

OtO Photonics

Pocket Hawk (PH) Series Product sheet



Description

PH Series spectrometer is built with the linear CCD array sensor and 32bits RISC controller. By simplification of the optical engine and specific sensor, the further miniaturized spectrometer is achieved. External MB type of PH Series can be chosen to enhance heat dissipation. The compact size and various of screw holes is very flexible for system integration.

PH Series spectrometer is constructed by the Crossed Czerny-Turner optical design and can provide the high optical resolution, high sensitivity, low stray light, and fast spectral response.

The electronics system is powered by USB port and PH Series communicates with the PC through the USB port. It also provides 8 pin or 4pin I/Os for external interface extension.

PH Series electronics operation is controlled by the RISC controller. So the user can communicate to the main program through the PC software and the protocol provided by OtO Photonics.

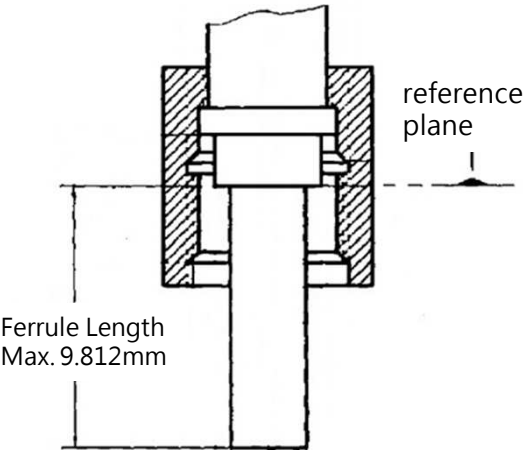


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Attention

Picture	Description
	Screw in the fiber optic connector with fingers. Do not use any tool to tighten it. Using tools such as wrenches to tighten the connector may cause the connector to press against and damage the inlet slit of the spectrometer. Such damage is not covered by the warranty. In cases where the connector needs to be firmly in place for long-term use, it is advised to apply a little glue to where the SMA905 connector is connected to the spectrometer.
	The SMA905 connectors on all spectrometers made by OtO Photonics is manufactured in accordance with international standards. Customers should ensure that the ferrule length of the fiber used is not longer than 9.812mm to avoid damaging the slit in the SMA950 connector. Such damage is not covered by the warranty.



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■ Main Features

▶ 1.1 Feature

- Optical resolution: Depending on the combination of various slits and gratings.
- PH1014/2014 High sensitivity 3000 pixel CCD sensor
- PH1034/2034 UV enhance 512 pixel CMOS sensor
- PH3134/4134 UV enhance 1024 pixel CMOS sensor
- Modular configuration with various slit options
- PH1014//2014 Minimum Integration times 1.5 ms
- PH1034/2034 Minimum Integration times 0.1 ms
- PH3134/4134 Minimum Integration times 21 us
- 16 bit, 15MHz A/D Converter
- Micro USB 2.0 @ 480 Mbps (High speed)
- 4pin customized USB connector
- 8-pin connector for interfacing to external
 - ▣ 6 user programmable digital I/O
- Plug-n-play interface for PC application
- Extremely precise continuous multiple exposures, providing up to 4,000 spectra buffering
- Flash ROM storage for
 - ▣ Wavelength Calibration Coefficients
 - ▣ Linearity Correction Coefficients
 - ▣ Intensity Calibration Coefficients

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► 1.2 Specification

SPEC		Content		
		PH1014/2014	PH1034/2034	PH3134/4134
CCD		High sensitivity 3000 pixel CCD sensor	UV enhance 512 pixel CMOS sensor	UV enhance 1024 pixel CMOS sensor
Parameters of Optical System		f/# : 4.5, NA :0.11, Focal Length(R1-R2) :39-44 (It is recommended that the Incident NA should larger than the NA of spectrometer.)		
Dark Noise (average)		30	12	13
Dynamic Range (avg.)*1		2200	5500	5000
SNR*2		200	350	350
Spectrometer		Crossed Czerny-Turner Optical Structure 2 nd & 3 rd order rejection		
Dimension		65(L) x 65(W) x 29.8(H) mm		
Grating		Various grating options		
Wavelength		330-1050nm	200-1050nm	200-1050nm
Slit Size		10, 25, 50, 100, 200 μ m		
Integration Time		1.5ms	0.1ms	21us
Wavelength Repeatability		NA	NA	NA
Wavelength accuracy		0.3nm	0.3nm	0.3nm
Resolution(FWHM)		From 2.2 nm to 12 nm, depending on different modular configuration		
Thermal Stability		NA		
Environmental Conditions	Storage	-30°C to +70°C		
	Operation	0°C to +50°C		
	Humidity	0% - 90% non-condensing		
Interfaces		Micro USB 2.0 @ 480 Mbps (High speed)		
Input Fiber Connector		SMA905: Φ 3.20 $\pm$ 0.01mm		
Recommend Tightening Torque		0.15 Nm (Mating Part : 5mm thick, Flatness 0.1mm, Aluminum sheet)		
Power		Supply voltage: 4.75V-5.25V		

