OtO Photonics

Owl (OW) Series Datasheet

Description

Owl (OW) Series spectrometer, built with the linear CCD/CMOS type sensor and high performance 32bits RISC controller in, is specially designed for high resolution measurement requirement. OW series has outstanding stability of thermo-hydro variation, vibration and shock on resolution and wavelength shift performance.

OW Series spectrometer is constructed by the 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 OW Series communicates with the PC through the USB port. It also provides 6 I/Os for external interface extension.

The optical detector used in OW Series spectrometer is a high sensitive CCD / CMOS linear image sensor. We provide the related information and the detailed instructions of how to operate with OW Series in this guide.

OW Series electronics operation is controlled by the RISC controller. Therefore, users can communicate to the main program through the PC software and the protocol provided by OtO Photonics.

Attention

Picture	Description
	To prevents over tightening and damaging of the slit in the spectrometer. Please Hand tightening the optical fiber only. **Do not** use any tool including wrench to tighten up the optical fiber and SMA905 connector. Apply adhesive to optical fiber connector after hand tightening is recommend if the fiber needs to be fixed robustly for a long time operation.

OtO Photonics

OW Series Datasheet

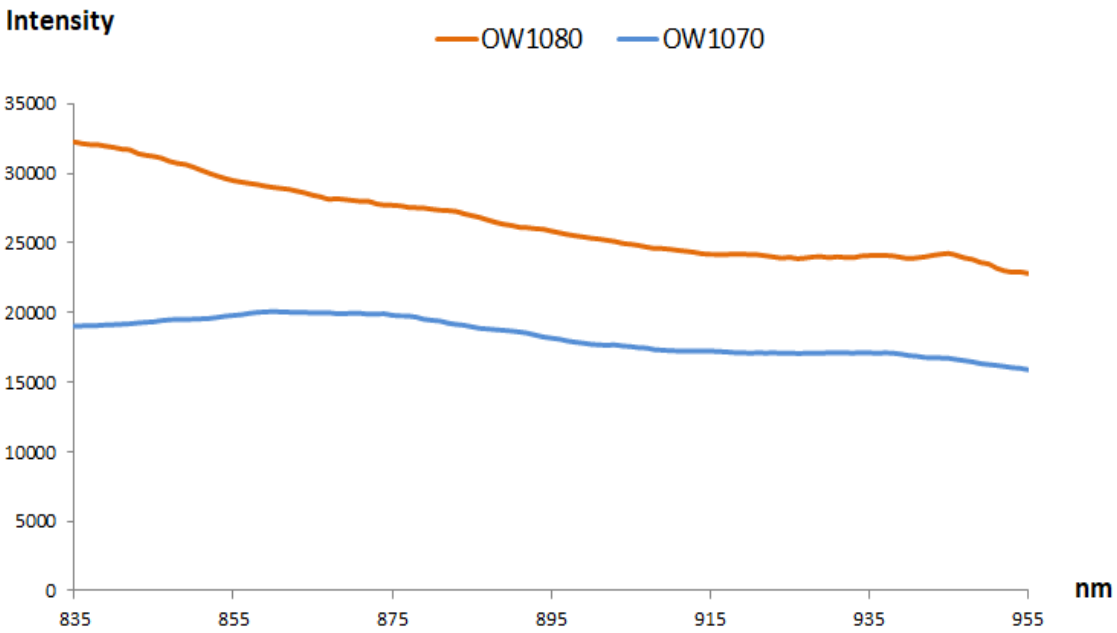
Overview

► 1.1 Lineup of OW Series

Model	Spectral Response Range (nm)			SNR	Dynamic Range	A/D	Stray Light	Thermal Stability
	NIRV1	NIRV2	NIRV3					
	835 ~ 955	810 ~ 875	920 ~ 970					
OW1070	√	√	√	400	2200	16 bits	<0.15%	<0.04nm/℃
OW1080	√	√	√	350	2200			

OW1070	● 3648 pixel CCD sensor ● Wavelength range : 835 ~ 955 nm、810 ~ 875 nm、920 ~ 970 nm ● Best choice for VCSEL, 3D sensing , thin film measurement ● High-Resolution 0.1~0.2 nm
OW1080	● 4096 pixel CMOS sensor, high sensitivity, microsecond (μs) measurement ● Wavelength range : 835 ~ 955 nm、810 ~ 875 nm、920 ~ 970 nm ● Best choice for VCSEL, 3D sensing , thin film measurement ● High-Resolution 0.1~0.2 nm

