



OceanOptics



OCEAN HR SERIES

High Resolution Spectrometers

Installation and Operation Manual

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Before You Get Started

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.

Warranty

For the most current warranty information, please visit www.oceanoptics.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.



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.



Warning

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

RoHS Compliant

This device complies with RoHS materials standards.

ISO Certification

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.

Introduction

Product Description

Ocean HR series high-resolution spectrometers are compact and robust, with rapid acquisition speed and excellent spectral stability. Ocean HR models cover various wavelength ranges within 190-1100 nm, with a choice of slit sizes to help you manage throughput and optical resolution.

Features

- Plug-and-play capability via the USB-C connection.
- User-interchangeable slit.
- LEDs show power and data transfer status.
- 4 GPIO pins.
- Includes OceanDirect Software.
- Ethernet Option.

Items Included with Shipment

- Ocean HR Spectrometer
- USB-C Cable
- Wavelength Calibration Data Sheet
- Linearity Calibration Data Sheet (please save Calibration sheets for future reference)

Installation and Setup

NOTE

Be sure to install the spectroscopy application BEFORE connecting the spectrometer to your PC. The software installs the drivers required for spectrometer installation. If you do not install the software first, the system will not properly recognize the spectrometer. If you have already installed the Ocean HR spectrometer to a computer running on a Windows platform prior to installing the operating software, consult the Troubleshooting section for information on correcting a corrupt Ocean HR installation.

Software Installation

Use OceanView version 2.0.13 or above for Ocean HR spectrometers. You can use OceanView on the following operating systems:

NOTE

Be sure that you download the correct software package for your computer version (32 or 64-bit). See the Frequently Asked Questions in Troubleshooting for more information on determining your computer version.

Windows			Mac
8	8.1	10	OS X Version 10.5 or later on Intel processor

*Software may run with previous operating systems but Ocean Optics does not actively support these installations.

Consult the OceanView manual for computer hardware requirements.

Configuring HR Spectrometers

Ocean HR spectrometers 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.

Hardware Setup

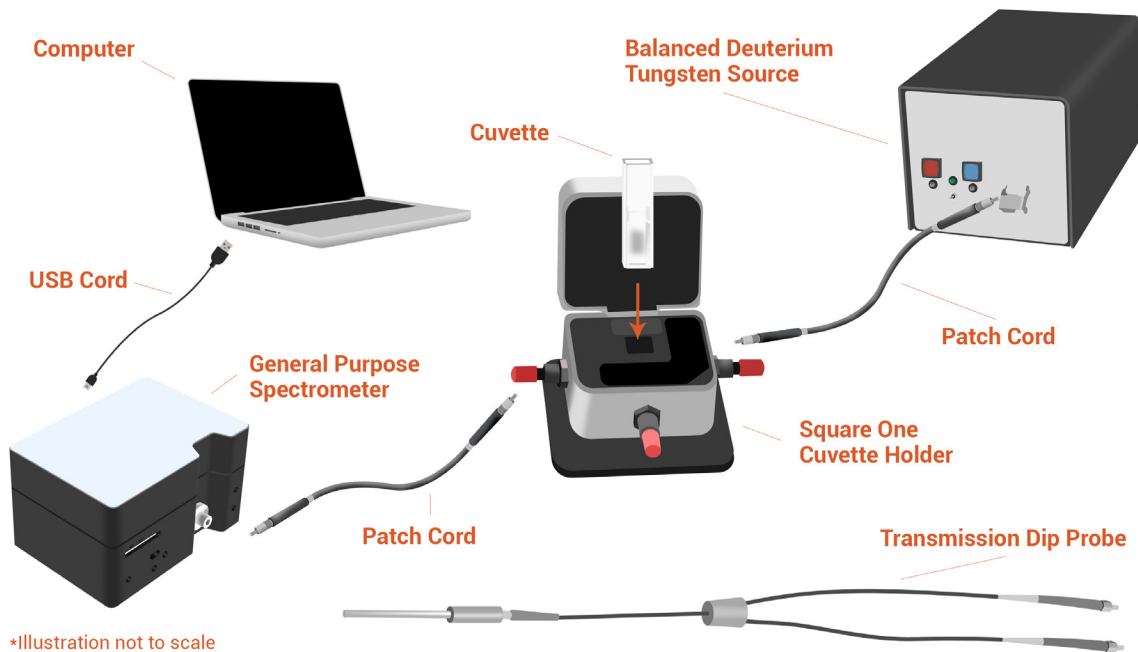
The Ocean HR Spectrometer connects to a computer via the USB port. When connected through a USB 2.0 or 1.1 port, the spectrometer draws power from the host computer, eliminating the need for an external power supply.

Follow the steps below to connect the Ocean HR to a computer via the USB port:

1. Install the spectrometer operating software on the destination computer.
2. Locate the USB cable (USB-CBL-2.0-6) provided with the spectrometer.

3. Insert the micro connector end of the cable into the side of the spectrometer and the larger end of the cable into the USB port of the computer.
4. Connect any spectroscopy accessories. To find operating instructions for Ocean HR-compatible products (such as light sources, sampling chambers, and probes), consult the Ocean Optics website at www.oceanoptics.com.
5. Attach the fiber to the fiber optic connector on the spectrometer.

If you installed the spectrometer operating software prior to connecting the Ocean HR, the software automatically installs the correct drivers. If the drivers do not successfully install (or if you connected the spectrometer to the computer before installing the software), consult Troubleshooting.



Hardware Features

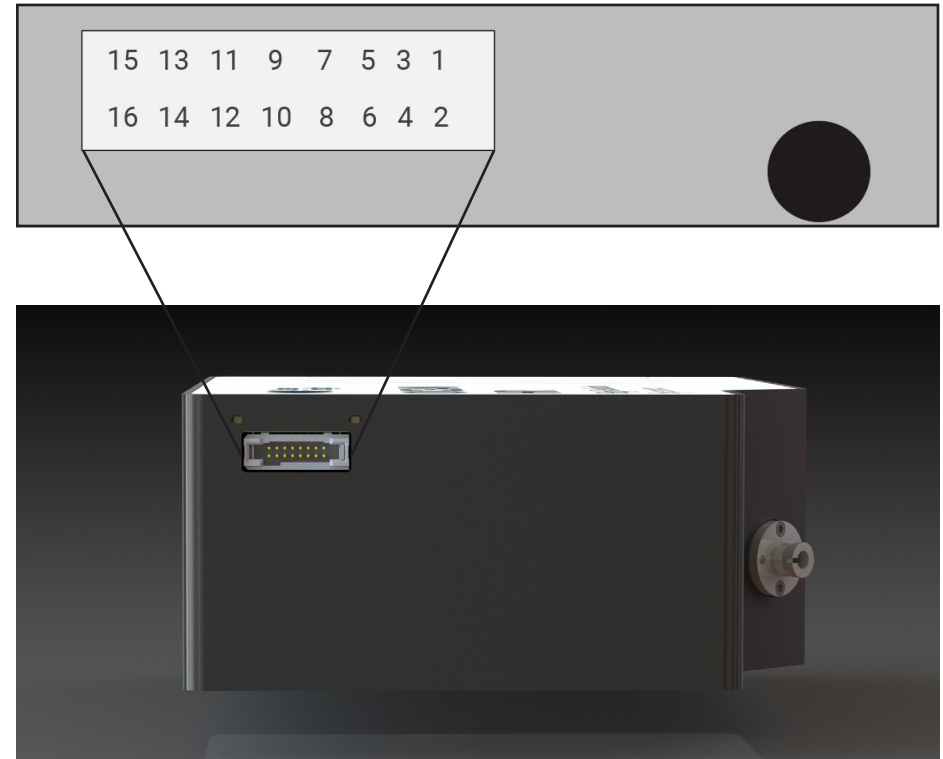
Status Indicator LEDs

Ocean HRs have two indicator lights that operate as shown:

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

NOTE

LEDs can be turned off in OceanView or by using a software API command in OmniDriver or OceanDirect.



16 Pin IO Connector

This port allows the Ocean HRs to be connected to Ocean Optics light sources and other external equipment.

PIN	Function	Description
1	RS-232-TX	Spectrometer transmit to host
2	RS-232-RX	Spectrometer receive from host
3	GND	Ground
4	RSTn	External reset input
5	LampEnable	Output
6	ExtTrigIn	External trigger input
7	SingleStrobe	Single strobe output
8	ContStrobe	Continuous strobe output

PIN	Function	Description
9	GPIO.0	General purpose I/O
10	GPIO.1	General purpose I/O
11	GPIO.2	General purpose I/O
12	GPIO.3	General purpose I/O
13	Reserved	
14	Reserved	
15	+5VDC	External power supply input
16	GND	Ground

Pins 4-12 on the auxiliary connector are 3.3V CMOS-compatible inputs or outputs, with +/- 1mA drive capability.

External Reset Input Pin

The Ocean HR can reset itself via an external reset pin. Applying a logic low input to the RSTn pin places the HR into a hardware reset condition and will remain in reset until the input is brought high again. Note that this is a full hardware reset. All operating parameters are also reset to defaults, which can be restored by re-initializing via software commands.

16 Pin Connector Cable (CBL-ISDF-DB15)

This cable connects to the following external light sources:

DH - 3PLUS
DH - 2000 (US)
HPX - (US)
HL - 2000 - FSHA
HL - 3P

16 Pin Connector Cable (CBL-ISDF-PX-DB15)

PX - 2

RS-232 Interface

The spectrometer supports an optional RS-232 interface for communication as an alternative to USB. Refer to the Serial Communications Protocol Technical Note available on our website for details on how to connect to and use the RS-232 interface.

