the longest amount of time one can integrate the spectrometer before the dark level rises to half of full scale.

30-Pin Accessory Connector Pinout

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

Location of NIRQuest 30-Pin Accessory Connector

30-Pin Accessory Connector Pinout Diagram

When facing the 30-pin Accessory Connector on the front of the vertical wall of the NIRQuest, 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
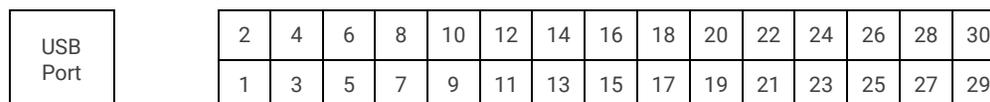
30-Pin Accessory Connector Pinout Diagram

30-Pin Accessory Connector – Pin Definitions and Descriptions

The following table contains information regarding the function of each pin in the NIRQuest's 30-Pin Accessory Connector:

Pin #	Function	Input/Output	Description
1	RS232 Rx	Input	RS232 receive signal −RS-232 functionality is not implemented in software.
2	RS232 Tx	Output	RS232 transmit signal − RS-232 functionality is not implemented in software.

Pin #	Function	Input/Output	Description
3	GPIO (2)	Input/Output	GPIO
4	GPIO (1)	Input/Output	GPIO. Controls the optional shutter.
5	Ground	Input/Output	Ground
6	I^2C SCL	Input/Output	I^2C clock signal for communication to other I^2C peripherals
7	GPIO (0)	Input/Output	GPIO
8	I^2C SDA	Input/Output	I^2C data signal for communication to other I^2C peripherals
9	N/A	N/A	Reserved
10	Ext. Trigger In	Input	TTL input trigger signal
11	GPIO (3)	Input/Output	GPIO
12	V_{CC} or $5V_{IN}$	Input or Output	Input power pin for NIRQuest – When operating via USB, this pin can power other peripherals – Ensure that peripherals comply with USB specifications (no TEC power)
13	SPI Data Out	Output	Reserved
14	V_{CC} or $5V_{IN}$	Input or Output	Input power pin for NIRQuest – When operating via USB, this pin can power other peripherals – Ensure that peripherals comply with USB specifications (no TEC power)
15	SPI Data In	Input	Reserved
16	GPIO (4)	Input /Output	GPIO
17	Single Strobe	Output	TTL 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	GPIO

Pin #	Function	Input/Output	Description
19	SPI Clock	Output	Reserved
20	Continuous Strobe	Output	TTL output signal used to pulse a strobe – Divided down from the master clock signal
21	SPI Chip Select	Output	Reserved
22	GPIO (6)	Input/Output	GPIO
23	N/A	N/A	Reserved
24	N/A	N/A	Reserved
25	Lamp Enable	Output	TTL signal driven Active HIGH when the Lamp Enable command is sent to the spectrometer
26	GPIO (7)	Input/Output	GPIO
27	Ground	Input/Output	Ground
28	GPIO (8)	Input/Output	GPIO
29	Ground	Input/Output	Ground
30	GPIO (9)	Input/Output	GPIO

30-Pin J2 Accessory Connector - Part Numbers

The part numbers for the 30-pin accessory connector on the NIRQuest 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).

NIRQuest 15-Pin Accessory Cable Pinout

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

NIRQuest512-2.5 Sensitivity

When configuring a system for operation out to 2.5µm it is important that you consider the following details:

- Short Integration Times: For the detector to be sensitive out to 2.5µm, the detector's band gap energy must be small. Unfortunately, this raises the absolute level of the detectors dark signal. Typical dark signals at 400ms (NIRQuest512-2.5) are shown below.
- Fiber Selection: For maximum signal intensity, alternative fiber materials should be used for wavelengths greater than 2.2µm.

NIRQuest Dark Signal Comparison
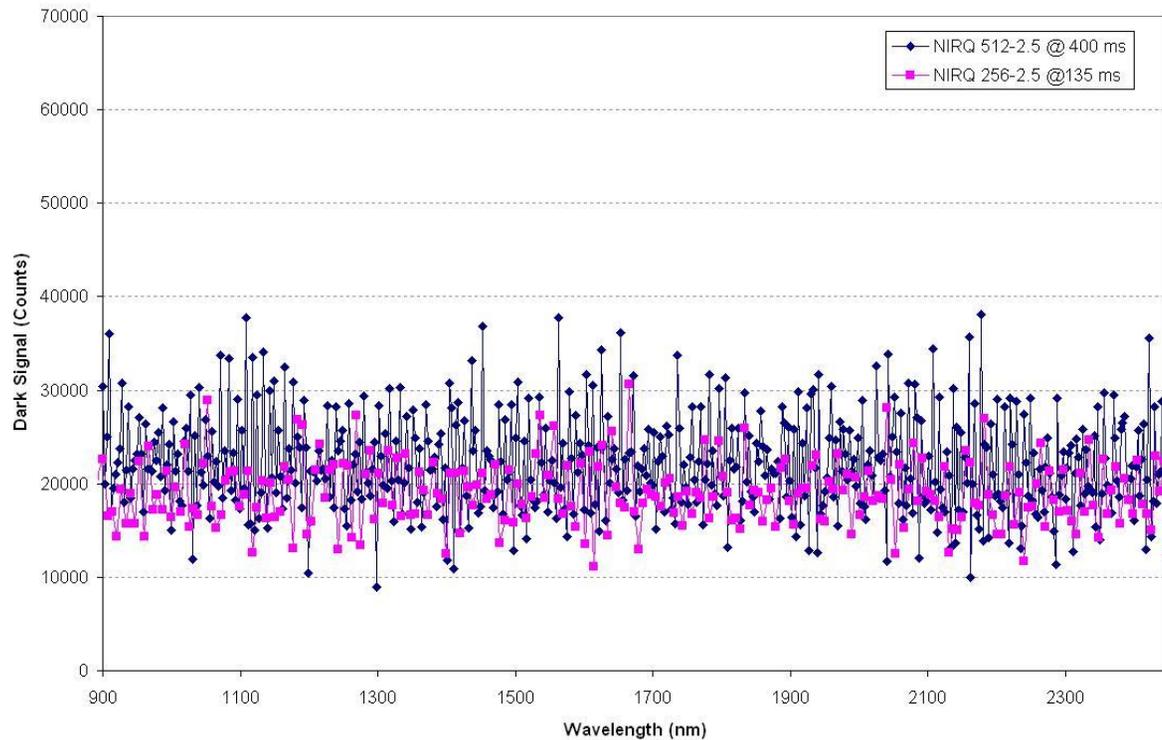
Unlock the Unknown

Ocean Insight exists to end guessing. We equip humanity with technology and data to make precisely informed decisions providing transformational clarity for human advancement in health, safety, and the environment.

Questions?
Chat with us at **OceanInsight.com**.
info@oceaninsight.com • **US** +1 727-733-2447
EUROPE +31 26-3190500 • **ASIA** +86 21-6295-6600