► 1.2 Efficiency Output



Main Features

► 2.1 Feature

- Responsive wavelength: 835 ~ 955 nm、810 ~ 875 nm、920 ~ 970 nm , and customizable within range 200-1000 nm.
- Optical resolution: 0.05 to 0.2 nm, depending on the combination of various slits and gratings
- A variety of sensor can be chosen for specific application:
  - OW1070: High sensitive CCD linear image sensor (3648 pixel)
  - OW1080: High sensitivity CMOS linear image sensor (4096 pixel)
  - Modular configuration with various grating, sensor, and slit options
- Integration times from 420μs ~ 24sec, depending on sensors
- 16 bit, 15MHz A/D Converter
- USB 2.0 @ 480 Mbps (High speed)
- 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

► 2.2 Specification

SPEC		Content	
		OW1070	OW1080
Sensor		3648 pixel CCD	4096 pixel CMOS
Dark Noise (Upper Limit)		40	50
Dynamic Range (avg.)		2200:1	
SNR		400	350
Spectrometer		Czerny-Turner Optical Structure 2nd & 3rd order rejection	
Dimension		163 (L) x 163 (W) x 61 (H) mm	
Grating		2 grating options	
Slit Size		5 μm	
Integration Time		4 ms ~ 24 sec	420 μs ~ 24 sec
Resolution (FWHM)	835 ~ 955 nm	0.1 ~ 0.2 nm	
	810 ~ 875 nm	< 0.1nm	
	920 ~ 970 nm		
Environment Conditions	Storage	-30°C to +70°C	
	Operation	-10°C to +50°C	
	Humidity	0% - 90% non-condensing	
Interfaces		USB 2.0 @ 480 Mbps (High speed)	
Input Fiber Connector		SMA 905	
Power		Power requirement (USB): 330mA at +5 VDC DC Jack for TEC: 500mA at +5VDC Supply voltage: 4.75-5.25 Power-up time : < 4s Maximum USB input power Vcc : +5.25VDC Maximum I/O signal voltage : +5.5VDC	