Troubleshooting

Sometimes things do not go according to plan. If problems arise, do not hesitate to contact us and our Tech Support team will leap into action. Some typical questions are answered here. For more information, consult the FAQs on the Ocean Optics website.

Ocean HRs Connected to Computer Prior to Application Installation

Windows Operating Systems

If you connected your Ocean HR 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 Optics 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.

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 Ocean HR 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.

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 Ocean HR spectrometers in a Mac operating system, you should not encounter any problems if you installed the spectrometer before the operating software.

Frequently Asked Questions

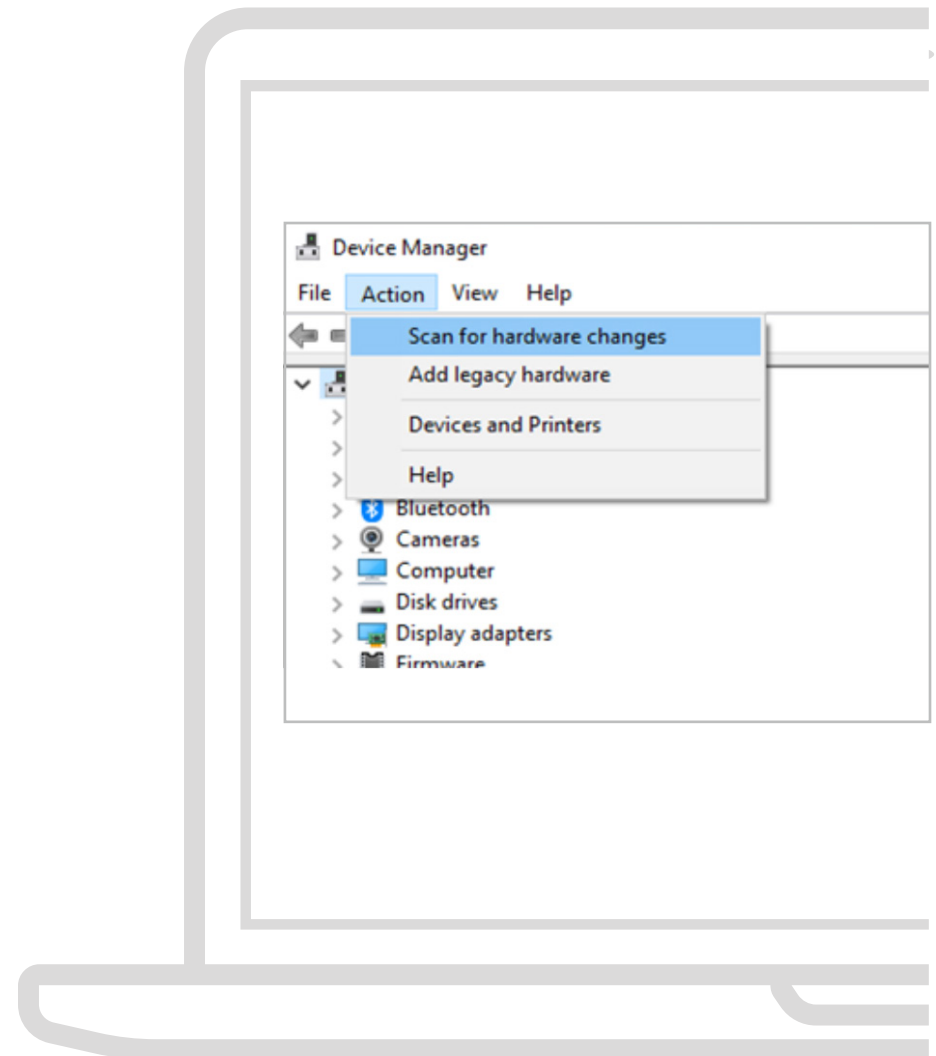
I connected the USB cable and started OceanView but I don't see my spectrometer attached.

Use the "Action -> Scan for hardware changes" selection in the Device Manager to rescan for attached devices.

I am having trouble installing the drivers, what should I do?

Hardware device driver installation is usually seamless on Microsoft Windows operating systems and should happen in the background when you connect your spectrometer to a computer with the software installed. However, some Windows systems require a bit more care when connecting your spectrometer for the first time.

If your spectrometer is not recognized by OceanView on your computer, you need to manually install the spectrometer drivers. See your OceanView manual for this procedure. Also consult the *Correcting Device Driver Issues* document on www.oceanoptics.com



How do I know my spectrometer has power?

The red LED on the spectrometer should be constantly on 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.

I connected the Ocean HR to the computer before installing my spectroscopy operating software to install the drivers. What do I do now?

As detailed below, the steps to take to resolve this issue differ, depending on your computer's operating system.

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 OceanView by opening the Schematic window and double-clicking the spectrometer icon.

NOTE

For RMA returns under warranty we will organize and pay for shipping both ways. For accidental damage, you pay only to have the product shipped to your closest Ocean Optics or distributor office.

Repairs

Sometimes accidents happen! If you need to return your Ocean Optics product for repair, here is what to do:

1. Contact us to evaluate and diagnose the problem. If it is determined that the product must be returned, the representative will issue an RMA number.
2. Package your product, ideally in the original packaging, and return it to Ocean Optics, along with the RMA number that you received.

Upon careful examination, we'll advise you with an estimate. When your product is ready, it will be returned to you.

Servicing

To keep your instrument in tip-top shape we recommend yearly wavelength recalibration. You can do this yourself if you have appropriate tools or we can do this for you. Contact your local representative to find out more about service availability and cost. We offer the following services:

- Wavelength Calibration
- Absolute Irradiance Calibrations

Technical Specifications

Test conditions for the following data: 25° C

Specification	HR2	HR4	HR6
Optical and Spectroscopic			
Integration Time	1ux - 6 s	3.8 ms-10 s	7.2 ms-5 s
Dynamic Range ¹	3400:1	1300:1	12000:1
Signal to Noise Ratio (per second with High Speed Averaging Mode)	25800:1	3000:1	3500:1
Signal to Noise Ratio (single scan @ 10 ms)	380:1	250:1	400:1
Optical Resolution (FWHM)	<1.0 nm w/25 µm slit (configuration-dependent)		
Scan Rate ²	725 Hz	74 Hz	74 Hz
Thermal Wavelength Drift ³	0.02 nm/° C	0.02 nm/° C	0.02 nm/° C
Triggering	Software, External rising edge, External level		
Wavelength Range (beginning/ ending wavelengths may vary marginally)	220-1050 nm	220-1050 nm	185 - 1100 nm
Entrance Slit	5, 10, 25, 50, 100, 200 µm		
Detector			
Active Pixels	2098	3648	2048

Technical Specifications

Specification	HR2	HR4	HR6
Corrected Linearity	99.40%	99.70%	99.70%
Electrical			
Connectors	USB Type-C, SMA, TFM-108-02-L-DH, RS-232, RJ-45 Ethernet Option		
USB Type-C Ratings: VCC	Minimum 4.40V, Nominal 5V, Maximum 5.25V		
IO Standard	3.3V CMOS		
Absolute Maximum Ratings: Voltage on any pin (other than input power)	5V		
Interface	USB 2.0 High Speed		
External Triggering Jitter	21 ns		
Mechanical			
Input Fiber Connector	SMA 905		
Physical Dimensions (LWH)	148.8 x 106.4 x 48.2 mm, 150.1 x 107.1 x 65.3 with Ethernet		
Weight	931 g		

Technical Specifications

Specification	HR2	HR4	HR6
Environmental			
Temperature (storage)		-30 °C - 70 °C	
Temperature (operation)		0 °C - 55 °C	
Humidity		<85%	
Operation		For indoor use	
Operating Altitude (maximum)		2000 m	
Overvoltage Category		1	
Pollution Degree		2	
¹ Dynamic range of the system is the range of the detectable light level and can be thought of as the maximum detectable light level at the minimum integration time divided by the minimum detectable light level at the maximum integration time.			
² Scan rate is dependent on factors external to the spectrometer.			
³ Tested with the UV-visible spectrometer model.			

Spectrometer Configuration

This section describes the spectrometer's configurable parameters. The spectrometer provides configurable integration time, acquisition modes, trigger modes, delays, and strobe signals. This configurability provides the

user with a high level of control over the timing of their integration and the ability to synchronize external devices such as lasers or light sources to the spectrometer.

Integration Time

The Integration Time defines the length of exposure time for the detector. The user may set the Integration Time through software. A longer Integration Time allows more photons to be collected each acquisition, increasing the signal value. A shorter Integration Time reduces the number of photons collected each acquisition, thereby reducing the signal value. Refer to the Spectrometer Technical Specifications table for the minimum and maximum values supported for Integration Time.

Trigger Modes

The time when the spectrometer receives a trigger is called a Trigger Event. The Trigger Event is the signal to start an Acquisition Cycle. An Acquisition Cycle consists of a delay, then one or more integrations, followed by a readout of the data to be returned to the host system.

The spectrometer supports different trigger modes, which are set with the Trigger Mode command. The supported trigger modes are briefly described in the following subsections. The combination of the Acquisition Mode and the Trigger Mode defines the timing for each acquisition. For more details on the timing and behavior of each trigger mode, refer to the Acquisition Mode section.