*1 : 65535/Dark Noise(average)

*2 : Single acquisition

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► 1.3 Wavelength Response

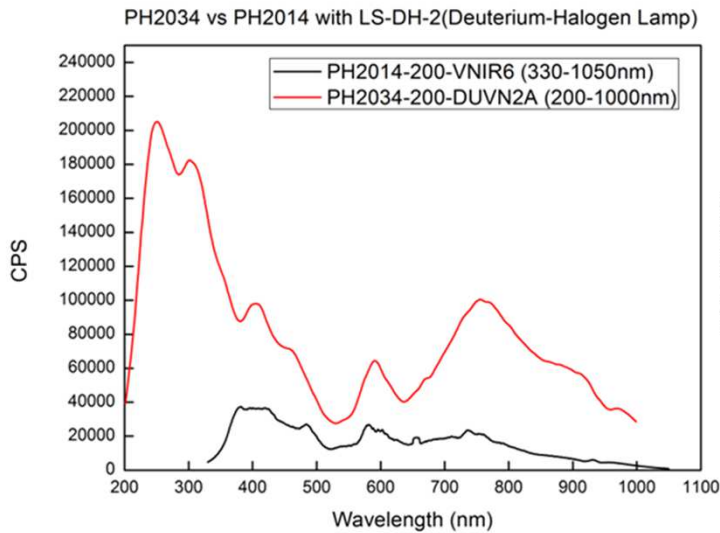


Fig. 1: PH2014 VS PH2034 Wavelength Response

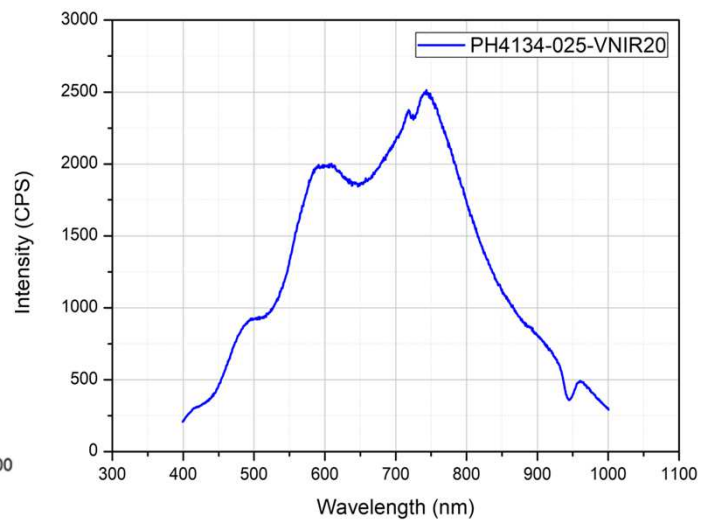


Fig. 1: PH4134 Wavelength Response

► 1.4 Lineup of PH Series

Model	Spectral Response Range (nm)			SNR	A/D	Stray Light	Thermal Stability
	VNIR6	DUVN2 DUVN2A	V23				
	330 ~ 1050	200 ~ 1050	450 ~ 750				
PH1014 /PH2014	√			200	16 bits	<0.2%	na
PH1034 /PH2034		√	√	350	16 Bits	<0.2% (450-750nm: <0.45%)	na
PH3134 PH4134		√	√	350	16 Bits	<0.3%	na

