FLAMENIR+

Scientific-grade Spectrometer

Installation and Operation Manual

For Products: FLAME-NIR+, FLAME-NIR

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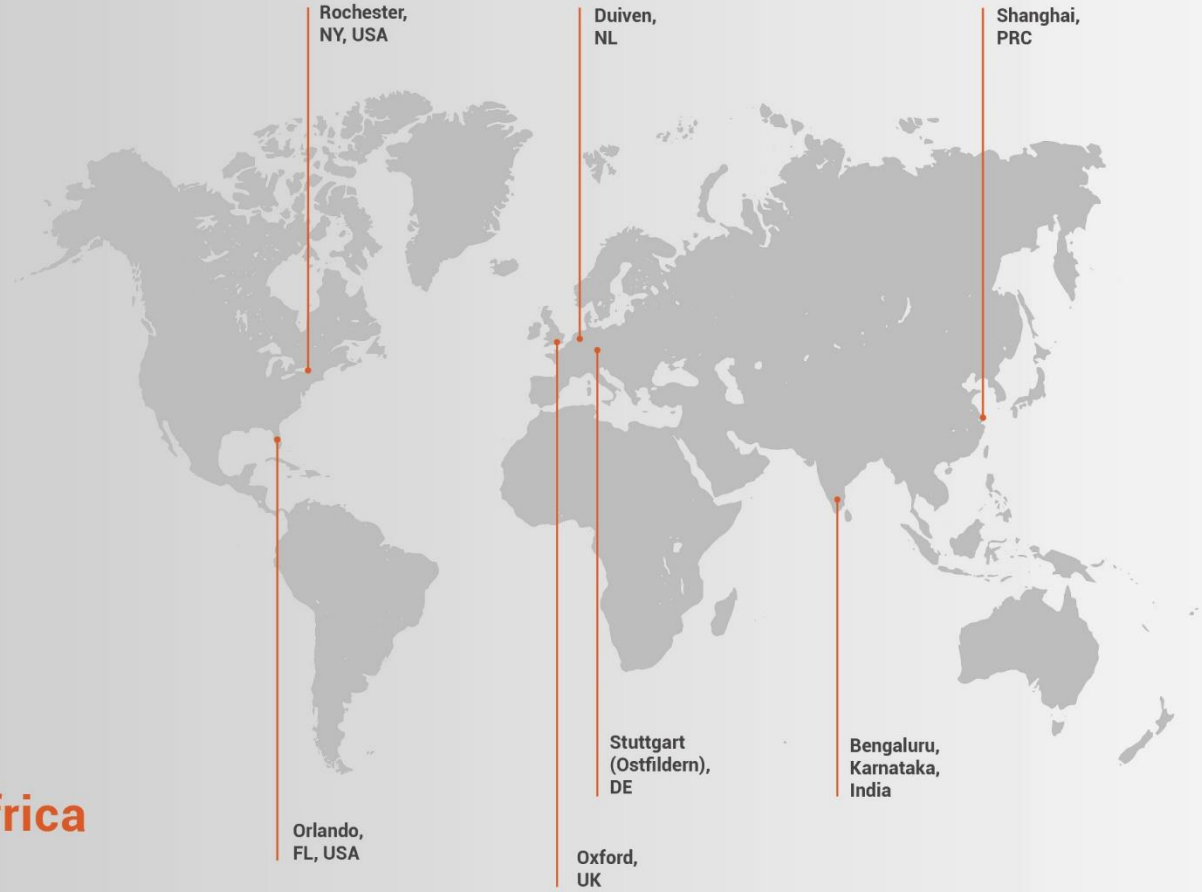

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Before You Get Started

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: 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: 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: 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 that results from improper use, faulty maintenance, improper repair, damage, or alteration by anyone other than Ocean Insight or its 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.

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.

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.

CE

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

EN 61326-1:2013

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

Shock: IEC 60068-2-64

Vibration: IEC 60068-2-31

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

ICES-003, Class A

CISPR 11:2009/A1:2010

EMC 2014/30/EU

RoHS Compliant

This device complies with the following standards:

RoHS 2015-863

Introduction

Product Overview

Combining the small size of the Flame optical bench with an uncooled InGaAs detector, the Flame-NIR+ spectrometer opens a new frontier in NIR spectroscopy. Without thermoelectric cooling, the Flame-NIR+'s power consumption is very low and makes the Flame-NIR+ ideal for integration into handheld and portable systems.

The Flame-NIR+ offers a significant 6-fold enhancement in sensitivity over the previous Flame-NIR model. The additional sensitivity has been achieved via enhancements to the optical performance of the unit. The electronics and interfacing of the Flame-NIR+ have not been changed.

The Flame-NIR+ benefits from all the advantages of the Flame product line, including interchangeable slits and low unit-to-unit variability. With a preconfigured range from 970 to 1700 nm, Flame-NIR+ is an ideal choice for many NIR applications including moisture measurement, grain and feed quality, measurement of fats and oils, and pharmaceutical ingredients blending.

Shipment Components

- Flame-NIR+
- Micro 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.