Structure

► 3.1 Mechanical Diagram

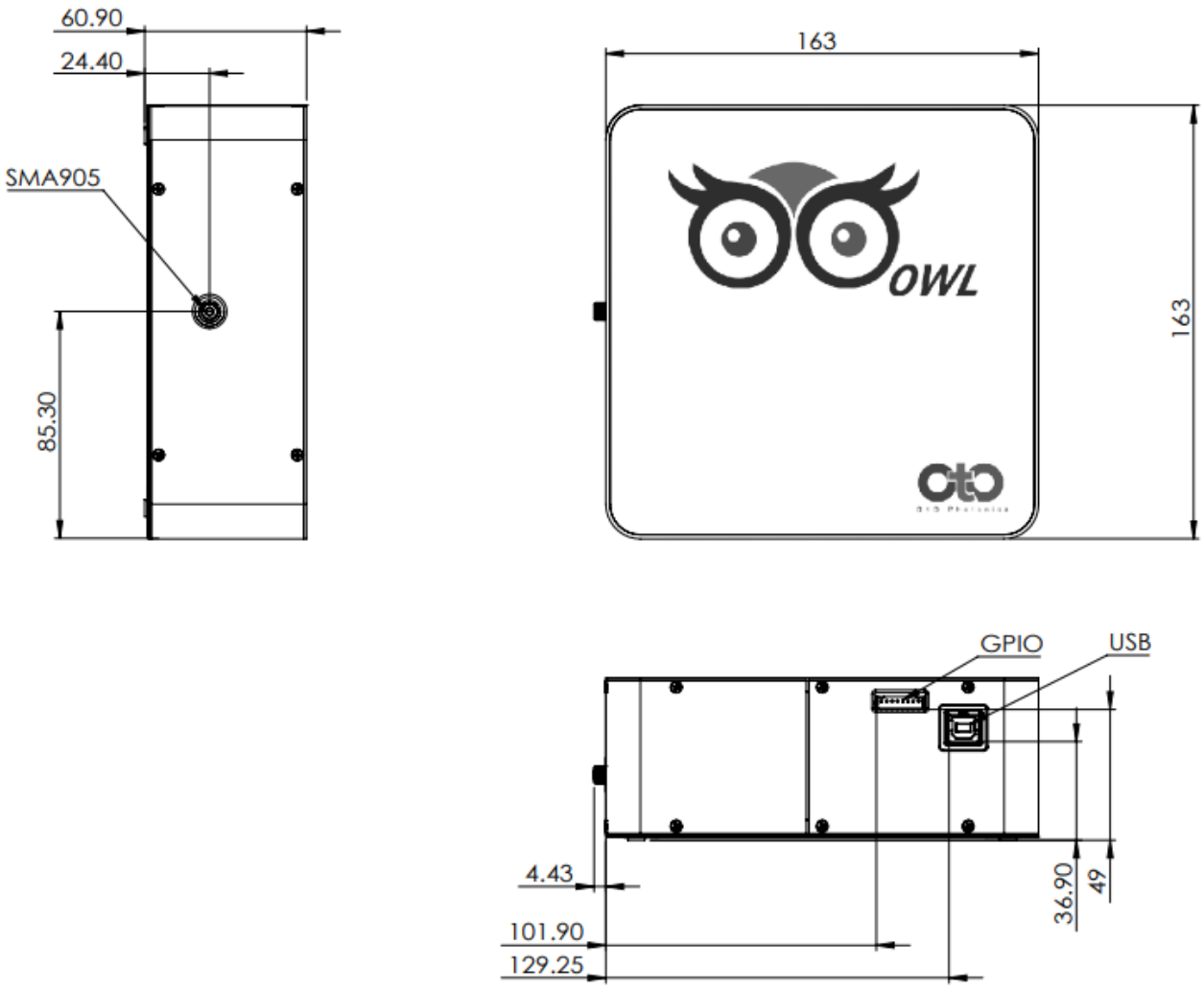
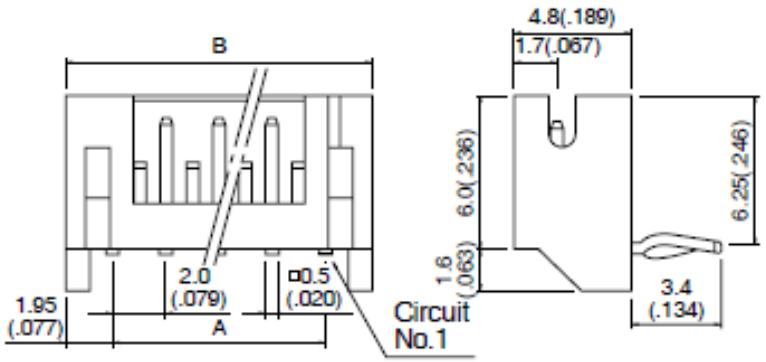


Fig. 1: OW10x0 outer dimensions

► 3.2 Electrical Pinout

The following listed is the pin description for the OW Series Extension Connectors. The Back Extension Port is a 8 pin 2.0mm connector.

Side entry type



Cir-cuits	Model No.		Dimensions mm(in.)		Q'ty / box	
	Top entry type	Side entry type	A	B	Top entry type	Side entry type
8	B 8B-PH-K-S	S 8B-PH-K-S	14.0(.551)	17.9(.705)	500	250

Fig. 3 : Back Extension Port 2.0 mm 8 pin drawing

Back Extension Port Pin# Description Alt Function

Pin No.	Direction	Pin Name	Function Description
1	Power	5V Input/Output	When connecting to PC USB port, this pin is also connected to VBUS. 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

- **Pin orientation**

Looking at Front of OW Series connector side, from left to right are Back Extension Port and PC USB.

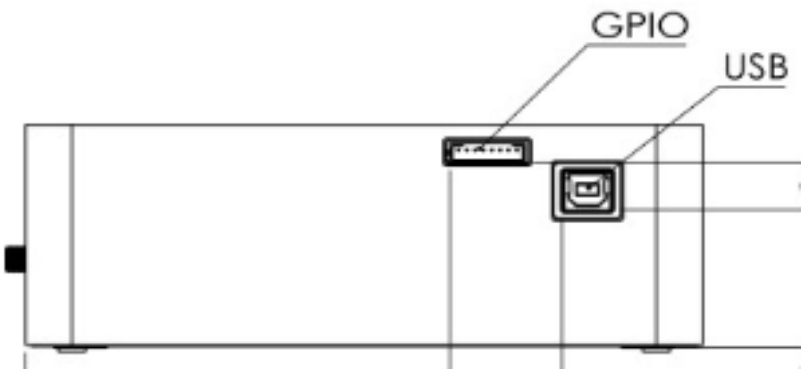


Fig. 4 : OW Series the front-view of connector mechanical graph

► 3.3 Sensor Overview

● SENSOR /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/CMOS 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 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.