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■ Structure

► 2.1 Mechanical Diagram

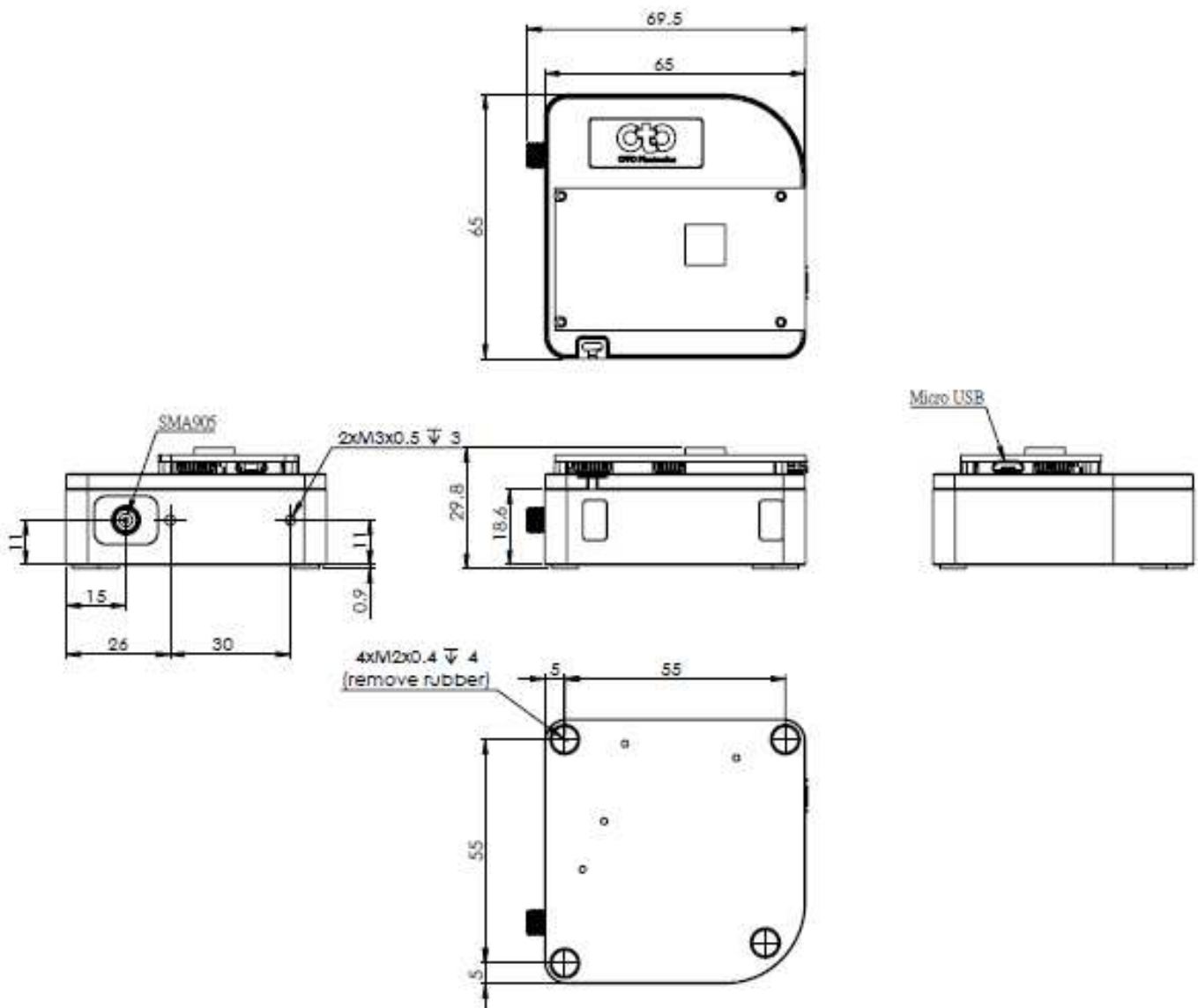


Fig. 1: PH Series outer dimensions

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► 2.2 Electrical Pinout

The following listed is the pin description for the PH Series Extension Connectors. There are two Extension Port (8 pin 1.0mm connector for GPIO, one of them is for OtO debug use), one Micro USB, one USB(4 pin, for special use)

● Pin orientation

Looking PH Series connector side, from right to left are GPIO Extension Port, Micro USB, USB