Calibration

Each spectrometer is calibrated for wavelength before it leaves Ocean Insight; however, the wavelength for all spectrometers will drift slightly as a function of time and environmental conditions. Additionally, Ocean Insight recommends that a calibration be performed after changing the slit on a spectrometer as it will optimize the performance of the device.

For more information on performing a calibration, or using Ocean Insight's Calibration Services, visit www.OceanInsight.com.

Installation

Overview

You must install the operating software application prior to connecting a Flame-NIR+ spectrometer to the computer. The Ocean Insight spectrometer operating software installs the drivers required for the spectrometer installation. If you do not install the software first, the system will not properly recognize the spectrometer.

If you have already connected the Flame-NIR+ to the computer prior to installing the operating software, consult Troubleshooting for information on correcting a corrupt installation.

1. Install the spectrometer operating software on the destination computer.
2. Locate the Micro USB cable provided.
3. Insert the small end of the cable into the Flame-NIR+.
4. Insert the rectangular end of the cable into the USB port of the PC.

If you installed the spectrometer operating software prior to connecting the Flame-NIR+, the software installs the Flame-NIR+ drivers. Once you install the software and hardware, and establish your sampling system, you are ready to take measurements.

Hardware Features

Flame-NIR+ LEDs

The Flame-NIR+ features two indicator lights that operate as shown below:

LED	Steady	Flashing
Red	Unit is on	N/A
Green	Unit is ready	Unit is acquiring data

NOTE

LEDs can be turned off in OceanView or by using a firmware command.

Change the Slit

The Flame-NIR+ allows you to change your spectrometer's slit to match your application requirements. Be sure to calibrate your spectrometer after changing the slit.

1. Find the SMA connector. If a fiber is attached, remove it.
2. Use the Allen key to remove the 2 the screws attaching the slit to the spectrometer.
3. Pull the slit out of the spectrometer.
4. Put the new INTSMA slit connector into the spectrometer, with the key of the connector on the left side.
5. Install the 2 screws again. Use the Allen key to tighten the screws carefully (do not over-tighten).
6. If necessary, connect the fiber again.

Accessories

Ocean Insight provides a range of standard cables and accessories that connect the Flame-NIR+ to our large range of sampling and light source accessories. Items specifically designed for the Flame-NIR+ are described here; they are not provided with the Flame-NIR+ spectrometer and must be purchased separately. Visit us at www.OceanInsight.com for a complete list of products available for all of your spectroscopy needs.

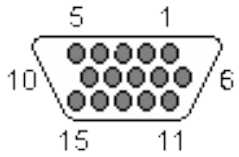
Cables and Connectors

Cables are available to connect your Flame-NIR+ spectrometer to accessories:

- Accessory cable for light sources and other accessories (DB15 Connector Cable).
- Accessory cable for HR-type connector (PAK50 Connector Cable).
- Breakout board (DD4 -BREAKOUT-BOARD) This breaks out the 40 pin DD4 connector to a set of header pins that can be used to wire each pin, as required.

DB15 Connector Cable (FLAME-CBL-DD4P-DB15P)

This cable connects the Flame-NIR+ to existing Ocean Insight accessories that use a DB-15HD connector.



15 PIN	DD4	Name		15 PIN	DD4	Name
1	4	Single Strobe		9	8	GPIO 2
2	3	Continuous Strobe		10	1	Ground
3	40	Vusb		11	22	Reserved for custom dev
4	2	External Trigger In		12	21	Reserved for custom dev
5	2	External Trigger In		13	5	Lamp Enable
6	7	GPIO 1		14	NC	Reserved (NC)
7	NC	Reserved (NC)		15	11	GPIO 4
8	2	External Trigger In				

PAK50 Connector Cable (FLAME-CBL-DD4P-PAK50P)

This cable connects the Flame-NIR+ to the Breakout Box.

PAK50P	DD4	Name	PAK50P	DD4	Name
1	25	RS232 Rx	16	11	GPIO 4
2	24	RS232 Tx	17	4	Single Strobe
3	8	GPIO 2	18	12	GPIO 5
4	40	VUSB	19	16	Reserved for custom dev
5	1	GND	20	3	Continuous Strobe
6	21	Reserved for custom dev	21	18	Reserved for custom dev
7	6	GPIO 0	22	13	GPIO 6
8	22	Reserved for custom dev	23	28	Reserved (do not connect)
9	7	GPIO 1	24	NC	Reserved (NC)
10	2	External Trigger In	25	5	Lamp Enable
11	9	GPIO 3	26	14	GPIO 7
12	40	VUSB	27	10	GND
13	17	Reserved for custom dev	28	NC	Reserved (NC)
14	40	VUSB	29	15	GND
15	19	Reserved for custom dev	30	NC	Reserved (NC)
For the DD4, connect shield to connector case, if shield is included.					