Internal Operation

► 4.1 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
1–12	Dummy pixels
13–30	Optical black pixels
31–32	Dummy pixels
33–2080	Optical active pixels
2081-2086	Dummy pixels

► 4.2 Digital Inputs & Outputs

- **General Purpose Inputs/Outputs (GPIO)**

OW 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), SE Series provides the flexibility to implement this.

GPIO Recommended Operating Levels:

VIL(max) = 0.8V

VIH(min) = 2.0V

GPIO Absolute Maximum/Minimum Ratings are as follows:

VIN(min) = -0.3V

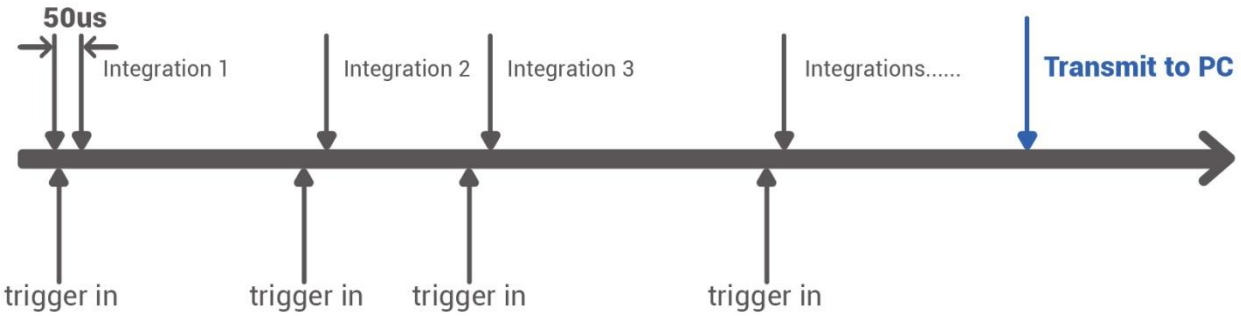
VIN(max) = 5.5V

- **Communication and Interface**

USB 2.0

480-Mbit **U**niversal **S**erial **B**us is the standard and popular communication interface in PC. Our PC software allows connecting multiple OW Series via USB and monitors multiple OW Series spectra. The low power requirement allows operating the OW Series through the USB cable and VBUS.

- **Extremely Precise Continuous Multiple Exposures**

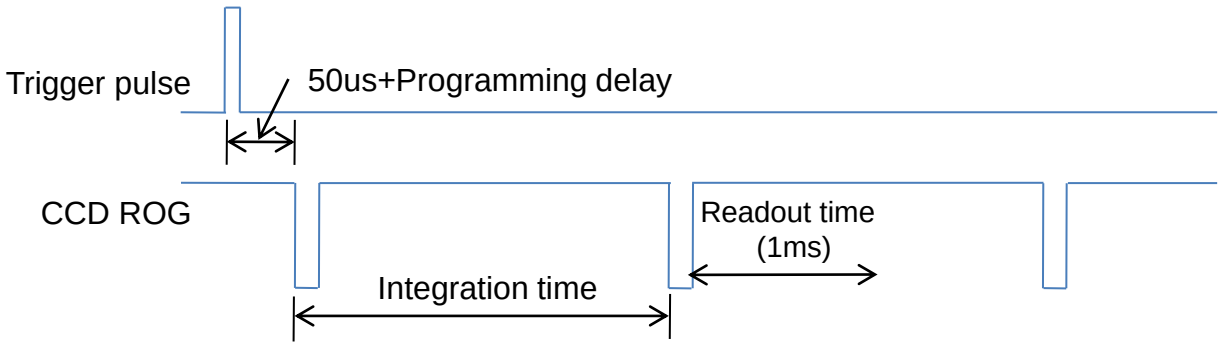


- Arbitrary integration times
- Spectra are stored in the huge memory on our board, providing up to 4000 spectra buffering
- After all integrations are done, the spectra are transmitted to your PC

