

Spectral Products

Spectrometers · Spectrophotometers · Color Instruments · Spectrographs · Monochromators

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Instructions

Triggering Options for SM Spectrometers

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Overview

Optical spectrometers provide a variety of methods to obtain data:

In Free-Run mode, the spectrometer operates freely, so that the spectrometer continuously measures the data internally according to the software settings, and transmits the data currently being measured or previous data upon request for transmission. In Free-Run mode, you cannot synchronize data retrieval, collection, or transmission with external events, but you can use External Trigger Mode.

In External Trigger Mode, connect an external trigger device to the spectrometer and send a TTL signal to the spectrometer to start the measurement. The start time and the time taken to complete the measurement differ slightly depending on the CCD type of the spectrometer.

Triggering Mode	Description
Free-Run Mode	The spectrometer periodically measures the spectrum inside. When the measurement data transmission request (API function call) is made to the spectrometer, the current measurement data or the previous data is transmitted.
Software Trigger Mode	Inside the spectrometer, the spectrometer will wait for a data transfer request (API function call) to arrive and starts measuring when the request occurs.
External Trigger Mode	A method of measuring light by sending a TTL signal to the spectrometer using an external trigger device connected to the spectrometer when an external event occurs. Measurement start time and measurement completion time are different for each model of the spectrometer. Therefore, when it is applied to the system where the measurement cycle is sensitive, it is necessary to refer to the timing chart of each model.

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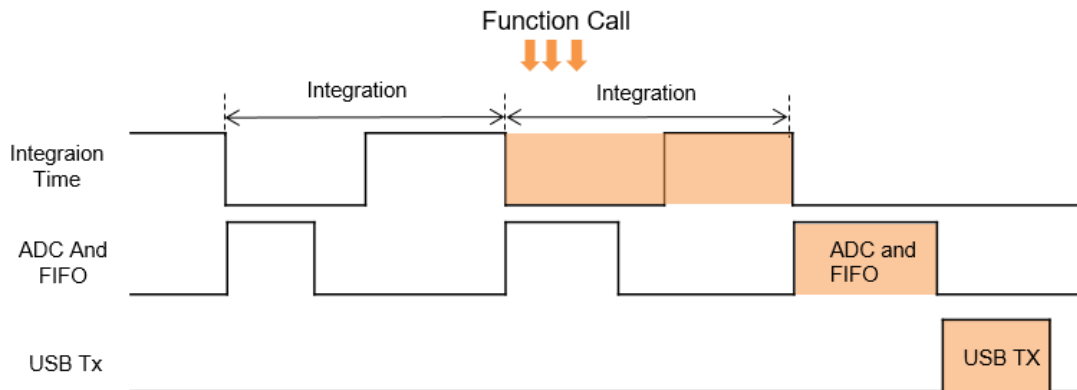
Internal Trigger Mode

(1) Free Run Mode

Free Run Mode periodically repeats the operation as much as the integration time set in the spectrometer until the function call. When calling a function, data is transferred to USB Tx after ADC And FIFO operation. It consists of Free Run Previous and Free Run Next Mode depending on whether data is sent before or after the function call.