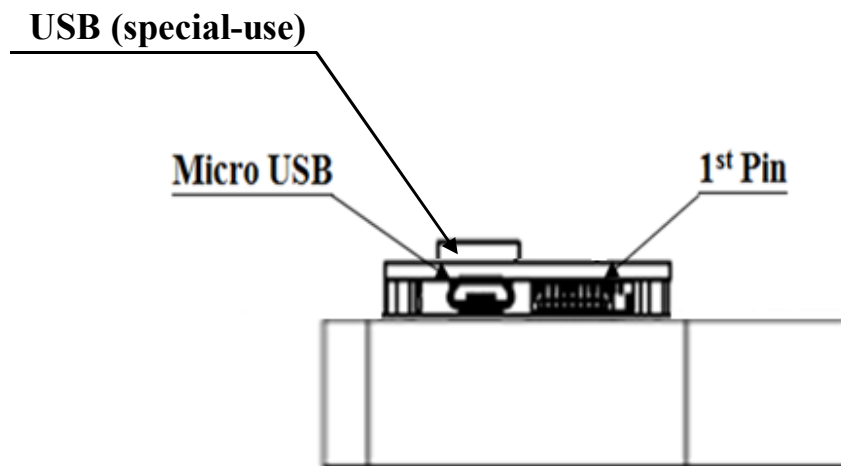


Fig. 3 : PH Series: the front-view of connector mechanical graph

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Back Extension Port Pin# Description Alt Function

*All I/Os are TTL-level input/output

Pin No.	Direction	Pin Name	Function Description
1	Power	5V	This pin can provide around 0.1A power for external device.
2	Output	TX	UART TX. TX is the output from the RISC controller.
3	Input	RX	UART RX. RX is the input for the RISC controller.
4	Output	GPIO0	General Purpose Output 0.
5	Output	GPIO1	General Purpose Output 1.
6	Output	LS_ON	Light Source Turn ON.
7	Input	Trigger_IN	External Trigger Input Signal.
8	GND	GND	GND

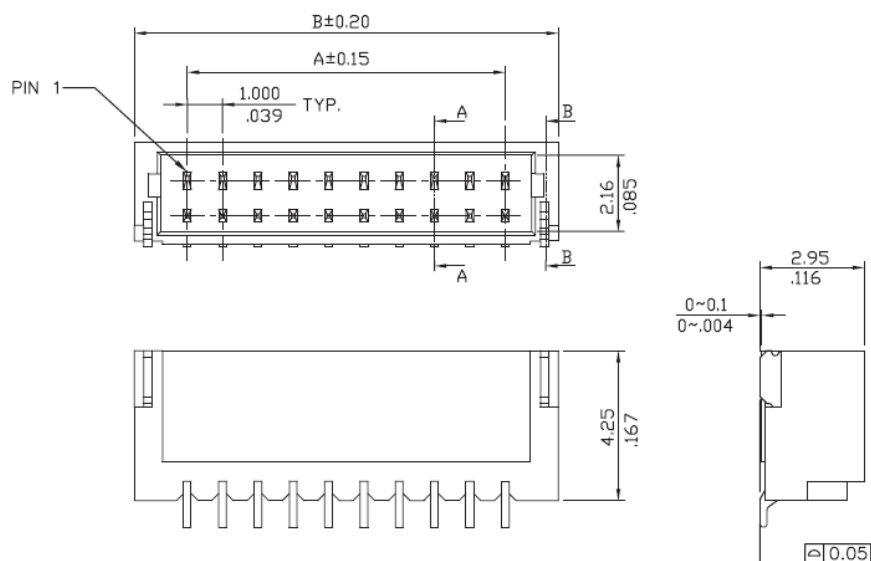


Fig. 4 : Back Extension Port 1.0 mm 8 pin drawing

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USB Port (Special –use)