Software Trigger Mode (0)

The Trigger Event is initiated with a command from software running on the host system. The integration time is set by software configuration.

External Edge Trigger Mode (1)

The Trigger Event is initiated by the rising edge of the External Trigger input signal on the 16 Pin IO Connector. The integration time is set by software configuration.

External Level Trigger Mode (2)

The Trigger Event is initiated by the rising edge of the External Trigger input signal on the 16 Pin IO Connector. The integration time is determined by the pulse width of the External Trigger input.

Acquisition Modes

The spectrometer may support different acquisition modes described in this section. These modes can be selected to perform multiple integrations within a single acquisition. This allows the hardware to perform integrations back-to-back and possibly provide hardware accelerated averaging. The following table summarizes some of the key differences between the acquisition modes and what configurations are supported.

Table 1 Acquisition Mode Summary Table

Acquisition Mode	Single Spectrum	High Speed Averaging Mode (HSAM)
Number of Integrations	1	Scans to Average
Number of Spectra returned	1	1
Integrations performed Back-to-Back	No	Yes
Trigger Modes Supported	<ul style="list-style-type: none"> • Software Trigger • External Edge Trigger • External Level Trigger 	<ul style="list-style-type: none"> • Software Trigger • External Edge Trigger
Description	Performs a single integration and returns a single spectrum.	Performs a number of integrations specified by the Scans to Average configuration. One spectrum containing the average for each pixel is returned.

Single Spectrum

The Single Spectrum Acquisition Mode performs a single integration per acquisition cycle. The spectrum is returned to the host system before the spectrometer accepts a new trigger. This is the default acquisition mode when powering on your spectrometer.

The Single Spectrum Acquisition Mode supports all Trigger Modes. The subsections below provide detailed timing diagrams and values for each Trigger Mode when operating in Single Spectrum Acquisition Mode.

Software Trigger Mode

The Software Trigger Mode is the default Trigger Mode on device power-on. In the Software Trigger Mode, the Trigger Event is initiated by a request from software on the host system. Note that there is some latency between the software on the host computer and the Trigger Event; this latency varies between computer systems. The Trigger Event starts an Acquisition Cycle which consists of an initial delay, an integration time, then a final delay before the data is returned to the host system.

The initial delay between the Trigger Event and the start of integration time is the sum of the user defined Acquisition Delay (t_{ACQDLY}) and a fixed delay (t_{BUSY1}).

The Integration Time (t_{INTEG}) is configurable in software by the user. This is the time that the detector is collecting spectra data.

The final delay (t_{BUSY2}) occurs after the Integration Time completes until the end of the Acquisition Cycle. After the Acquisition Cycle completes, the spectrometer transfers data to the host computer and is then ready for another trigger.

The Single Strobe timing is relative to the Trigger Event. The Single Strobe has a configurable delay defined as t_{SSDLY} . The Single Strobe is a single pulse that goes high at the end of t_{SSDLY} and stays high for a specified time of t_{SSH} . The values for the Single Strobe delay and pulse width are set by the user in software.

The Continuous Strobe signal is a series of pulses with a user specified period that starts with the beginning of the integration time (t_{INTEG}). The pulses have a 50% duty cycle and only full periods are exercised during the integration time. If a subsequent Continuous Strobe period cannot be completed before the end of the integration time, the continuous strobe signal is turned off and set low.

The following timing diagram shows an acquisition cycle for a Software Trigger event.

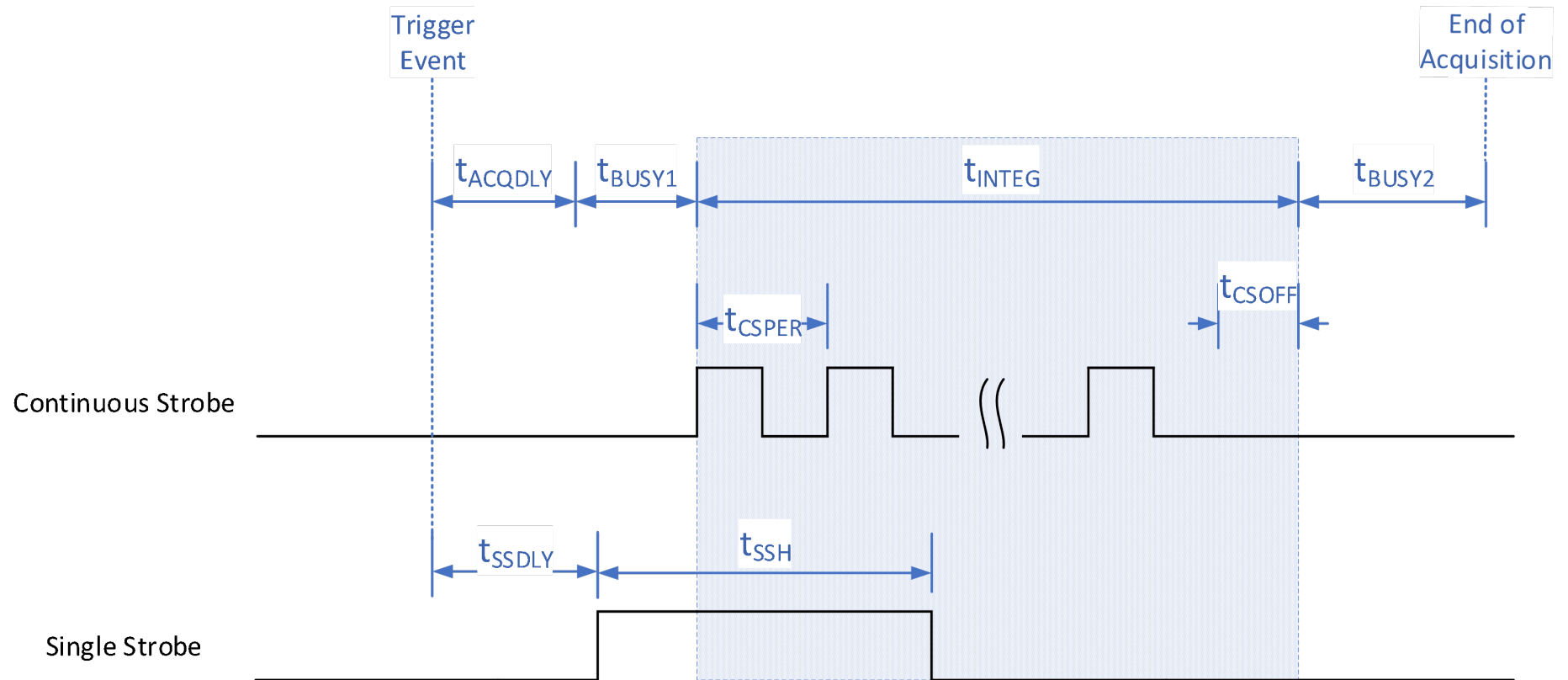


Figure 1 Software Trigger Timing Diagram

Table 2 HR2 Software Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	1 μ s	--	218 μ s	1 μ s when $t_{INTEG} \geq 218 \mu$ s (219 μ s - t_{INTEG}) when $t_{INTEG} < 218 \mu$ s
t_{INTEG}	Integration Time	1 μ s	--	6 s	User specified, 1 μ s resolution
t_{BUSY2}	Final Busy	--	218 μ s	--	Constant at 218 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	

Table 3 HR4 Software Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	--	3706 μ s	--	Constant at 3706 μ s
t_{INTEG}	Integration Time	3800 μ s	--	10 s	User specified, 1 μ s resolution
t_{BUSY2}	Final Busy	--	3706 μ s	--	Constant at 3706 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	

Table 4 HR6 Software Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
tACQDLY	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
tBUSY1	Initial Busy	--	15 ns	--	Constant at 15 ns
tINTEG	Integration Time	7200 μ s	--	5 s	User specified, 1 μ s resolution
tBUSY2	Final Busy	--	4977 μ s	--	Constant at 4977 μ s
tSSDLY	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
tSSH	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
tCSPER	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
tCSOFF	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	

External Edge Trigger Mode

The External Edge Trigger mode for the spectrometer uses a rising edge on the External Trigger input signal from the 16 pin IO connector as the source for a Trigger Event. The External Trigger signal must have a minimum high time of at least 10 ns. There is a short delay ($t_{ETRGDLY}$) between the external signal rising edge and Trigger Event where the acquisition cycle begins.

For the case of an External Edge Trigger, T0 is defined as the moment the external trigger signal goes from low to high. After the External Edge Trigger Delay ($t_{ETRGDLY}$), there is the integration delay ($t_{BUSY1} + t_{ACQDLY}$), followed by the integration time (t_{INTEG}), then finally the last busy time (t_{BUSY2}).

The Single Strobe signal for the case of an edge trigger event is similar to

that of a software trigger. The Single Strobe Delay is relative to the Trigger Event. The Single Strobe Width defines the pulse width of the Single Strobe output signal.

Also, the Continuous Strobe signal function while in External Edge Trigger mode is the same as that of the software trigger. The Continuous Strobe output signal starts with the start of the integration time. Only full periods of the Continuous Strobe are exercised during integration time.

The following timing diagram shows an acquisition cycle for an External Edge Trigger event.