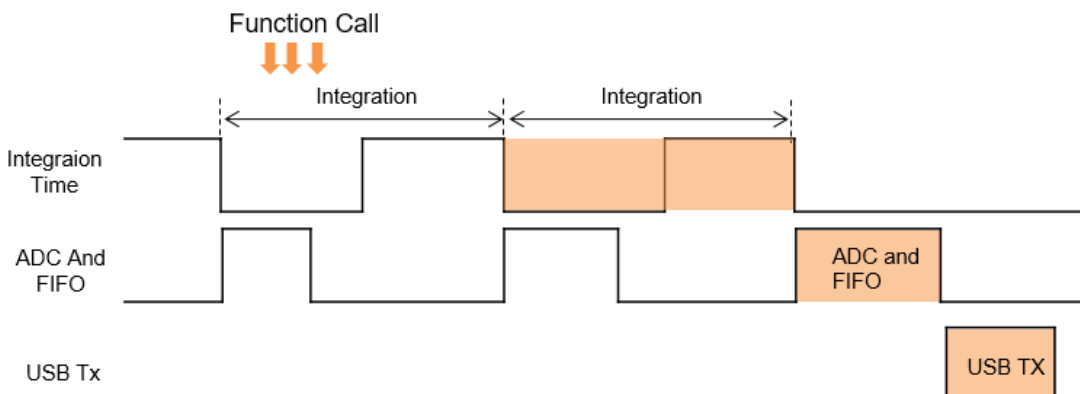
① Free Run Previous

How to get the result value using the previous data after the function call.



② Free Run Next

A method of completing the current measurement cycle and using the next optical measurement data to obtain a result.



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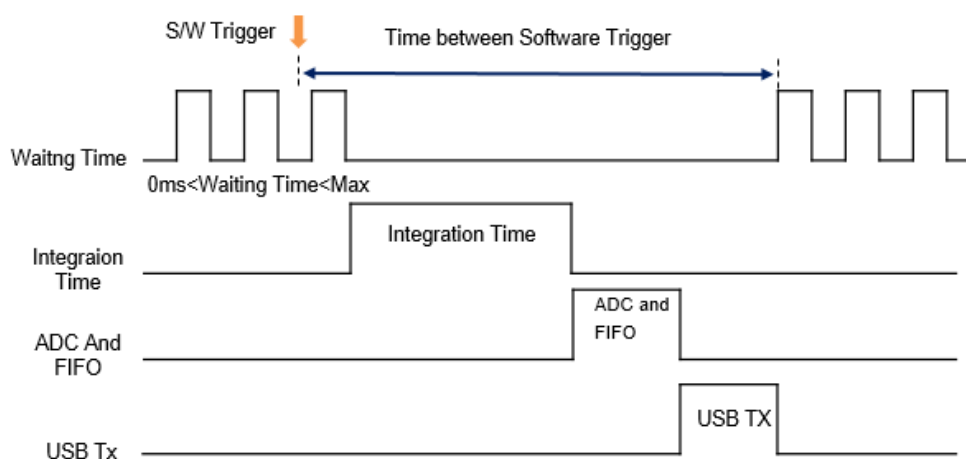
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(2) Software Trigger

NOTE: SM240 and SM440 do not support Software Trigger Mode.

Other models SM245, SM642, SM303, and SM304 wait for the measurement signal in the spectroscope in the standby state until the trigger input. When the spectrometer is on standby, the Waiting Time, which is preparation before light exposure to the CCD, is repeated periodically. Waiting time is ~0-1ms for SM245 and ~0-7ms for other models. When the function is called and a trigger occurs, the waiting time is completed, and the measurement (Integration Time + ADC and FIFO + USB Tx) is started.



	Free Run Previous	Free Run Next	Software Trigger	Waiting Time
SM240	O	X	X	Only Free Run
SM245	O	X	O	~0-1ms
SM642	O	O	O	~0-7ms
SM303	O	O	O	~0-7ms
SM304	O	O	O	~0-1ms
SM440	O	X	X	Only Free Run
SM445	O	O	O	~0-4ms

Table: Internal Trigger Information by Model

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External Trigger Mode

External Trigger Mode determines whether a trigger occurs through the External Trigger Input Pin (Pin 1) on the back of each Spectrometer. The spectrometer is in the standby state until the trigger is input. During standby, the waiting time (preparation before CCD light exposure) is periodically performed. When the trigger is input, after completing the current Waiting Time, the optical data is collected for the integration time, Analog to Digital (ADC) is used by the AD Converter, and the data accumulated in the FIFO is Tx through USB.

