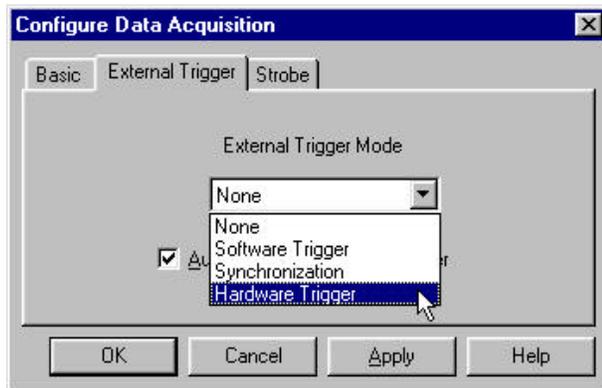


External Triggering Options

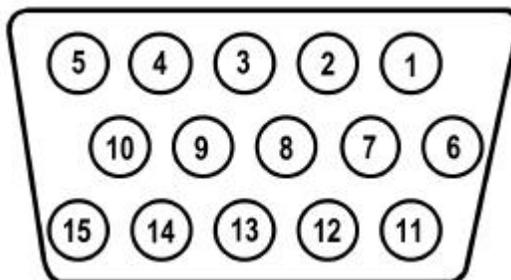
Our S2000 and S1024DW Spectrometers provide four methods of acquiring data. In the Normal Mode, Ocean Optics spectrometers are “free running.” That is, the spectrometer is continuously scanning, acquiring, and transferring data to your computer, according to parameters set in the software. In this mode, however, there is no way to synchronize the scanning, acquiring and transferring of data with an external event.

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



 In order for you to use one of the External Triggering Options, it is imperative that you know the specifications and limitations of your triggering device. The design of your triggering device may prevent you from using one of the external triggering modes as it is described in these pages.

For each external trigger mode, Pin 3 of the J2 (D-SUB-15) Accessory Connector supplies voltage to the spectrometer. To operate in the Software Mode, the triggering device must be connected to Pin 8 of the J2 (D-SUB-15) Accessory Connector. To operate in the Synchronization Mode, the triggering device must be connected to Pin 5 of the J2 (D-SUB-15) Accessory Connector. And to operate in the Hardware Mode, the triggering device must be connected to Pin 4 of the J2 (D-SUB-15) Accessory Connector.



J2 (D-SUB-15) Accessory Connector (female)

External Software Trigger

In this level-triggered mode, the spectrometer is “free running,” just as it is in the Normal Mode. The spectrometer is continually scanning and collecting data. With each trigger, the data collected up to the trigger event is transferred to the software. If you continuously apply triggers, such as by holding down the button on an external switch, this mode is equivalent to operating in the Normal Mode.

In the Software Mode, you set the integration time in the software. (It is the only external triggering mode where the integration time is set in the software.) All other acquisition parameters are set in the software as well. The source for the integration clock comes from the A/D converter.

Use the Software Mode if you:

- are using a continuous illumination source, and the light intensity is constant before, during and after the trigger
- need to set the integration time in the software

To Use the Software Mode:

1. Supply a line from your triggering device to Pin 3 of the J2 Accessory Connector to provide the positive voltage +5VDC to the spectrometer. (See figure on page 1 for pin location.) We do not advise using an outside source to supply the voltage, as it is based on a referenced ground and your reference may be different from ours. Using Pin 3 to supply voltage ensures that the spectrometer will receive the appropriate voltage for the trigger event.
2. Supply a line from Pin 8 of the J2 Accessory Connector to your triggering device. (See figure on page 1 for pin location.)
3. Set your acquisition parameters in the software via the Acquisition Dialog Bar or the Configure Data Acquisition dialog box. To access the dialog box, click the Data Acquisition icon or select **Spectrum | Configure Data Acquisition** from the menu.
4. Select **Spectrum | Configure Data Acquisition** from the menu. Choose the **External Trigger** page and select **Software Trigger**.
5. To save processed data with each external trigger, enable the **Automatically save file on trigger** box. If you enable this function, you will be presented with a file save dialog box *with each trigger*. To avoid manually naming a file for each trigger, you can enable the **Autoincrement Filenames** function by selecting **File | Autoincrement Filenames | Enabled** from the menu. Choose a base name and starting index for the autoincremented files.
6. Once you select an external trigger mode, it will appear on your computer that your spectrometer is unresponsive. Instead, it is waiting for the trigger. Activate your triggering device. The acquisition parameters, the name of the window acquiring data and the trigger mode are all displayed in the main status bar.