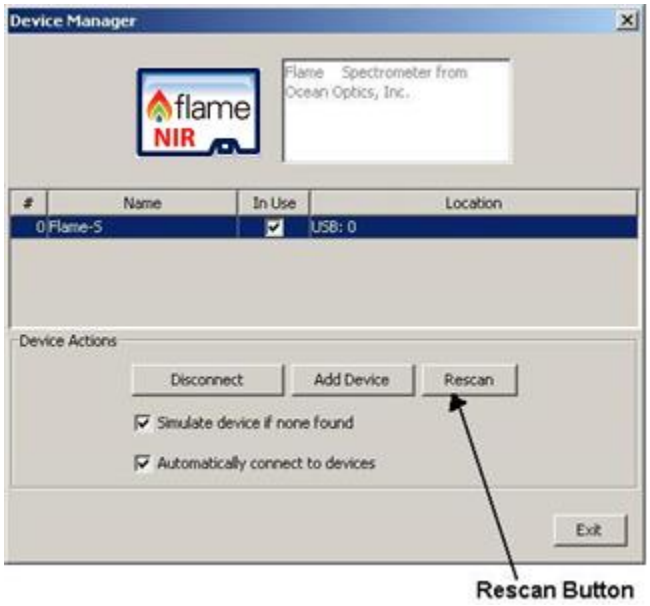
Breakout Box (HR4-BREAKOUT)

The Breakout Box is a passive module that separates the signals from the Flame-NIR+'s DD4 40-pin connector to an array of standard connectors and headers, enabling functionality with a wide range of accessories. 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.

Troubleshooting

I don't see my spectrometer in OceanView.

Be sure the USB is connected. Use the Rescan button in the Device Manager to rescan for attached devices.



How do I know my spectrometer has power?

The red LED on the spectrometer should be on steadily if the unit is receiving power.

How do I know my spectrometer is transmitting data?

The green LED on the spectrometer flashes when transmitting data.

Connected to computer prior to software installation.

Windows Operating Systems

If you connected your Ocean Insight Flame-NIR+ device to the computer prior to installing your spectrometer operating software application, 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 Insight website: www.OceanInsight.com or contact our customer support.

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 **Universal Serial Bus Devices** option and expand the **Universal Serial Bus Devices** selection by clicking on the "**+**" sign to the immediate left.

   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.
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 Flame-NIR+ from your computer.
6. Replug the spectrometer into your computer.

The system should now 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 Flame-NIR+ 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.

How do I determine if my computer is 32-bit or 64-bit?

Errors can occur if you download the wrong version of software (for 32-bit or 64-bit computers). To verify your computer version for most Windows computers, go to the Properties window (under Computer or My Computer). If no version is listed, then your system is a 32-bit.

How do I check the configuration of my spectrometer?

Check the label on the bottom of your spectrometer. You can also check your configuration using your spectrometer operating software. In OceanView, open the Schematic window and double click the spectrometer icon.