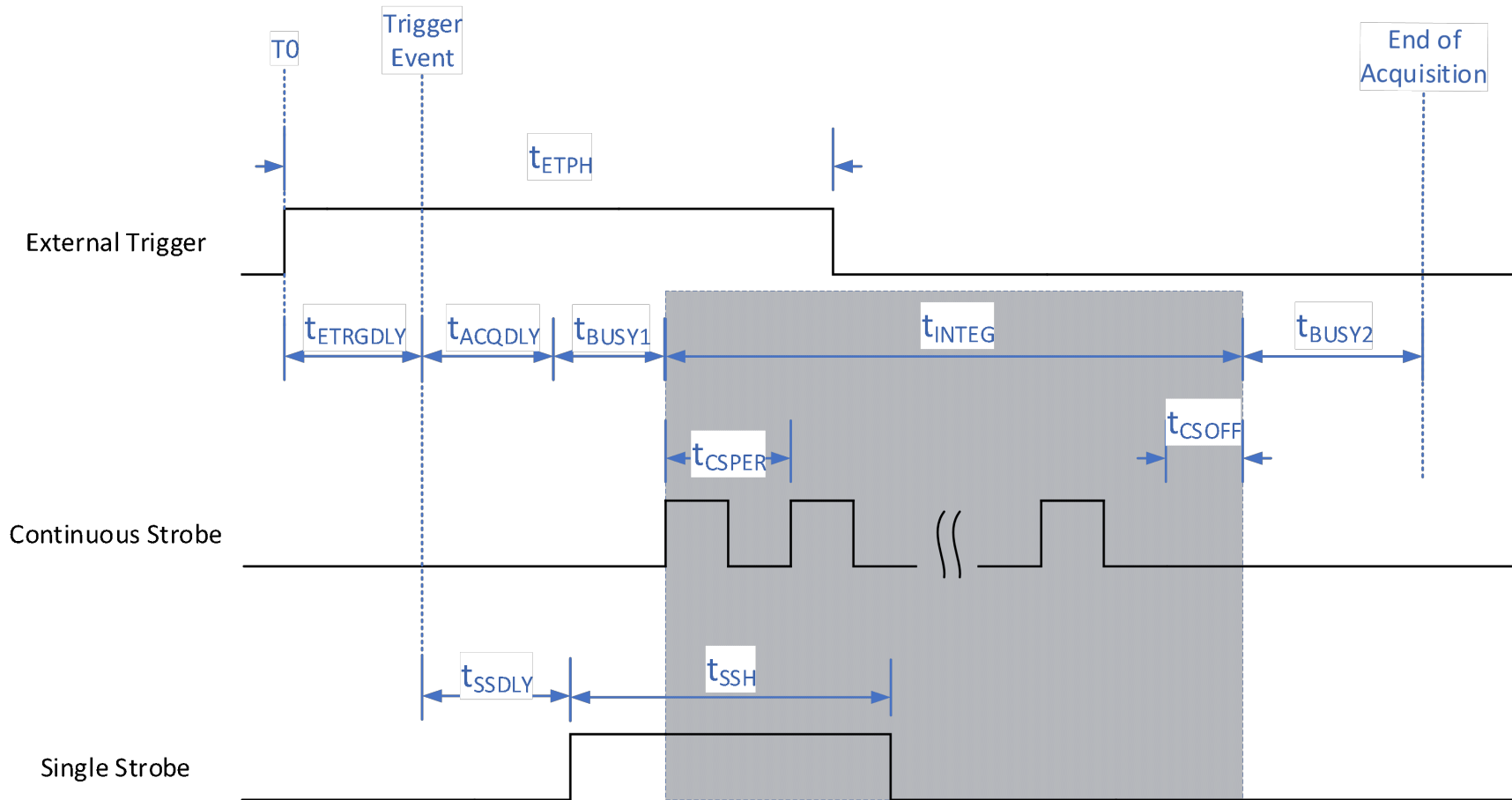


Figure 2 External Edge Trigger Timing Diagram

External Edge Trigger timing characteristics are defined in the tables below.

Table 5 HR2 External Edge Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ETPH}	External Edge Trigger Pulse Width	10 ns	--	--	
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	Time from External Trigger rising edge to Trigger Event
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	1 μ s	--	218 μ s	1 μ s when $t_{INTEG} \geq 218 \mu$ s (219 μ s - t_{INTEG}) when $t_{INTEG} < 218 \mu$ s
t_{INTEG}	Integration Time	1 μ s	--	6 s	User specified, 1 μ s resolution
t_{BUSY2}	Final Busy	--	218 μ s	--	Constant at 218 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	

Table 6 HR4 External Edge Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ETPH}	External Edge Trigger Pulse Width	10 ns	--	--	
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	Time from External Trigger rising edge to Trigger Event
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	--	3706 μ s	--	Constant at 3706 μ s
t_{INTEG}	Integration Time	3800 μ s	--	10 s	User specified, 1 μ s resolution
t_{BUSY2}	Final Busy	--	3706 μ s	--	Constant at 3706 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	-	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	-	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	

Table 7 HR6 External Edge Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ETPH}	External Edge Trigger Pulse Width	10 ns	--	--	
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	Time from External Trigger rising edge to Trigger Event
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	--	15 ns	--	Constant at 15 ns
t_{INTEG}	Integration Time	7200 μ s	--	5 s	User specified, 1 μ s resolution
t_{BUSY2}	Final Busy	--	4977 μ s	--	Constant at 4977 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	

External Level Trigger Mode

The External Level Trigger mode for the spectrometer waits for a trigger signal in the 16 Pin IO Connector on the External Trigger Input pin. In External Level Trigger mode, rather than using the software configured integration time, the integration time is directly related to the pulse width of the trigger pulse. The rising edge of the External Trigger signal causes a Trigger Event after a short constant time (t_{ETRGDLY}). There is a constant delay from the Trigger Event to the start of integration (t_{BUSY1}). The start of Integration Time can be further delayed by configuring the Acquisition Delay (t_{ACQDLY}).

Since the trigger pulse width determines the integration time, the trigger signal must remain high for a minimum time. If the External Level Trigger pulse does not meet the minimum pulse width, an error will occur and the received spectral values will be all 0's.

The Single Strobe signal functions the same as the other trigger modes.

However, the Continuous Strobe signal is slightly different. The Continuous Strobe is active during the integration time, but the Continuous Strobe signal will be forced low at the end of the integration time. This means the final period of the Continuous Strobe signal is not guaranteed to be a full period.

The following timing diagram shows an acquisition cycle for an External Level trigger event.

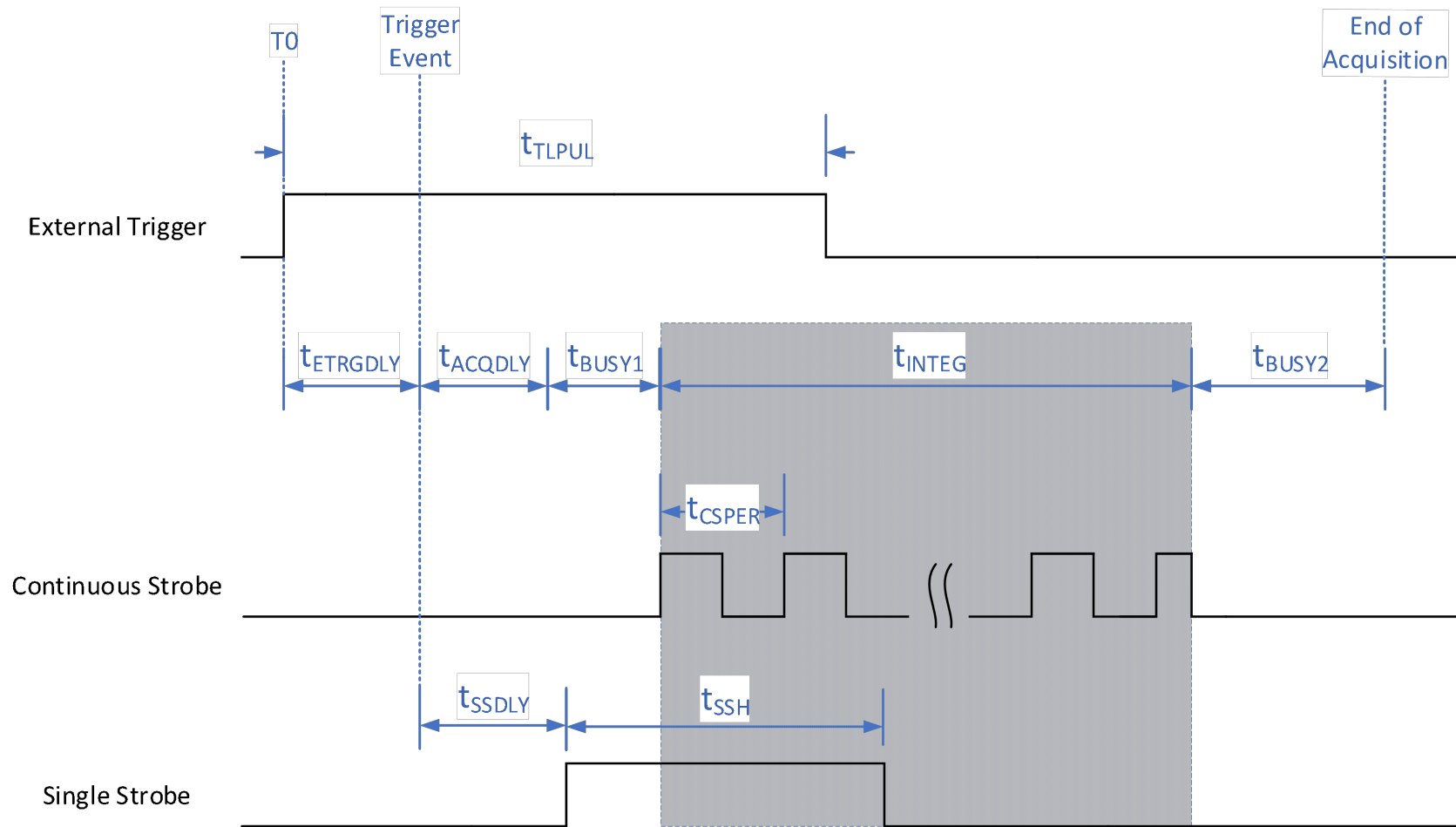


Figure 3 External Level Trigger Timing Diagram

External Level Trigger timing characteristics are defined in the tables below.