Finally, an output signal (Run signal) is output through the output pin on the back of each spectrometer. (In the case of the SM2xx series, the same operation is performed in Free Run / External Mode.)

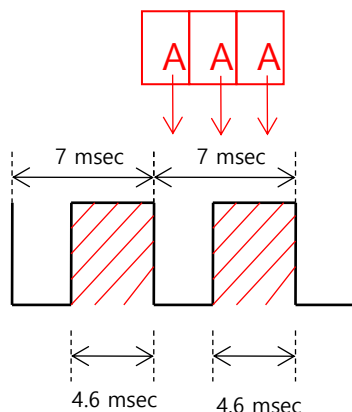
Integration Time and ADC Time have a fixed time value, while Waiting Time and USB Tx have variable time values. (Waiting Time varies depending on where the trigger signal is input, and USB Tx has a variable time value because it is affected by USB communication conditions (hardware, process priority, etc.)

(1) External Trigger Recognition



In the case of Falling Edge (5V -> 0V TTL), if Low (0V) is kept over 10μsec, A is recognized as External Trigger Input.

(2) Waiting Time



Waiting time is the time to prepare for light measurement and is the delay time before exposing light to CCD. In External Trigger Mode, only the Waiting Time operation is repeated inside the spectrometer until the trigger input signal occurs. At this time, the external trigger signal does not know which timing of the waiting time to enter. As shown in A, the waiting time has a variable time from 0 to 7ms depending on the input position of the trigger.

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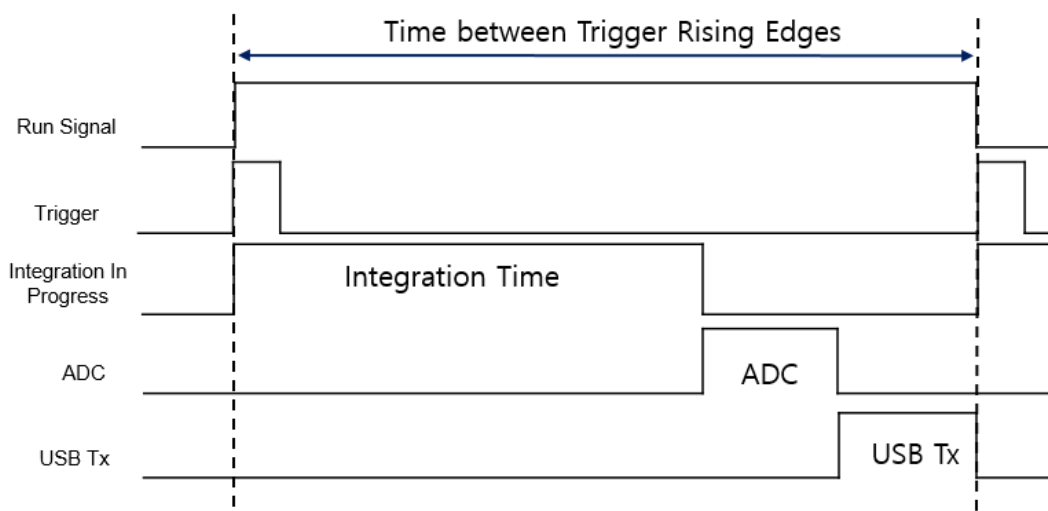
(3) USB Tx

Depending on the model, the time of USB Tx varies from 1 to 6ms. However, customizing up to 1ms is possible according to the customer's needs.

(4) Timing Chart

① SM240, SM245 (External Trigger)

SM240 and SM245 are in standby mode without internal operation until the trigger signal is input in external mode. When the trigger signal is initiated, the spectrometer immediately starts measuring. The measurement proceeds to Integration Time + ADC + USB Tx. During the ADC and USB Tx operation, the measurement does not start immediately after the trigger signal is input.