Specifications

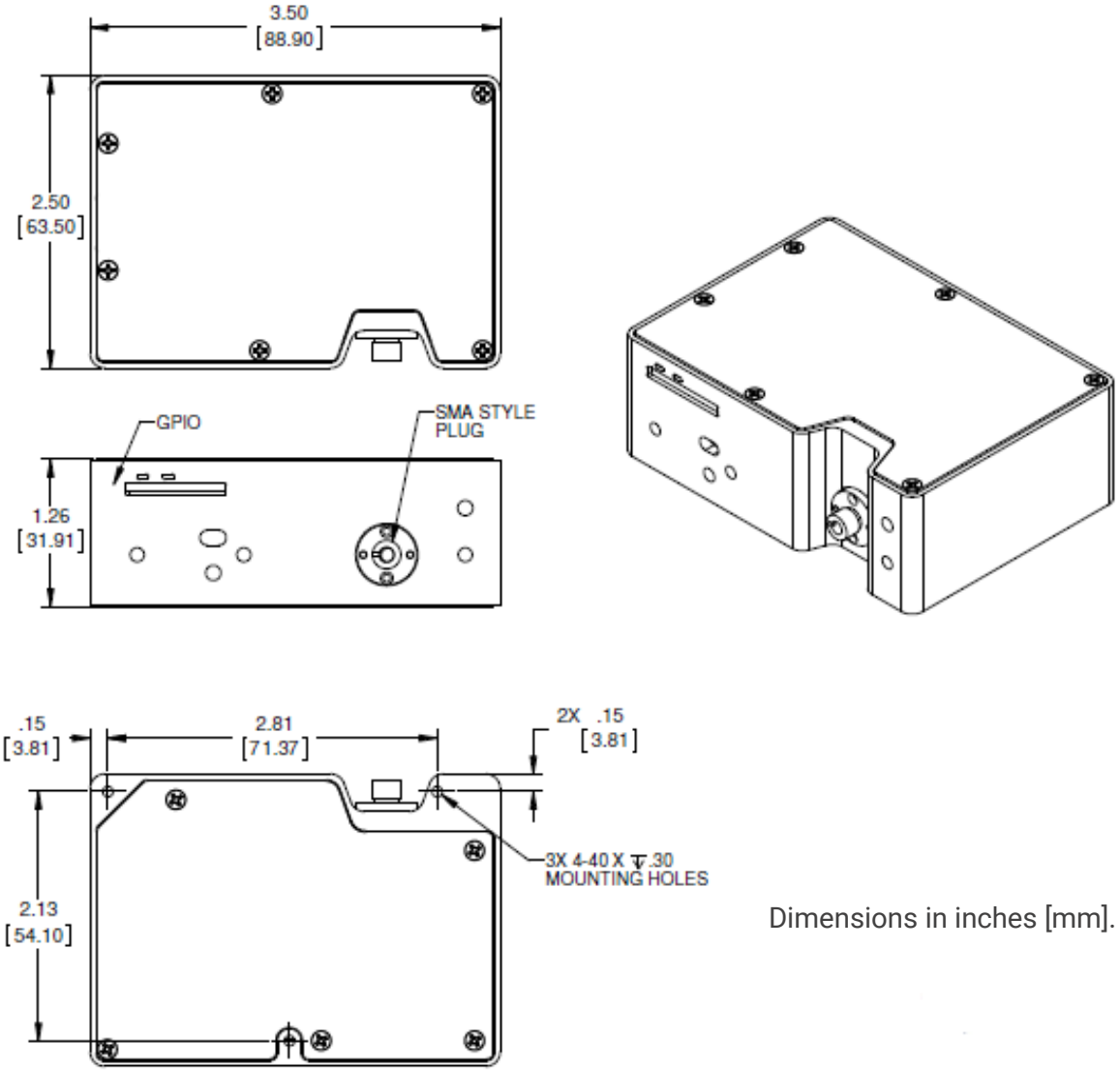
Spectrometer Specifications

	FLAME-NIR	FLAME-NIR+
Spectroscopy		
Integration Time[1]	1 ms to 65 seconds[1]	
Dynamic Range	6000:1	
Signal-to-Noise (single acquisition)	6000:1	
Resolution (FWHM with 25 µm slit)	10 nm (typical)	
Wavelength Range	950 – 1650 nm	970 - 1700 nm
Scan Rate (max) [2]	400 Hz	
Thermal Stability	0.08 nm/C (0.014 pixel/C)	
Triggering	4 modes	
Triggering Jitter	5 µs	
Detector		
Detector	InGaAs linear image sensor	

Pixels	128 pixels
Invalid Pixels	Minimum:0 Maximum: 2
Electronic Shutter	Yes
Readout Noise (single dark spectrum)	9 counts (typical)
Corrected Linearity[3]	>99.8%
Electrical	
Power Requirement (spectrometer functions)	250 mA at +5 VDC
Supply Voltage	4.75 – 5.25 V
Connectors	Micro-USB and JAE DD4 (DD4RA40JA1) 40-pin connector
Micro-USB Absolute Maximum Ratings: V_{CC}	+ 5.5 VDC
DD4 Absolute Maximum Ratings: V_{CC} (Pin 40) Voltage on any pin (other than input power)	 + 5.5 VDC +4VDC
Interface	USB 2.0
Mechanical	
Input Fiber Connector	SMA 905
Entrance Slit[4]	25 µm

Physical Dimensions	88.9 mm x 63.5 mm x 31.9 mm (excluding feet)
Weight	265 g
Storage Temperature	-30° to +70° C
Operating Temperature	0 to 50° C
Humidity	0% - 90% noncondensing
[1] Because the baseline will rise rapidly with temperature and extended integration times Ocean Insight recommends integration time be kept below 5 seconds when using the FLAME-NIR+.	
[2] Scan rate is dependent on the operating computer and not the spectrometer. These figures assume a non-real-time operating system.	
[3] Linearity is measured at 25°C using the linearity correction dark subtraction and the electronic dark correction (if applicable).	
[4] Alternative slit options available by request.	

Mechanical Diagram



Dimensions in inches [mm].

Electrical Pinout

The Flame-NIR+ features a 40-pin accessory connector, located on the front of the unit as shown:

DD4 Accessory Connector Pinout Diagram

When facing the 40-pin Accessory Connector on the front of the vertical wall of the Flame-NIR, pin number 1 is on the right.

Listed below is the pin description for the Flame-NIR+ Accessory Connector located on the front vertical wall of the unit. The Flame-NIR+ will include a JAE DD4 receptacle, part number DD4RA40JA1. Most accessories that plug into the Flame-NIR+ will include a JAE DD4 plug, part number DD4PA40MA1. There is also a vertical connector, JAE part number DD4BA40WA1.

Pin #	Function	Voltage Level	Description
1	Ground	N/A	Ground
2	Trigger	5 or 3.3 V	The TTL trigger signal.
3	Continuous Strobe	5 V	TTL output signal used to pulse a strobe that is divided down from the Master Clock signal.
4	Single Strobe	5 V	TTL output pulse used as a strobe signal, which has a programmable delay relative to the beginning of the spectrometer integration period.