It is important to note that since this is a level-triggered mode, the amount of delay between the trigger pulse and when a spectrum is acquired is indeterminate because the delay is dependent upon:

- how fast the software polls the Pin 8 line and recognizes it is HIGH
- the amount of time until the start of the next integration period

External Synchronization Trigger

In this edge-triggered mode, the spectrometer is idle until you apply the initial trigger to the spectrometer. With each trigger, the following occurs:

1. the spectrometer stops taking its current scan and data is transferred to the software
2. the spectrometer begins a new scan
3. the spectrometer integrates until another trigger is applied

In the Synchronization Mode, the integration time is set by the frequency of triggers applied to the spectrometer. The effective integration time is the time between rising edges of signals applied to Pin 5 of the J2 Accessory Connector. All other acquisition parameters are set in the software. The source for the integration clock is the external triggering device itself, such as a periodic TTL signal.

Use the Synchronization Mode if you:

- must synchronize your scans to an external clock source
- are using a lock-in amplifier
- are using a chopper

To Use the Synchronization Mode:

1. Supply a line from your triggering device to Pin 3 of the J2 Accessory Connector to provide the positive voltage +5VDC to the spectrometer. (See figure on page 1 for pin location.) We do not advise using an outside source to supply the voltage, as it is based on a referenced ground and your reference may be different from ours. Using Pin 3 to supply voltage ensures that the spectrometer will receive the appropriate voltage for the trigger event.
2. Supply a line from Pin 5 of the J2 Accessory Connector to your triggering device. (See figure on page 1 for pin location.)
3. Set other acquisition parameters in the software via the Acquisition Dialog Bar or the Configure Data Acquisition dialog box. To access the dialog box, click the Data Acquisition icon or select **Spectrum | Configure Data Acquisition** from the menu.
4. Select **Spectrum | Configure Data Acquisition** from the menu. Choose the **External Trigger** page and select **Synchronization**.
5. To save processed data with each external trigger, enable the **Automatically save file on trigger** box. If you enable this function, you will be presented with a file save dialog box *with each trigger*. To avoid manually naming a file for each trigger, you can enable the **Autoincrement Filenames** function by selecting **File | Autoincrement Filenames | Enabled** from the menu. Choose a base name and starting index for the autoincremented files.
6. Once you select an external trigger mode, it will appear on your computer that your spectrometer is unresponsive. Instead, it is waiting for the trigger. Activate your triggering device. The acquisition parameters, name of the window acquiring data and trigger mode are displayed in the main status bar.

External Hardware Trigger

In this edge-triggered mode, the spectrometer is idle until you apply a trigger to the spectrometer. With each trigger, the following occurs:

1. the spectrometer is cleared and then begins integrating
2. the spectrometer integrates for a fixed period of time, determined by the jumpered pins on the spectrometer's circuit board
3. the data is transferred to the software
4. the spectrometer then sits idle, waiting for the next trigger

In the Hardware Mode, you set the integration time by positioning jumpers over pins on the spectrometer's circuit board. All other acquisition parameters are set in the software. The source for the integration clock is the external triggering device itself. This mode is ideal for use with laser and other short-pulse events.

Use the Hardware Mode if you:

- are using a pulsed excitation or light source in your experiment
- are doing LIF (fluorescence with pulsed excitation) or phosphorescence experiments
- are able to jumper the pins on Jumper Block 4 of the spectrometer's electronic board
- need to synchronize an acquisition with an external event

To Use the Hardware Mode:

1. Supply a line from your triggering device to Pin 3 of the J2 Accessory Connector to provide the positive voltage +5VDC to the spectrometer. (See figure on page 1 for pin location.) We do not advise using an outside source to supply the voltage, as it is based on a referenced ground and your reference may be different from ours. Using Pin 3 to supply voltage ensures that the spectrometer will receive the appropriate voltage for the trigger event.
2. Supply a line from Pin 4 of the J2 Accessory Connector to your triggering device. (See figure on page 1 for pin location.)
3. To set the integration time, look at the charts below. After finding the Spectrometer and A/D converter you are using, choose your integration time. You have four choices.