Table 8 HR2 External Level Trigger Timing Characteristics

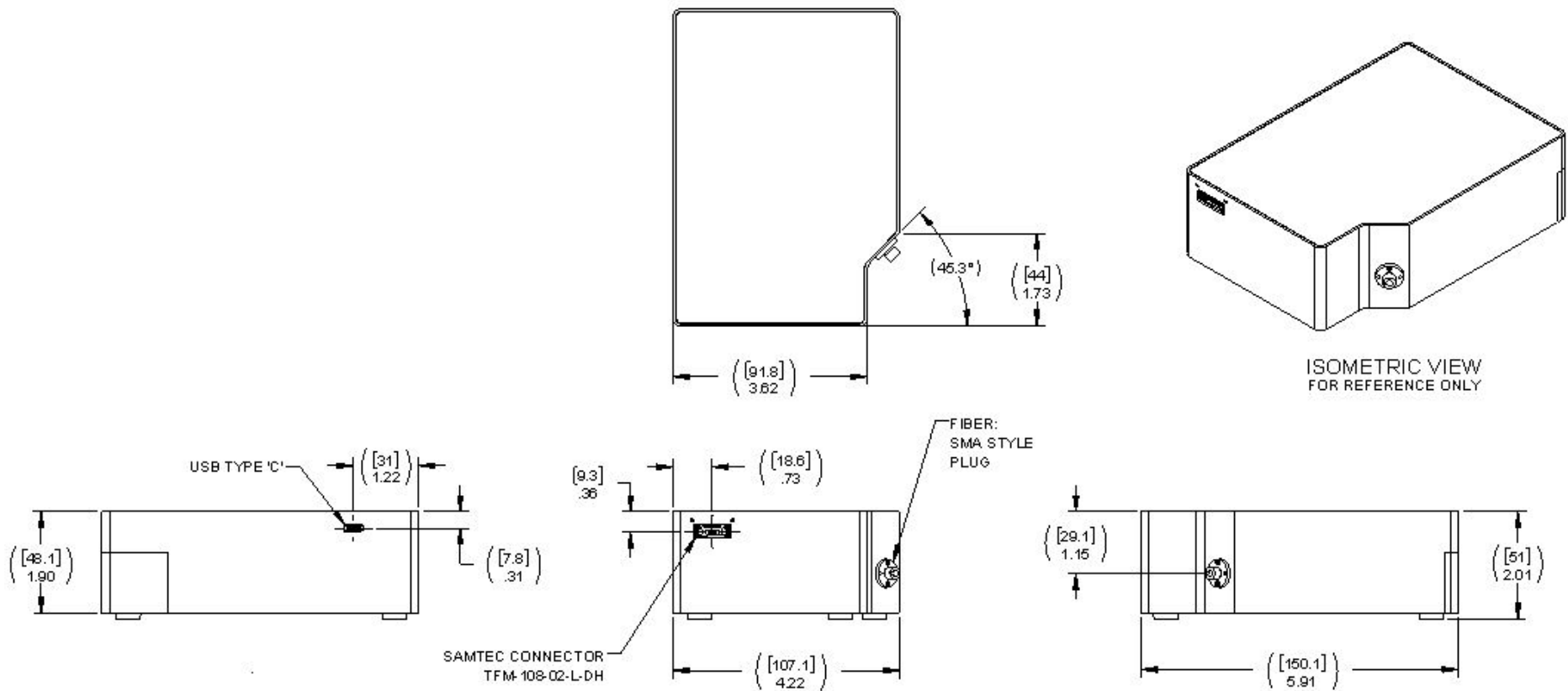
Symbol	Description	Time			Notes
		min	typ	max	
t_{TLPUL}	External Level Trigger Pulse Width	220 μ s	--	6 s	Integration time is equal to t_{TLPUL}
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	Time from External Trigger rising edge to Trigger Event
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	--	1 μ s	--	Constant at 1 μ s
t_{INTEG}	Integration Time	220 μ s	--	6 s	Integration time is equal to t_{TLPUL} .
t_{BUSY2}	Final Busy	--	218 μ s	--	Constant at 218 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	-	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	-	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Continuous Strobe negates at end of integration time.

Table 9 HR4 External Level Trigger Timing Characteristics

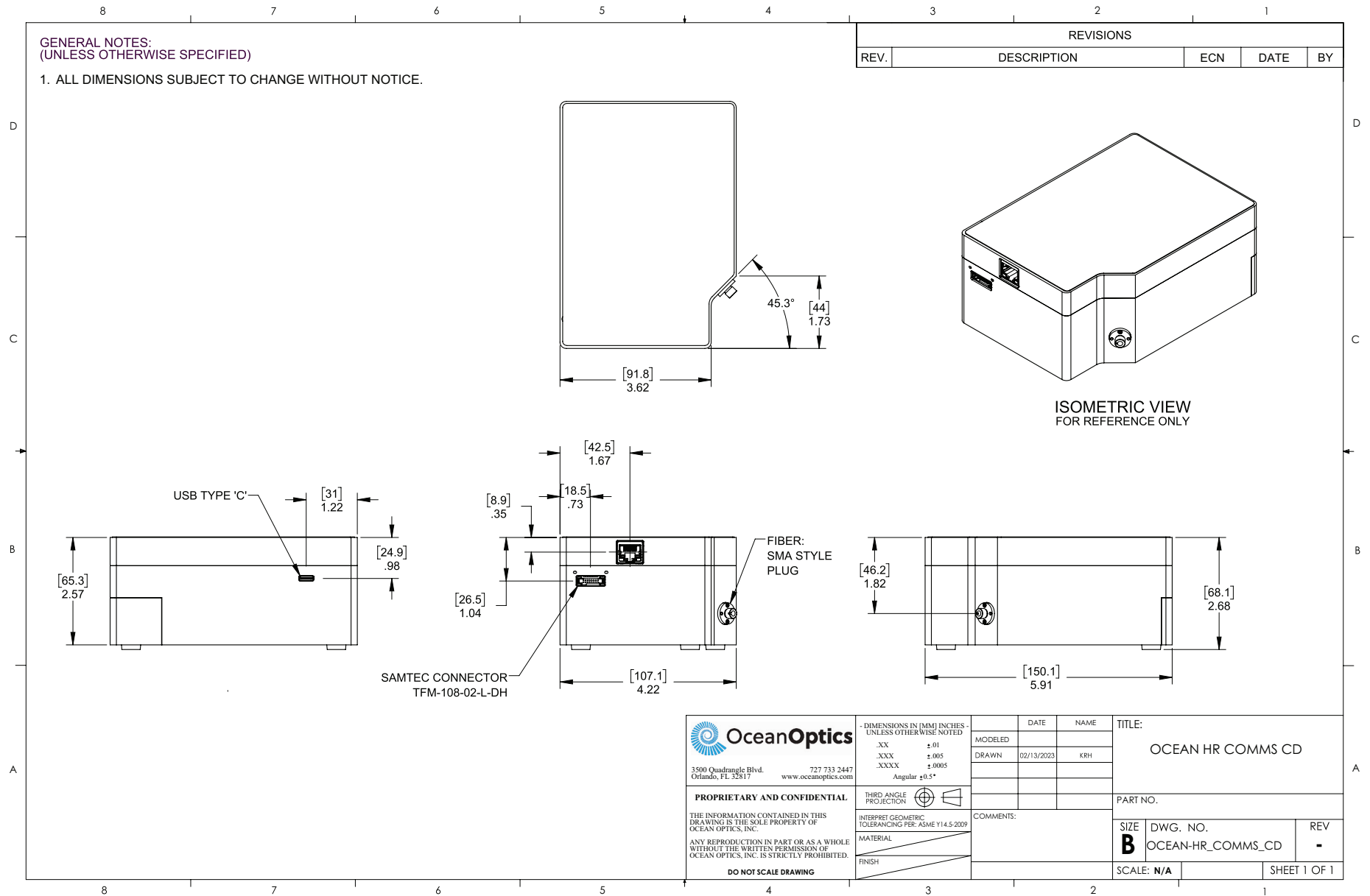
Symbol	Description	Time			Notes
		min	typ	max	
t_{TLPUL}	External Level Trigger Pulse Width	3800 μ s	--	10 s	Integration time is equal to t_{TLPUL}
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	Time from External Trigger rising edge to Trigger Event
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	--	3706 μ s	--	Constant at 3706 μ s
t_{INTEG}	Integration Time	3800 μ s	--	10 s	Integration time is equal to t_{LPUL} .
t_{BUSY2}	Final Busy	--	3706 μ s	--	Constant at 3706 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Continuous Strobe negates at end of integration time.

Mechanical Dimensions

Mounting: Recommend use of two #4-40 holes located on the Samtec/Fiber input side for a mounted configuration.