Pin #	Function	Voltage Level	Description
5	Lamp Enable	5 V	A TTL signal that is driven Active HIGH when the Lamp Enable command is sent to the Flame.
6	GPIO 0	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
7	GPIO 1	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
8	GPIO 2	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
9	GPIO 3	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
10	Ground	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
11	GPIO 4	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
12	GPIO 5	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
13	GPIO 6	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
14	GPIO 7	2.5 V	General Purpose Software Programmable Digital Inputs/Output*
15	Ground	N/A	Ground
16	SPI Master Clock	3.3 V	Reserved for custom dev
17	SPI Master MOSI	3.3 V	Reserved for custom dev
18	SPI Master CS	3.3 V	Reserved for custom dev
19	SPI Master MISO	3.3 V	Reserved for custom dev
20	Ground	N/A	Ground
21	I^2C Master Clock	3.3 V	Reserved for custom dev
22	I^2C Master Data	3.3 V	Reserved for custom dev
23	Ground	N/A	Ground
24	RS232 TX	-6 to +6 V	RS232 Transmit signal for communication with PC connect
25	RS232 RX	N/A	RS232 Receive signal for communication with PC connect
26	Reserved	N/A	Reserved
27	Reserved	N/A	Reserved
28	Reserved	N/A	Do not connect

Pin #	Function	Voltage Level	Description
29	Reserved	N/A	Reserved
30	Reserved	N/A	Reserved
31	Reserved	N/A	Reserved
32	Reserved	N/A	Reserved
33	Reserved	N/A	Reserved
34	Reserved	N/A	Reserved
35	Reserved	N/A	Reserved
36	Reserved	N/A	Reserved
37	Reserved	N/A	Reserved
38	5V Out	5 V	The input power pin from the Flame.
39	Ground	N/A	Ground
40	5V In	N/A	The input power pin to the Flame. Additionally, when operating via a Universal Serial Bus (USB) this is the USB power connection (+5V), which can be used to power other peripherals (care must be taken to ensure the peripheral complies with USB Specifications). The entire assembly should not draw more than 500 mA. NOTE: Do not connect both USB power and Auxiliary power (as an input) at the same time.
* See the Caution below.			

Caution

Do not connect the GPIO pins to 5V. The GPIOs are not 5V tolerant and will be damaged if connected to 5V. The maximum voltage is 4V for the 3.3V logic pins and 3V for the 2.5V logic pins.

Detector Overview

Detector Description

The detector used for the Flame-NIR+ is an InGaAs photodiode array with integrated CMOS readout circuit.

During each integration period, the current through each photodiode charges an integrated capacitor. After the integration period completes, the charge in each capacitor is measured and then reset. When the capacitor is fully charged, the detector is considered saturated and provides the maximum output level.

Detector Charge Capacity

Ocean Insight products aim for a large signal-to-noise ratio (SNR) in optical measurements so that small signal variations can be observed and a large dynamic range is available. The maximum single scan SNR on most CCD based devices is dominated by the well depth. This is because the maximum possible SNR for an integrating photodetector is limited by photon shot noise, which is the square root of the number of electrons collected during the integration period.

The Flame-NIR+, however, has a very large charge storage capacity compared to most CCDs. As a result, the maximum single scan SNR is significantly higher. In fact, photon shot noise is not typically the dominant source of noise in Flame-NIR+ measurements. Instead, SNR is dominated by other sources of noise such as readout noise or thermal noise, depending on the integration time.

Signal Averaging

Signal averaging is an important tool in the measurement of spectral structures. It increases the S:N and the amplitude resolution of a set of samples. The types of signal averaging available in our software are time-based and spatial-based.

When using the time-base type of signal averaging, the S:N increases by the square root of the number of samples. Signal averaging by summing is used when spectra are stable over the sample period. Thus, even though the maximum single scan SNR is 6000:1 on the Flame-NIR, a S:N of 60,000:1 should be readily achieved by averaging 100 spectra.

Spatial averaging or pixel boxcar averaging can be used to improve S:N when observed spectral structures are broad. The traditional boxcar algorithm averages *n* pixel values on each side of a given pixel.

Time-based and spatial-based algorithms are not correlated, so the improvement in S:N is the product of the two processes.

Internal Operation

Pixel Definition

The Flame-NIR+ has 128 pixels, all of which are optically active and not masked. This is slightly different from other Ocean Insight spectrometers, which have “dummy” and optical black pixels. Therefore, all pixels read from the Flame-NIR+ in OceanView, OmniDriver,

and directly via USB are active and unmasked. This also means that electronic dark correction is not available on the Flame-NIR+. An invalid pixel is defined as a pixel that has an abnormally high amount of dark current (a “hot” pixel) or which has an abnormally low responsivity (a “dead” pixel)”.

CCD Detector Reset Operation

At the start of each integration period, the detector transfers the signal from each pixel to the readout registers and resets the pixels. The total amount of time required to perform this operation is ~8-9μs. The user needs to account for this time delay when the pixels are optically inactive, especially in the external triggering modes.

Strobe Signals

Single Strobe

The Single Strobe signal is a programmable TTL pulse that occurs at a user-determined time during each integration period. This pulse has a user-defined High Transition Delay and Low Transition Delay. The pulse width of the Single Strobe is the difference between these delays. It is only active if the Lamp Enable command is active.

Synchronization of external devices to the spectrometer's integration period is accomplished with this pulse. The Strobe Delay is specified by the Single Strobe High Transition Delay (SSHTD) and the Pulse Width is specified by the Single Strobe Low Transition Delay (SSLTD) minus the Single Strobe High Transition Delay (PW = SSLTD – SSHTD). Both values are programmable in 500 ns increments for the range of 0 to 65,535 (32.7675 ms).