► 4.3 Trigger Mode

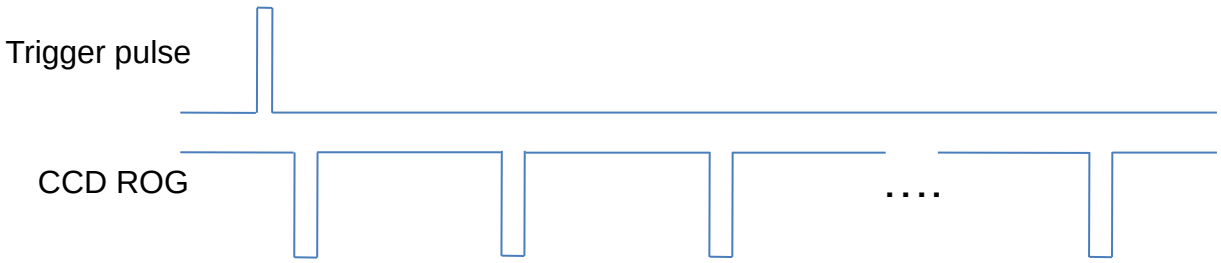
- **Single Trigger Single Data**

Single Trigger Single Data (integration time has been set by the command first). Spectrometer waits for single pulse to acquire one spectrum. The trigger edge can be set by rising edge or falling edge.



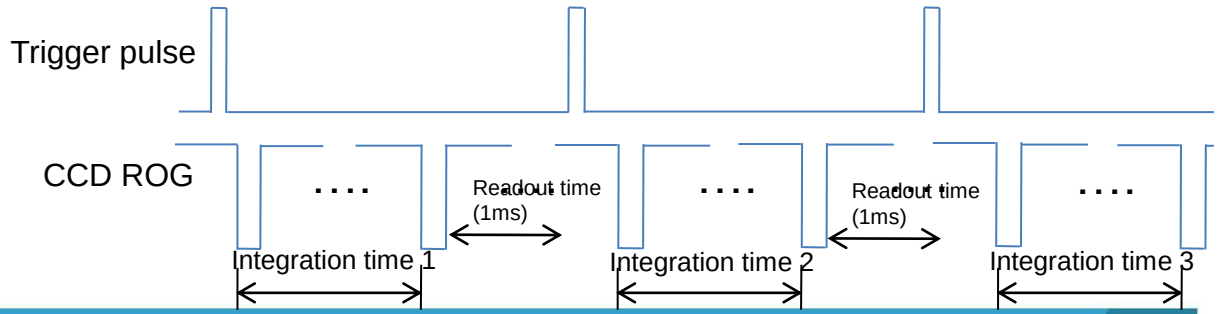
- **Single Trigger Multiple Data**

Single Trigger Multiple Data (integration time and frame number has been set by the command first). Based on single trigger pulse, the system will continue to capture the spectrums. The data is continuous.



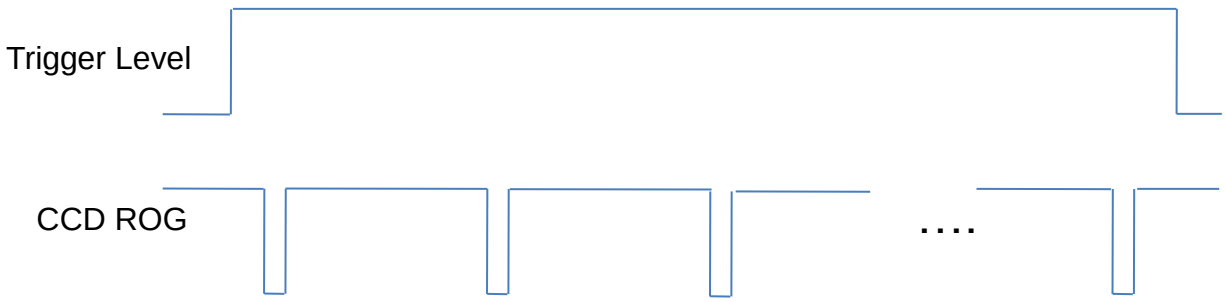
- **Multiple Trigger Multiple Data**

Multi Trigger Multi Data (different integration times have been set by the command first). Based on pre-setting different integration times, the spectrums will be captured for each trigger pulse.