Mechanical drawings for Ethernet



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	MODELED				OCEAN HR COMMS CD
	DRAWN	02/13/2023	KRH		
THIRD ANGLE PROJECTION	INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5-2009		COMMENTS:		PART NO.
MATERIAL	FINISH				SIZE B
				DWG. NO. OCEAN-HR_COMMS_CD	
				REV -	
				SCALE: N/A	
				SHEET 1 OF 1	

Table 10 HR6 External Level Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{TLPUL}	External Level Trigger Pulse Width	7200 μ s	--	5 s	Integration time is equal to t_{TLPUL}
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	Time from External Trigger rising edge to Trigger Event
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial Busy	--	6 μ s	--	Constant at 6 μ s
t_{INTEG}	Integration Time	7200 μ s	--	5 s	Integration time is equal to t_{LPUL} .
t_{BUSY2}	Final Busy	--	4977 μ s	--	Constant at 4977 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Continuous Strobe negates at end of integration time.

High Speed Averaging Mode (HSAM)

High Speed Averaging Mode enables the spectrometer to perform multiple integrations within one acquisition cycle. The spectrometer performs averaging of the integrations on the hardware. The result is that each pixel of the spectrum returned to the host computer represents the average of that pixel value over the specified number of integrations.

HSAM only supports Software and External Edge Trigger modes. External Level Trigger is not supported with HSAM. If configured for Software Trigger, the Trigger Event occurs when the spectrometer recognizes the request for spectra capture. If configured for External Edge Trigger mode, then the Trigger Event occurs a short delay ($t_{ETRGDLY}$) after the rising edge of the External Trigger input signal.

The following timing diagram shows an acquisition cycle when configured with HSAM over N number of integrations.

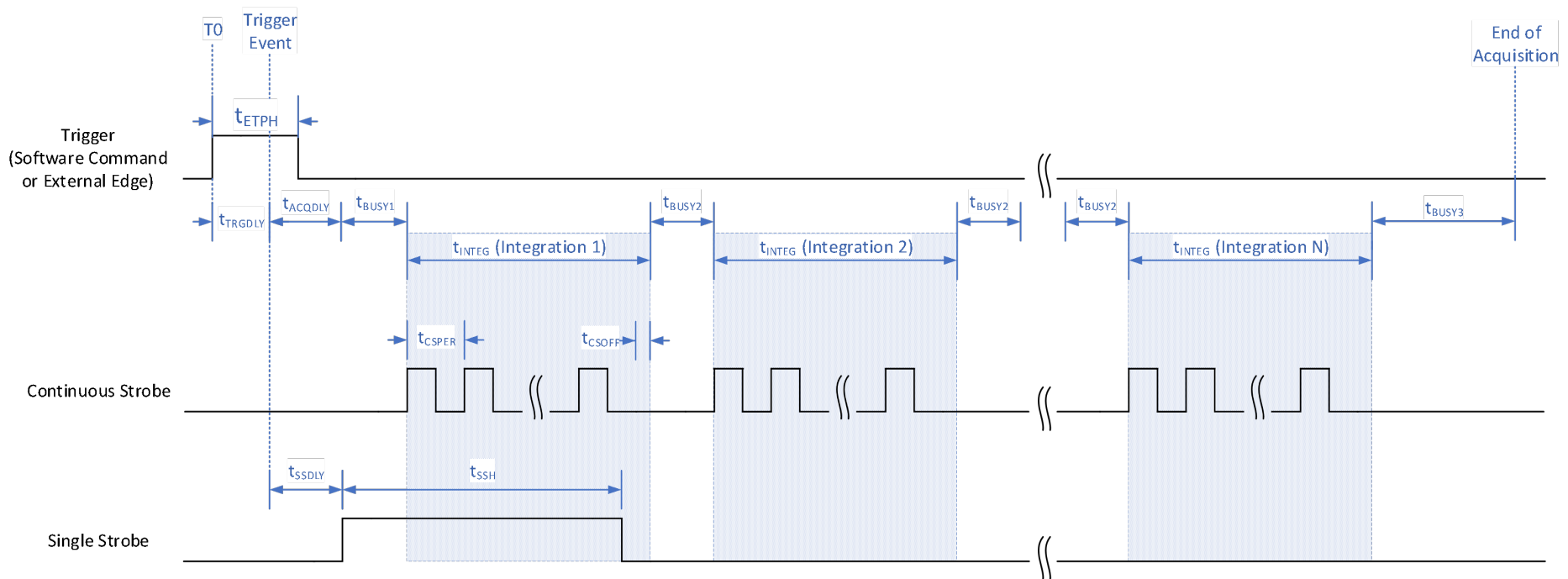


Figure 4 HSAM Timing Diagram

HSAM timing characteristics are defined in the tables below.

Table 9 HR4 External Level Trigger Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ETPH}	External Edge Trigger Pulse Width	10 ns	--	--	
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial busy time	--	1 μ s	--	Constant at 1 μ s
t_{INTEG}	Integration Time	218 μ s	--	6 s	User specified, 1 μ s resolution
t_{BUSY2}	Busy time between integrations	--	0 μ s	--	Constant at 0 μ s. Integrations are back-to-back in High Speed Averaging Mode
t_{BUSY3}	Final busy time	--	218 μ s	--	Constant at 218 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of the first integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of the first integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	
N	Number of Integrations	2	--	65,535	User specified.

Table 12 HR4 HSAM Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ETPH}	External Edge Trigger Pulse Width	10 ns	--	--	
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial busy time	--	3706 μ s	--	Constant at 3706 μ s
t_{INTEG}	Integration Period	3800 μ s	--	10 s	User specified, 1 μ s resolution
t_{BUSY2}	Busy time between integrations	--	0 μ s	--	Constant at 0 μ s. Integrations are back-to-back in High Speed Averaging Mode
t_{BUSY3}	Final busy time	--	3706 μ s	--	Constant at 3706 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of the first integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of the first integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	
N	Number of Integrations	2	--	65,535	User specified.

Table 13 HR6 HSAM Timing Characteristics

Symbol	Description	Time			Notes
		min	typ	max	
t_{ETPH}	External Edge Trigger Pulse Width	10 ns	--	--	
$t_{ETRGDLY}$	External Edge Trigger Delay	20 ns	--	30 ns	
t_{ACQDLY}	Acquisition Delay	0 μ s	--	335,500 μ s	User specified, 1 μ s resolution
t_{BUSY1}	Initial busy time	--	15 ns	--	Constant at 15 ns
t_{BUSY2}	Busy time between integrations	--	835 μ s	--	Constant at 835 μ s
t_{INTEG}	Integration Period	7200 μ s	--	5 s	User specified, 1 μ s resolution
t_{BUSY3}	Final busy time	--	4977 μ s	--	Constant at 4977 μ s
t_{SSDLY}	Single Strobe Delay	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of the first integration time.
t_{SSH}	Single Strobe Width	0 μ s	--	--	User specified, 1 μ s resolution. Single Strobe returns low at the end of the first integration time.
t_{CSPER}	Continuous Strobe Period	0 μ s	--	t_{INTEG}	User specified, 1 μ s resolution. Should be less than Integration Time to activate.
t_{CSOFF}	Continuous Strobe Off Time	0 μ s	--	t_{CSPER}	
N	Number of Integrations	2	--	65,535	User specified.

Strobe Signals

The spectrometer supplies two strobe output signals to allow the user to synchronize external devices to trigger events and integration time. Each strobe signal can be independently enabled or disabled. The following subsections define the Single Strobe and Continuous Strobe Output signals and their configurable parameters. The Single and Continuous Strobe signals are accessible on the 16 Pin IO Connector.

Single Strobe

Synchronization of external devices to the spectrometer's Trigger Event can be accomplished with the Single Strobe output. The Single Strobe output is an active-high programmable pulse that occurs at a user-defined time during each acquisition cycle. The Single Strobe output has two user configurable settings, Single Strobe Delay and Single Strobe Width.

Single Strobe Enable

The Single Strobe Enable option is used to enable or disable the Single Strobe output. If disabled, the Single Strobe output will be constantly driven low. If enabled, the Single Strobe output will be driven active-high based on the Single Strobe Delay and Single Strobe Width configurations.

Single Strobe Delay

The timing of the Single Strobe output signal is referenced from the Trigger Event. The Single Strobe Delay (t_{SSDLY}) defines the time from the Trigger Event until the rising edge of the Single Strobe output.

Note that there is a delay from the Trigger Event until the start of integration. So, if the Single Strobe Delay is less than the Integration Delay, then the Single Strobe will assert before the start of integration.

Single Strobe Width

After the Single Strobe Delay has elapsed and the Single Strobe output has gone high, it will remain active for a duration equal to the Single Strobe Width (t_{SSH}). The Single Strobe output will return to a low or inactive state at the end of the Single Strobe Width.

Note that if the Single Strobe output is configured for a longer period than the Integration Time, it will reset to its inactive state at the end of the integration time.

Refer to the timing diagrams in the Acquisition Modes section for more detailed information on the timing of the Single Strobe output.

Continuous Strobe

The Continuous Strobe output signal is a periodic signal with a 50% duty cycle that occurs during the Integration Time of each acquisition cycle. The Continuous Strobe output has a user configurable Continuous Strobe Period (t_{CSPER}). The Continuous Strobe signal is only active during the integration time (t_{INTEG}). It is driven low at all other times.