The timing of the Single Strobe is based on the Start of Integration (SOI). SOI occurs on the rising edge of ϕROG, which is used to reset the detector. In all trigger modes using an External Trigger, there is a fixed relationship between the trigger and the SOI. In the Normal mode and Software Trigger mode, the SOI still marks the beginning of the Single Strobe, but due to the nondeterministic timing of the software and computer operating system, this timing will change over time and is not periodic. That is, at a constant integration time, the Single Strobe will not be periodic, but it will indicate the start of the integration.

The Trigger Delay (TD) is another user programmable delay, which specifies the time in 500 ns increments that the SOI will be delayed beyond the normal Start of Integration Delay (SOID).

An example calculation of the Single Strobe timing follows:

If the TD = 1 ms, SSHTD = 50 ms, and SSLTD = 70 ms, then the rising edge of the Single Strobe will occur approximately 51.82 ms (1 ms + 50 ms + 8.2 us) after the External Trigger Input goes high and the Pulse Width will be 20 ms (70 ms – 50 ms).

Continuous Strobe

The Continuous Strobe signal is a programmable frequency pulse-train with a 50% duty cycle. It is programmed by specifying the desired period whose range is 2 µs to 60 s. This signal is continuous once enabled but is not synchronized to the Start of Integration or External Trigger Input. The Continuous Strobe is only active if the Lamp Enable command is active.

Synchronizing Strobe Events

If the application requires more than one pulse per integration period, the user needs to ensure the continuous strobe and integration period are synchronized. The integration time must be set so that an equal number of strobe events occurs during any given integration period.

External Triggering

The Flame-NIR+ Spectrometer has several ways of acquiring data. In the Normal/Free-Run mode, the spectrometer is "free running." That is, the spectrometer is continuously scanning, acquiring, and transferring data to your computer, according to parameters set in the software. In this mode, there is no way to synchronize the scanning, acquisition, and transfer of data with an external event. However, trigger pulses for synchronizing an external event with the spectrometer are available.

Each trigger mode involves connecting an external triggering device to the spectrometer and then applying an external trigger to the spectrometer before the software receives the data. The length of the integration time and the source for the integration clock depend upon the mode chosen. All other acquisition parameters are set in the software.

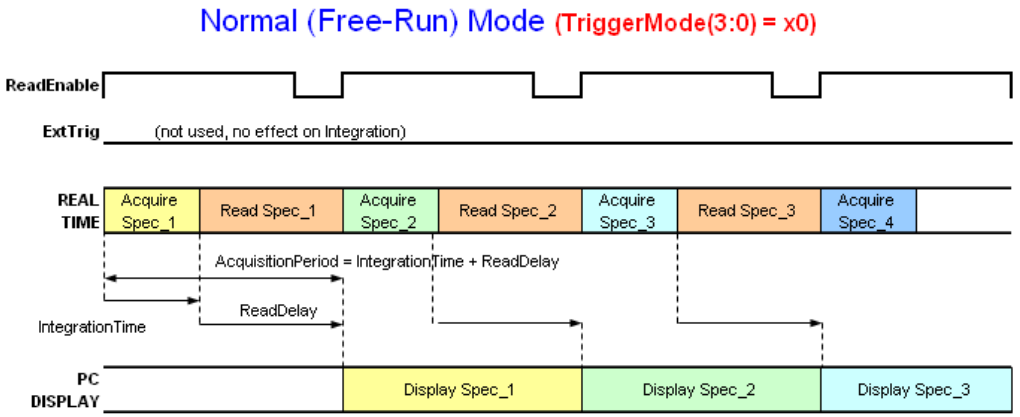
You can trigger the Flame-NIR+ using a variety of External Triggering options through the 40-pin Accessory Connector on the spectrometer. See www.OceanInsight.com for more information.

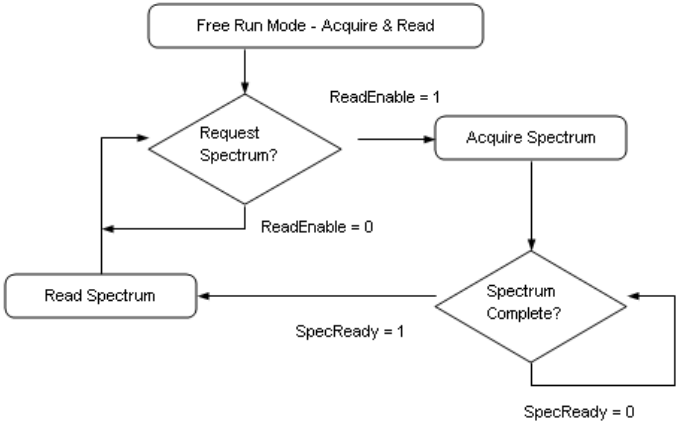
Triggering Modes

The Flame-NIR+ supports three triggering modes, (plus Normal mode), which are set with the Trigger Mode command.