	Min Integration Time	ADC	Min USB Tx	Min Trigger Cycle	Max Trigger Rate (Hz)
SM240	1ms	4.1ms	3.9ms	9ms	111 Hz
SM245	1ms	4.1ms	3.9ms	9ms	111 Hz

Table: Detailed motion time by model

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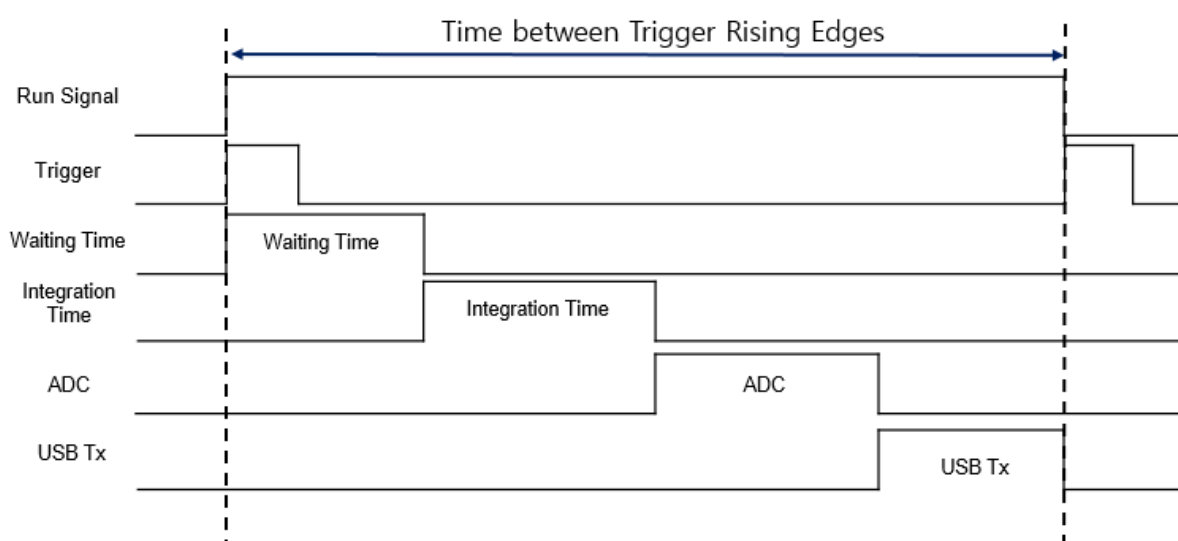
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② SM642, SM303, SM304, SM445 (External Trigger)

SM642, SM303, SM304, and SM445 are on standby until the trigger signal is input in external trigger mode. In the standby state, a waiting time is periodically performed before light exposure to the CCD. After the external trigger input, the FIFO is initialized at the end of the Waiting Time in progress, and after the set Integration Time, ADC, and USB Tx, it becomes the trigger input standby state again. The Max Trigger Rate varies by the model because the Waiting Time, ADC, and USB Tx times are variable.



	Waiting Time	Min Integration Time	ADC	Min USB Tx	Min Trigger Cycle(us)	Max Trigger Rate (Hz)
SM642	~0-7ms	7ms	4.1ms	4.7ms	15.8ms	63.3 Hz
SM303	~0-7ms	7ms	4ms	1.9ms	12.9ms	77.5 Hz
SM304	~0-1ms	1ms	<1ms	<1ms	3ms	333.3 Hz
SM445	~0-4ms	0.01ms	7.386ms	4ms	11.396ms	87.75 Hz