Continuous Strobe Enable

The Continuous Strobe Enable option is used to enable or disable the Continuous Strobe output. If disabled, the Continuous Strobe output will be constantly driven low. If enabled, the Continuous Strobe output will be driven active-high based on the Continuous Strobe Period configuration.

Continuous Strobe Period

When operating in Software Trigger or External Edge Trigger modes, the Continuous Strobe signal is only exercised if it can complete a full period within the integration period. For the Continuous Strobe signal to be fully realized for at least one period, the integration time must be greater than the Continuous Strobe Period. If there are multiple Continuous Strobe periods within an integration period, only full periods are generated. This means the time between the last Continuous Strobe period and the end of integration time (t_{CSOFF}) is between 0 and t_{CSPER} .

When operating in External Level Trigger mode, the Continuous Strobe output will return to a low logic level at the end of the integration time. This may truncate any Continuous Strobe period in progress, resulting in a partial period.

Refer to the timing diagrams in the Acquisition Modes section for more information on the Continuous Strobe timing.

Acquisition Delay

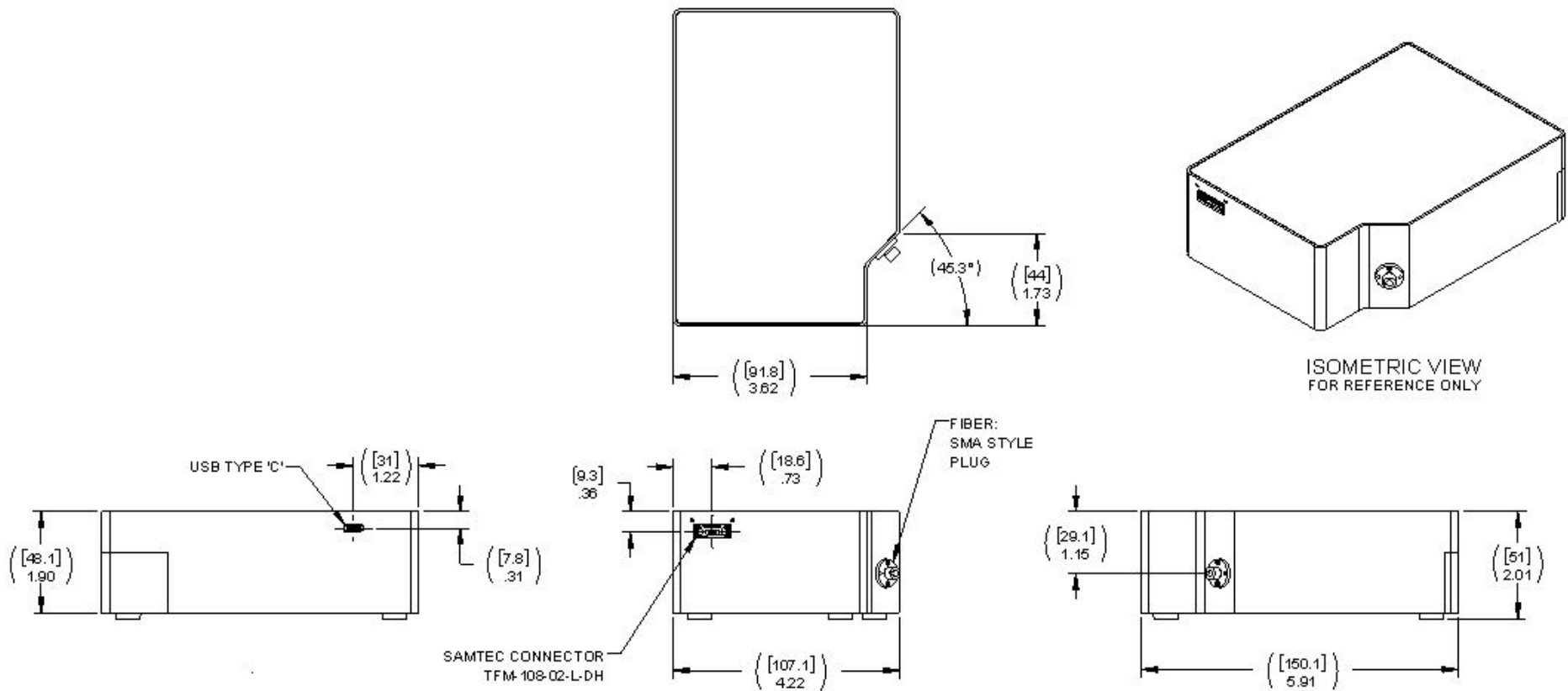
The Acquisition Delay is a user programmable time that delays the start of integration from the Trigger Event. The Acquisition Delay does not affect the length of integration, it only delays the start of integration relative to the Trigger Event.

Note that the start of the Continuous Strobe output signal is only active during integration, so the Acquisition Delay will also delay the start of the Continuous Strobe output. The Single Strobe is relative to the Trigger Event, so it is not affected by the Acquisition Delay.

Refer to the timing diagrams in the Acquisition Modes section for more information on the Acquisition Delay timing.

Mechanical Dimensions

Mounting: Recommend use of two #4-40 holes located on the Samtec/Fiber input side for a mounted configuration.



Calibration

Each Ocean HR contains wavelength calibration coefficients, linearity coefficients, and a serial number unique to each spectrometer. The 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.

Wavelength Calibration

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

For instructions on how to calibrate your Ocean HR spectrometer, visit www.oceanoptics.com.

Irradiance Calibrations

Irradiance calibrations and relative irradiance calibrations are about quantifying the spectra, by translating the signal (incident number of photons) to a calibration. This can be either absolute (an atomic emission light source of known output power) or relative (corrected for instrument response function but not absolute units). It can be considered a measurement technique and is used widely in remote sensing, light metrology and anywhere where you wish to characterize the incident light source. Irradiance calibrations are not required for many techniques because these measure the relative signal changes with respect to the sample and not the light source.

You can find out more about irradiance calibration techniques at www.oceanoptics.com.

OceanView has wizards that will step you through absolute irradiance and relative calibrations. More information on these is located in OceanView.

Ethernet Interface

This section describes the steps necessary to configure and utilize the spectrometer's Ethernet interface.

Required Tools and Software

The following list of devices, cables, and software are required to utilize the Ethernet interface.

- Ocean Optics spectrometer with Ethernet interface
- USB Cable
- Ethernet Cable
- Ocean Optics RS-232 cable (CBL-ISDF-DB9), Power Cable (CBL-ISDF-PWR), or similar cable to provide +5VDC (5 Amp) power supply to the 16 Pin IO Connector
- OceanView v2.0.17 or higher

Network Setup

The Network Setup allows the user to select between automatic or manual configuration of the network parameters. The network parameters that are configurable include the IPv4 Address (IPv6 is not supported), Subnet Mask, and Gateway. The port number is not configurable, it is fixed with a value of 57350. Once the parameters are configured, they are saved on the spectrometer and retained after power-off.

NOTE: To change the Network Setup parameters, the spectrometer must be connected to the host system via USB.

NOTE: Ensure that any firewalls do not block multicast address 239.239.238.238. This address is used for probing devices, so if it is blocked, spectrometers on the network may not be found.

NOTE: The port number is not configurable. It is important that port number 57350 is not blocked.

Automatic Mode

In automatic mode, the spectrometer's IPv4 Address is assigned by the DHCP server on the user's network. The spectrometer is initially configured for automatic network configuration by default. Therefore, the user may connect to the spectrometer via Ethernet without any user configuration.

Manual Mode

The manual configuration option allows the user to set a static IPv4 address, the Subnet Mask, and Gateway. This provides the user with more control in setting up multiple spectrometers within their network or manually managing the devices on their network.

Network Configuration with OceanView

To configure the network settings to Automatic or Manual mode, perform the following steps:

1. Ensure that no cables are connected to the spectrometer and OceanView is not running.
2. Connect the spectrometer to the host system via USB.
3. Open OceanView software.
4. The OceanView software should connect to USB devices automatically by default. If OceanView does not find the spectrometer, follow the steps below:
 - a. Open the Device Manager by clicking on the Magnifying Glass icon or pressing the F5 key. An example Device Manager window is shown in Figure 1.
 - b. Click on the "Rescan" button to probe the USB bus for devices.
 - c. Highlight the desired spectrometer, then click on the "Connect" button.
 - d. Once the device is connected, a check mark will appear under the "Connected" column.
 - e. Click on the "Exit" button to close the window.

5. Click on the Schematic Window tab to open the panel.
6. Right click on the spectrometer icon and then click on the “Network Setup” option from the drop-down menu. This will open the Network Settings window. An example Network Settings window is shown in Figure 2.
7. In the Network Settings window, use the radio buttons to select the configuration mode: “Auto (DHCP)” or “Manual”.
8. If the “Auto (DHCP)” mode is selected, the configuration fields are grayed out.
9. If the “Manual” mode is selected, configure the spectrometer networking parameters.
 - a. The IPv4 Address, Subnet Mask, and Gateway values must be properly formatted before OceanView will allow the settings to be saved. It is up to the user to set correct and valid values.
 - b. If the network parameter values are not correct for the user’s network, then there may be issues connecting to the spectrometer via Ethernet.
10. Click on the “Save Settings” button to commit the new configuration.
11. The Network Settings window may now be closed using the “Close” button.