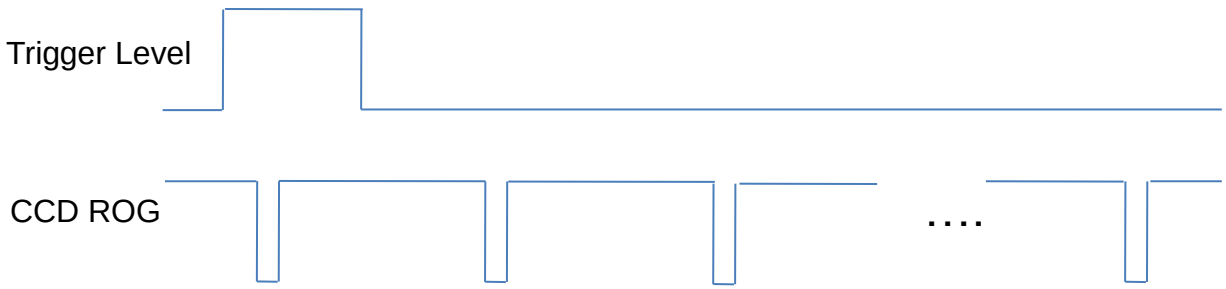
- **Software Level Trigger**

Software Level Trigger (integration time has been set by the command first, spectrometer waits for external trigger signal). When the trigger signal is high, software will continue to capture the spectrums.



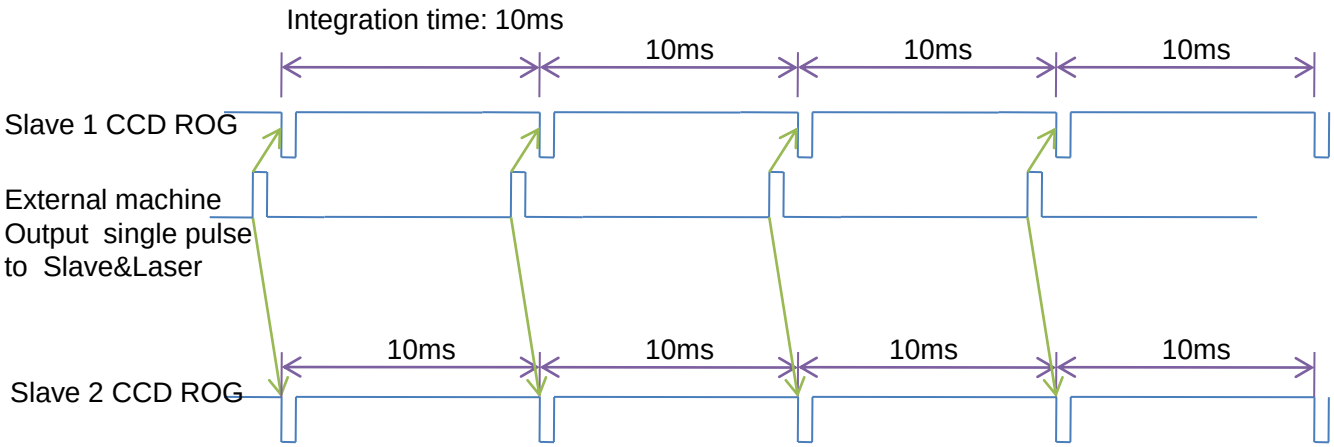
- **Software Level Trigger continuous data**

Software Level Trigger continuous data(integration time has been set by the command first, spectrometer acquires data by command). When the trigger signal is high, software will continue to capture the spectrums even the trigger level is changed to low later.