S2000 Miniature Fiber Optic Spectrometer

| Integration Time | | | Integration Time Equation | Jumper Block 4 (JP4) | |
|---------------------------------------|---|--------------------------------------|---------------------------|----------------------|----------|
| DAQ700 (200 kHz Master Clock Freq) | ADC500, SAD500 (1 MHz Master Clock Freq) | ADC1000 (2 MHz Master Clock Freq) | | Pins 1-2 | Pins 3-4 |
| 44 ms | 8.8 ms | 4.4 ms | $8.8/F_m$ | open | open |
| 133 ms | 27.5 ms | 13.3 ms | $27.5/F_m$ | open | shorted |
| 275 ms | 55 ms | 27.5 ms | $55/F_m$ | shorted | open |
| 675 ms | 137.5 ms | 67.5 ms | $137.5/F_m$ | shorted | shorted |

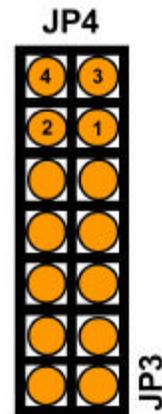
F_m = the master clock frequency in MHz; shorted = connected; open = disconnected

S1024DW Miniature Fiber Optic Spectrometer

| Integration Time SAD500 (1 MHz Master Clock Freq) | Integration Time Equation | Jumper Block 4 (JP4) | |
|--|---------------------------|----------------------|----------|
| | | Pins 1-2 | Pins 3-4 |
| 5 ms | $1000/F_m$ | open | open |
| 60 ms | $12000/F_m$ | open | shorted |
| 300 ms | $60000/F_m$ | shorted | open |
| 655 ms | $131070/F_m$ | shorted | shorted |

F_m = the master clock frequency in Hz (i.e., 200 kHz for the SAD500); shorted = connected; open = disconnected

4. Once you have selected the integration time, note the configuration of the pins in the Jumper Block 4 column of the chart.
5. Remove your spectrometer from its housing. Do not tamper with the optical bench. (If you have more than one channel in your system, you may have to disconnect the channels from one another. The master spectrometer is always on the bottom of a multiple channel system.) In the center of the green circuit board, near the optical bench, find Jumper Block 4, labeled JP4. (See the figure to the right.) Jumper Block 4 consists of the first four pins, which are numbered 1, 2, 3, and 4. Using jumpers, configure the pins to match the integration time you selected.



For example:

- You have an S2000 and an ADC1000 A/D converter
 - Out of your four choices for an integration time, you select 13.3 milliseconds
 - Pins 1-2 must be open and Pins 3-4 must be shorted
 - Leave Pins 1-2 uncovered and place a jumper over Pins 3-4
6. Set other acquisition parameters such as averaging and boxcar smoothing in the software via the Acquisition Dialog Bar or the Configure Data Acquisition dialog box. To access the dialog box, click the Data Acquisition icon or select **Spectrum | Configure Data Acquisition** from the menu.
 7. Select **Spectrum | Configure Data Acquisition** from the menu. Choose the **External Trigger** page and select **Hardware Trigger**.
 8. To save processed data with each external trigger, enable the **Automatically save file on trigger** box. If you enable this function, you will be presented with a file save dialog box *with each trigger*. To avoid manually naming a file for each trigger, you can enable the **Autoincrement Filenames** function by selecting **File | Autoincrement Filenames | Enabled** from the menu. Choose a base name and starting index for the autoincremented files.
 9. Once you select an external trigger mode, it will appear on your computer that your spectrometer is unresponsive. Instead, it is waiting for the trigger. Activate your triggering device. The acquisition parameters, name of the window acquiring data and trigger mode are displayed in the main status bar.

It is important to note that if you apply triggers faster than the fixed integration time, you will miss acquisitions.