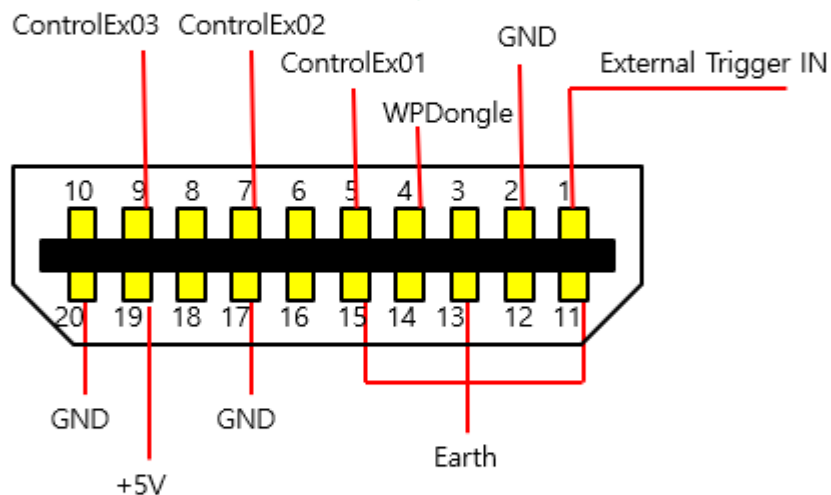
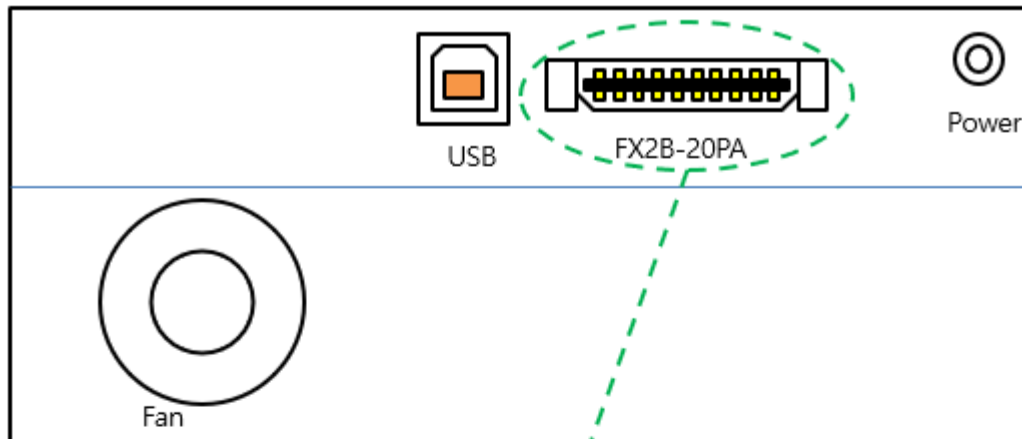
Table: Detailed motion time by model

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※ Pinout Diagrams for SM spectrometers (except SM240/SM440)



PIN	Description	PIN	Description
1	External Trigger Input	11	Earth
2	GND	12	Reserved
3	Reserved	13	Earth
4	WPDongle(EEPROM WP)	14	Reserved
5	ControlEx01	15	Earth
6	Reserved	16	Reserved
7	Run Signal	17	GND
8	Reserved	18	Reserved
9	ControlEx03	19	+5V Out (5mA Max)
10	Reserved	20	GND

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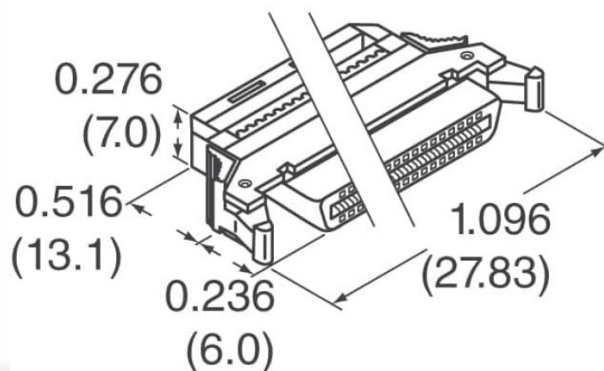
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※ External (Male) Connector for SM spectrometers

Part Number: FX2B-20SA-1.27R



[Externa Trigger Connectors]