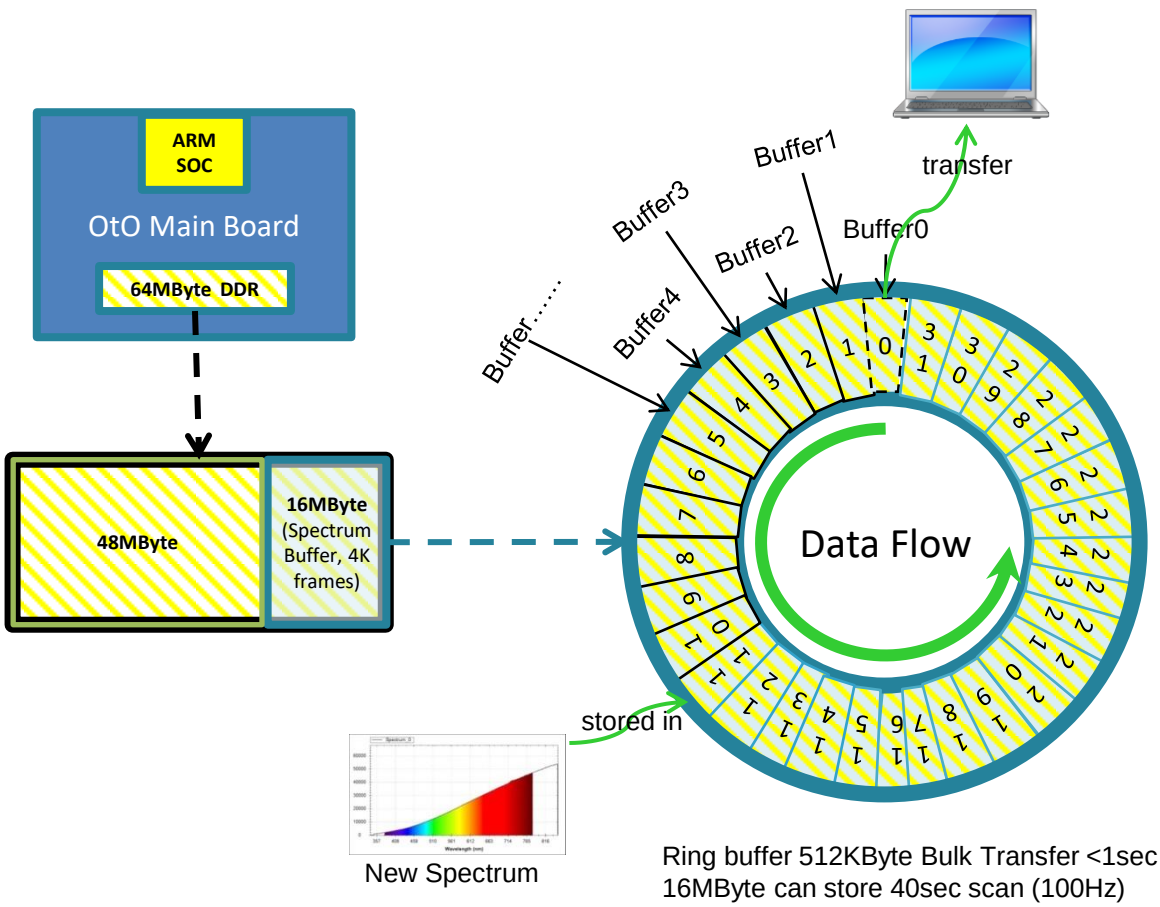
- **External Trigger control integration time**

In multiple external trigger modes, OW series can support the integration time is controlled by the external trigger signal. Customer can request this kind of trigger mode when placing an order. If customer uses this kind of the spectrometer, the user can configure the OW spectrometer in this kind of operation mode through USB. Then send the external trigger pulse to the spectrometer. The time internal of two trigger pulses is equal to the integration time.



► 4.4 Ring Buffer

OW series support the ring buffer function to record the continuous spectrum. Customer can request this kind of ring buffer function when placing an order. With this ring buffer function, user can record the continuous spectrum. For example, 10ms integration time, the PC host can receive 360K continuous spectrums in one hour. In this operation mode, the PC host can configure the length of each transfer to save the USB transfer efficiency. The ring buffer can provide the flexibility when the USB transfer is busy for a while. The fast integration time 1ms is supported in ring buffer function.



USB Port Interface Communications and Control Information

► Overview

OW 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 OW Series via the USB interface. This information is only pertinent to users who wish to not utilize SpectraSmart software to interface to OW Series.

Hardware Description

OW 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.

USB Info

OW Series USB Vendor ID number is 0x0638 and the Product ID is 0x0AAC. OW Series is USB 2.0 compliance. The data exchange between host and spectrometer is via bulk streams. The detail USB information please refer USBIF @ http://www.usb.org.

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 OW Series Spectrometer

Description: To connect Windows host to OW Series

a.Function Name: UAI_SpectrometerOpen

b.Arguments:

dev: 8 OW 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.

☐ 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. OW 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.

☐ Acquire Spectra

Description: Initiates a spectra acquisition. OW 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 OW Series will be returned.

☐ **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 OW Series will be returned. The minimum integration time is in micro-second and the maximum Integration time is in milli-second.

☐ **Close OW Series Spectrometer**

Description: To connect Windows host to OW 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.