Normal

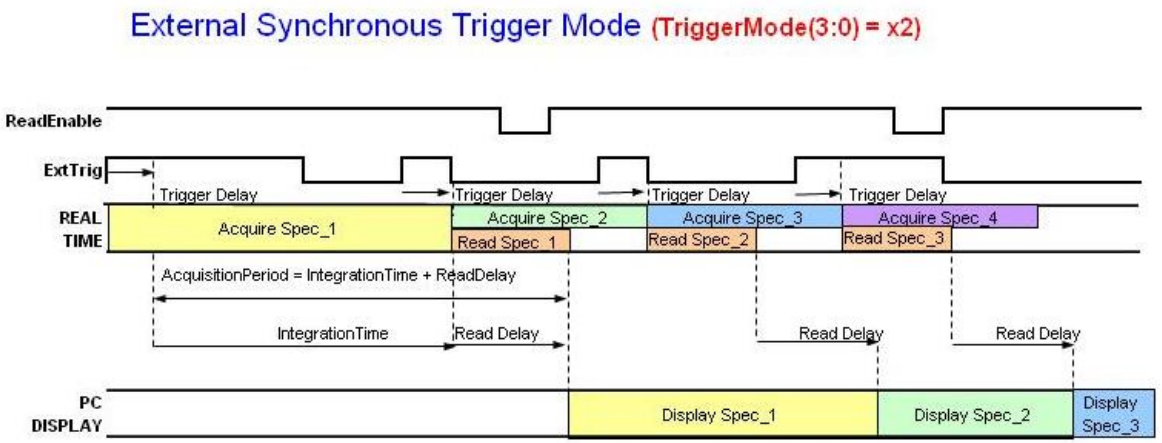
In the Normal (Free-run) mode, the spectrometer will acquire one spectrum for each “get spectrum” command issued from the host software. The integration time for each spectrum is pre-programmed prior to the host issuing its “get spectrum” command. The spectrometer waits in a repetitive idling loop until it receives the next “get spectrum” command. Once the command is received, the spectrometer exposes the detector for the pre-programmed integration time, and its resulting spectrum is written to an internal FIFO. The spectrometer signals the host that a spectrum is ready, and the host reads out the new spectrum. Upon reading out the new spectrum, the host immediately commands the spectrometer to acquire the next spectrum. In this process, the spectrometer is responding “on-demand” to the host’s “get spectrum” commands. The spectrometer waits in an idle state between each spectrum and the next “get spectrum” command. The spectrometer does not pre-fetch any spectra in anticipation of the next “get spectrum” command.

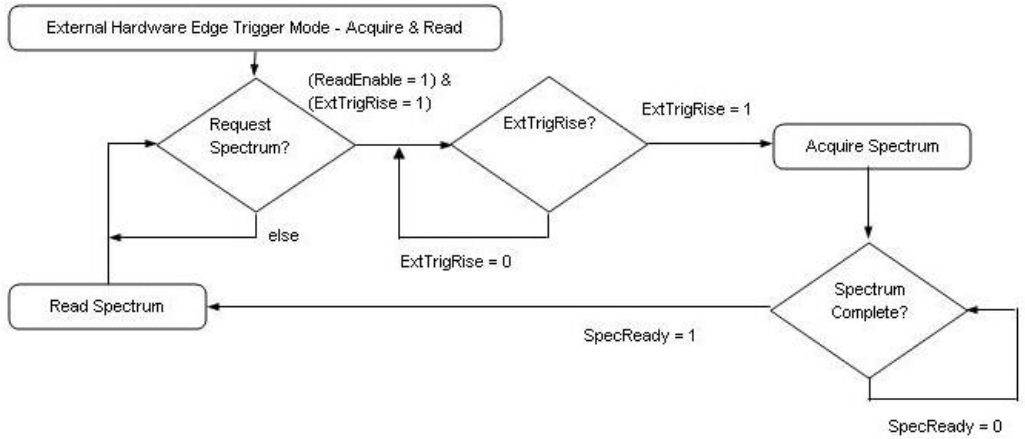




External Synchronous Trigger Mode

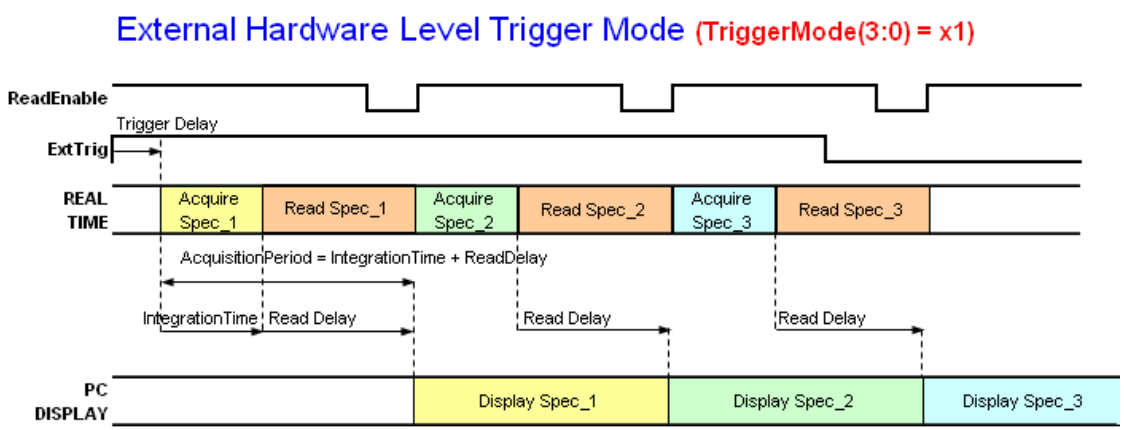
In the External Synchronous Trigger mode, two external triggers are required to complete a data acquisition. The first rising edge starts the integration period and the second rising edge stops the integration and starts the next. Thus, the integration time is the period between the two external trigger pulses. After the integration period, the spectrum is retrieved and available to the user. As in normal mode, no further spectra are acquired until the original spectrum is read by the user.