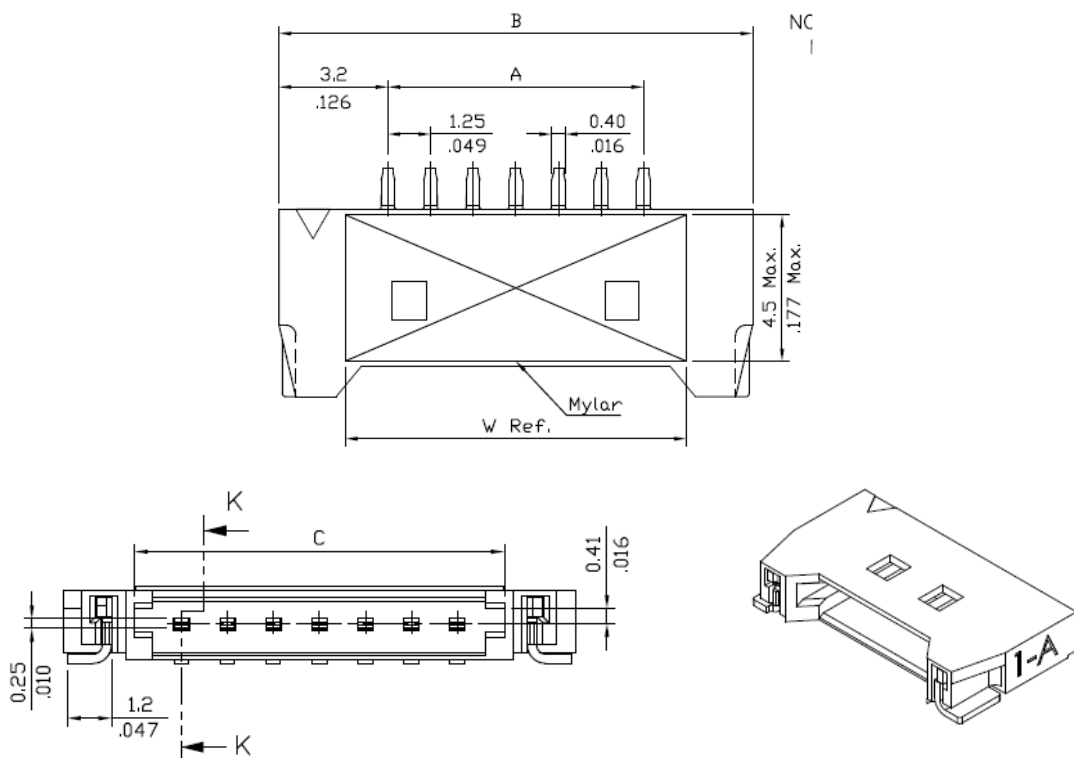


Fig. 5: USB(Special-use) 1.0 mm 4 pin drawing

□ Pin# Description

Pin No.	Direction	Pin Name
1	+5V	+5V
2	Data-	USB-
3	Data+	USB+
4	GND	GND

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● **CCD/SYSTEM NOISE**

There are three major sources impact the Vout signal reading. One is the light source stability, the second is the electronics noise, and the other is CCD detector noise. If we don't consider the outer light source influence, we can check the dark noise performance of this system first. The dark noise we define here is the RMS of Vout signal under 1ms integration time in dark condition. So the dark noise will be only contributed by electronics readout noise and the CCD sensor.

The other major parameter to define the noise performance is the SNR. The SNR we define here is the ratio of the full signal (65535 counts) to the RMS value under the full signal condition. The higher SNR performance indicates the readout signal is more stable. It will be helpful for the low signal differentiation.

● **SIGNAL AVERAGING**

The software-SpectraSmart provides two options for the signal curve operations. The first one is the signal averaging. By the averaging method, we can reduce the noise impact on each pixel. Surely, more sampling points will bring the better averaging performance. But it will need more time to get one spectra. When we use the time-base type of signal averaging, the S:N increases by the square root of the number of samples. Thus, a S:N is readily 10x achieved by averaging 100 spectra.

The other curve smoothing is boxcar filter. It can average the adjacent points to show the smoother curve, but it will lower optical resolution. So if the target signal is peak type, the boxcar may not be suitable for this.

These two methods can be enabled at the same time if the measurement target is suitable for this operation. But if the user would like to check all the original data and performance, time-based average or boxcar smoothing needs to be un-checked. The default setting for these two average methods is un-checked.

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Internal Operation

► 3.1 Pixel Definition

The baseline signal is around 1,000 counts in our current system. We can provide the tool/command to manually adjust the baseline. (adjust the AFE OFFSET) The other baseline adjustment method is to enable the background removal from the software. It depends on the user how to use the baseline. Normal output signal is not obtained immediately after device switch on. Use the output signal added 22500 pulses or above to CLK clock pulse.