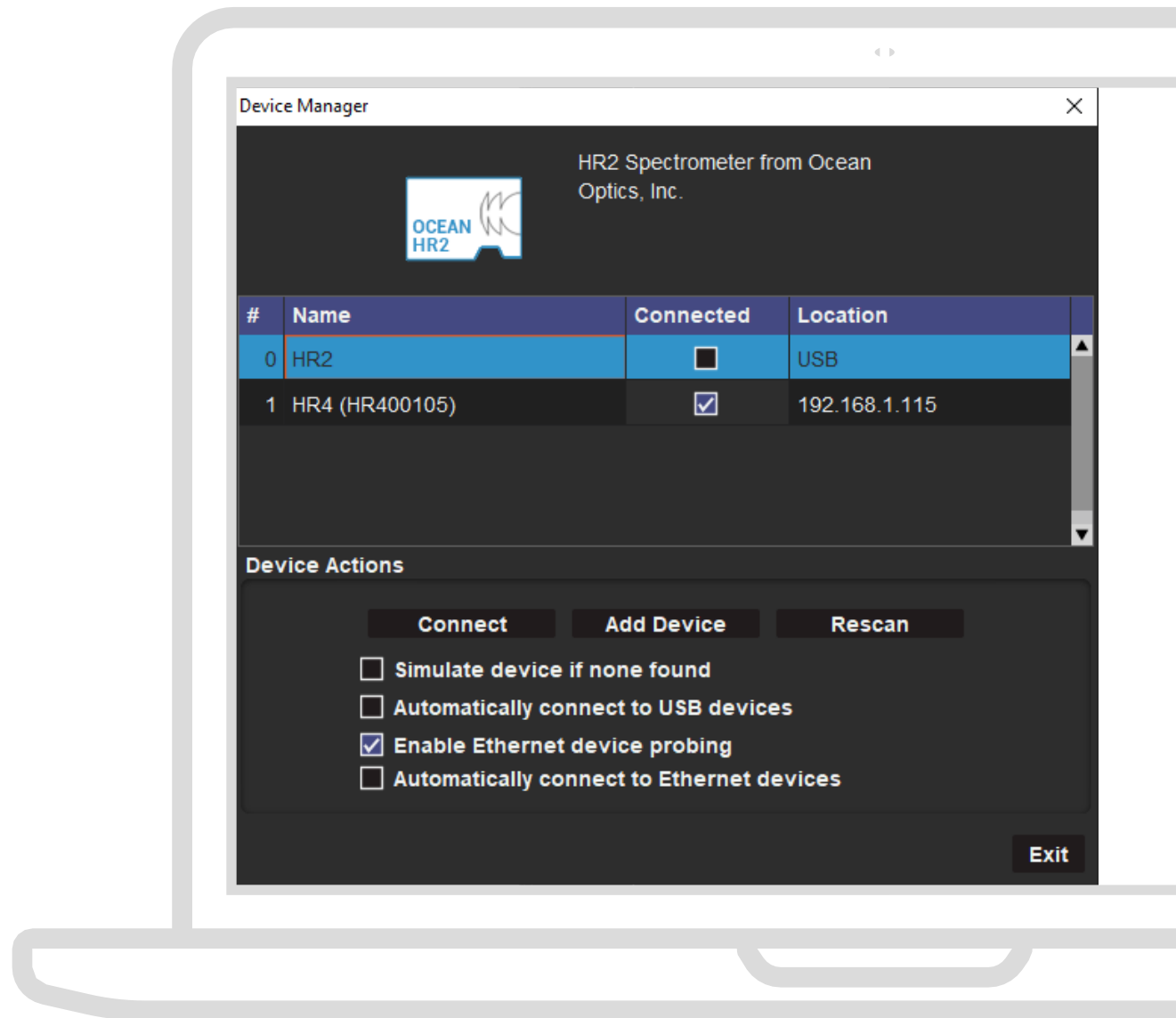


Figure 1 Device Manager window showing HR2 found via USB and HR4 connected on the network

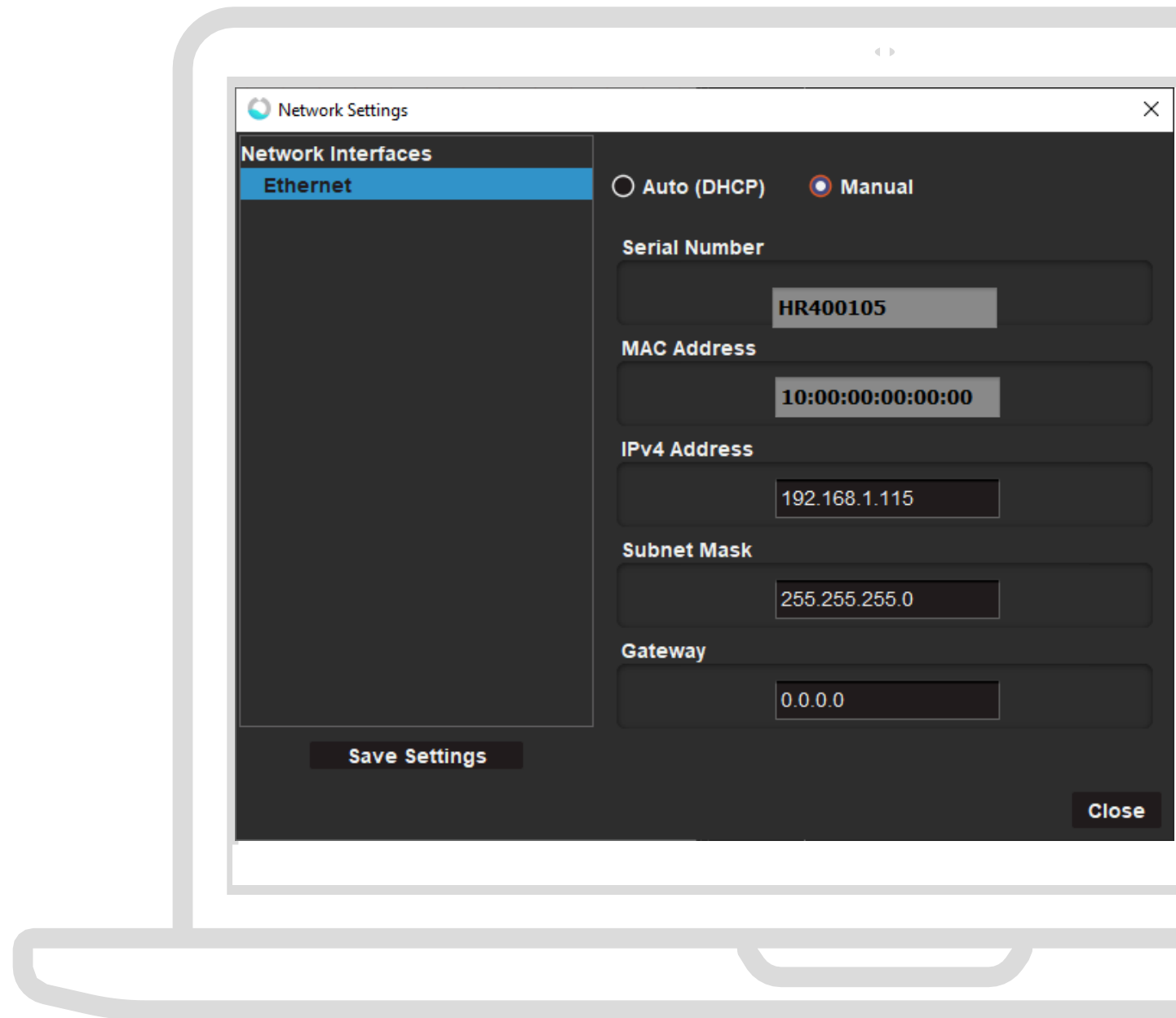


Figure 2 Network Settings window showing Manual configuration parameters

Connecting to Spectrometer via Ethernet

Once the spectrometer is configured with the desired network configuration parameters, it should be available to connect via Ethernet. Note that the spectrometer is initially configured in Automatic network configuration mode, so it will be available to connect to without any further user configuration. If the user desires to manually set the network address, follow the steps in the Manual Configuration section.

NOTE: The spectrometer only supports one data connection at a time. If the user desires to connect through the Ethernet interface, the USB cable should not be connected. Alternatively, if the user desires to connect through the USB interface, the Ethernet cable should not be connected.

To connect to the spectrometer via Ethernet, perform the following steps:

1. Ensure that no cables are connected to the spectrometer and OceanView is not running.
2. Connect the spectrometer to the network shared with the host system via Ethernet cable.
3. Connect power to the spectrometer via 16 Pin IO Connector.
4. Open OceanView software.

5. Connect to the spectrometer in OceanView.
 - a. Open the Device Manager by clicking on the Magnifying Glass icon or pressing the F5 key. An example Device Manager window is shown in Figure 1.
 - b. By default, the option to “Enable Ethernet device probing” is disabled. Check the box for this option to enable searching for devices connected via Ethernet.
 - c. Click on the “Rescan” button to search for devices.
 - d. Highlight the desired spectrometer, then click on the “Connect” button.
 - e. Once the device is connected, a check mark will appear under the “Connected” column.
 - f. The Device Manager window may now be closed by using the “Exit” button.
6. The device is now connected and ready to use.

10/100 Ethernet covers a wide range of spectrometers, ensuring uninterrupted communication of the spectrometer. The following devices have 10/100 Ethernet options:

Ocean SR Series
Ocean HR Series

Questions?

Chat with us at www.oceanoptics.com.

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ASIA +86 21-6295-6600

Unlock the Unknown

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