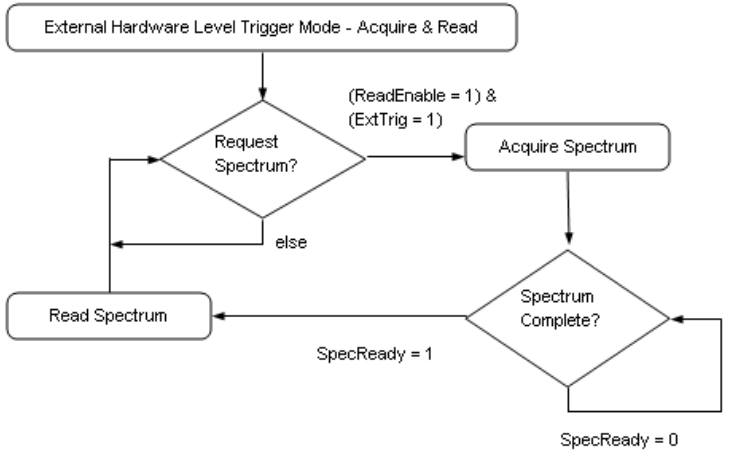




External Hardware Level Trigger Mode

In the External Hardware Level Trigger mode, a rising edge detected by the spectrometer from the External Trigger input starts the integration period specified through the software interface. After the integration period, the spectrum is retrieved and is ready to be read by the user. If the trigger level remains active in a logic one state, back-to-back acquisitions can occur, as in the Normal mode, until the trigger transitions to an inactive level. As in Normal mode, no further spectra are acquired until the original spectrum is read by the user.

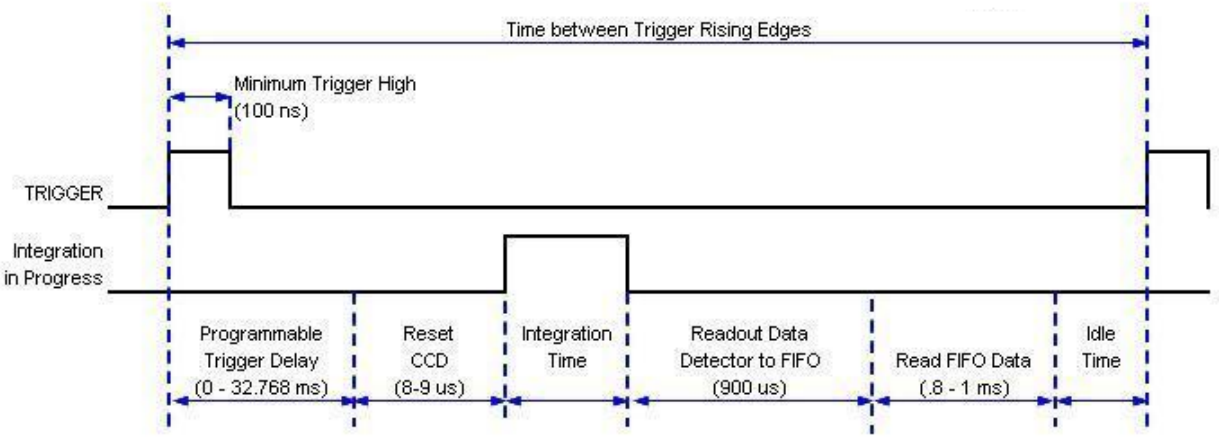




External Hardware Edge Trigger Mode

In the External Hardware Edge Trigger mode, a rising edge detected by the spectrometer from the External Trigger input starts the integration period specified through the software interface. After the integration period, the spectrum is retrieved and is ready to be read by the user. If another trigger is sent a new integration cycle will begin. If a spectrum request is not received before the integration cycle has ended, then that data will be deleted and a new trigger and spectrum request is required. Only one acquisition will be performed for each External Trigger pulse, no matter what the pulse's duration is. No further spectra are acquired until the original spectrum is read by the user.

HR2000+, USB2000+, Flame-S and Flame-NIR -- Timetable for Hardware Edge Trigger Mode



Additional Delay	0	us
Initialize CCD Binning	9	us
Integration time	1,000	us
Read Detector	900	us
Minimum Idle States	1,000	us
Min Trigger Cycle	2,909	us
Min Trigger Cycle	2,909	us
Max Trigger Rate	344	Hz

Unlock the Unknown

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