- The following is a description of all of the pixels

Pixel	Description
1-13	Dummy pixels
14-31	Optical black pixels
32	Dummy pixels
33-3032	Optical active pixels
3033-3038	Dummy pixels

► 3.2 Digital Inputs & Outputs

● General Purpose Inputs/Outputs (GPIO)

PH Series has 6 user programmable 3.3V digital Input/Output pins, which can be accessed at the 8-pin Extension connector. Through software, the state of these I/O pins can be defined and used for multi-purpose applications. If the user needs the special timing generation (like single pulse or PWM), PH Series provides the flexibility to implement this.



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■ **USB Port Interface Communications and Control Information**

► **4.1 Overview**

PH Series is a microcontroller-based Miniature Fiber Optic Spectrometer that can communicate via the Universal Serial Bus. This section contains the necessary programming information for controlling PH Series via the USB interface. This information is only pertinent to users who wish to not utilize SpectraSmart software to interface to PH Series.

● **Hardware Description**

PH Series utilizes a 32 bit RISC controller built in USB 2.0. Program code and data coefficients are stored in SPI Flash. The RISC controller supports 32 MByte DDR and 64 Mbits Flash.



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● INSTRUCTION SET

Application Programming Interface

The list of the APIs is shown in the following table followed by a detailed description of each function call.

❑ Open PH Series Spectrometer

Description: To connect Windows host to PH Series

a.Function Name: UAI_SpectrometerOpen

b.Arguments:

dev: 8 PH Series spectrometers can be attached to one host at the same time. dev is the device number to specify which one will be opened.

handle: the unique Windows identifier to operate devices. Windows will return the identification number which is necessary for further operation.



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❑ Query Frame Size

Description: To get the data frame size of the spectrometer.

a.Function Name: UAI_SpectromoduleGetFrameSize

b.Arguments:

device_handle: a pointer to the device information structure which is returned

when device open.

size: a 16-bit unsigned integer will be returned to indicate the data length.

❑ Acquire Wavelength

Description: Initiates a wavelength acquisition. PH Series will acquire a complete wavelength distribution.

a.Function Name: UAI_SpectrometerWavelengthAcquire

b.Arguments:

device_handle: a pointer to the device information structure which is returned when

device open.

buffer: the storage buffer acquired data.



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❑ **Acquire Spectra**

Description: Initiates a spectra acquisition. PH Series will acquire a complete intensity distribution which corresponds to the wavelength which is acquired by `OtO_UAI_SpectrometerWavelengthAcquire`.

a. **Function Name:** `UAI_SpectrometerDataAcquire`

b. **Arguments:**

device_handle: a pointer to the device information structure which is returned when device open.

integration_time_us: a 32-bit unsigned variable to determine the integration time of the micro-seconds.

buffer: the storage buffer acquired data.

average: the spectrum could be averaged by several continuous acquisitions to reduce the noise.

❑ **Query Wavelength Range**

Description: To get the minimum and maximum wavelength

a. **Function Name:** `UAI_SpectromoduleGetWavelengthStart`

Function Name: `UAI_SpectromoduleGetWavelengthEnd`

b. **Arguments:**

device_handle: a pointer to the device information structure which is returned when device open.

lambda: a 32-bit floating type data which is indicate the minimum or maximum wavelength, in nm, of PH Series will be returned.



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❑ Query Integration Time Range

Description: To get the minimum and maximum integration time.

a.Function Name: UAI_SpectromoduleGetMinimumIntegrationTime

Function Name: UAI_SpectromoduleGetMaximumIntegrationTime

b. Arguments:

device_handle: a pointer to the device information structure which is returned when device open.

Integration Time: a 16-bit integer type data which indicates the minimum or maximum integration time of PH Series will be returned. The minimum integration time is in micro-second and the maximum Integration time is in milli-second.

❑ Close PH Series Spectrometer

Description: To connect Windows host to PH Series

a.Function Name: UAI_SpectrometerClose

b.Arguments:

handle: the unique Windows identifier to operate devices. Windows will detach the device and any operation is invalid after this function is executed.