



830 Douglas Ave - Dunedin, FL 34698

727-733-2447 Phone

[www.oceanoptics.com](http://www.oceanoptics.com) - [info@oceanoptics.com](mailto:info@oceanoptics.com)

## Operation Instructions for SIR Series Spectrometers and Software

On May 20, 2010, Ocean Optics acquired Sandhouse Design, LLC. Sandhouse developed a unique line of high-powered LED light sources for research and spectroscopic applications. These products have been widely used in biotechnology, process control and industrial applications.

We're pleased to include these exceptional technologies for light into the Ocean Optics product family. Should you need additional information, please be sure to contact an Ocean Optics Applications Scientist.



## 1. Warnings

Use only the **5Volt 4amp power supply** included with the SIR analyzer. Use of any other power supply could result in permanent damage to the electronics.

Storage temperature: 0C to 45C

Operating temperature: 10C to 30C

## 2. Essentials of Operation.

The SIR spectrometer is based on a rotating grating and single point detector. The rotating stage has a very high resolution positioning system and feedback encoder which allows very high spectral resolution and repeatability.

The SIR system works well for continuous sources of light. When sampling pulsed or modulated sources, the spectrometer must be synchronized with the external source.

Please see the external triggering and interface section at the end of this document for more information.

The rotating grating positional feedback is precisely timed with sampling of the light through the high speed analog acquisition system.

The ideal sampling resolution is based on the slit width and the step size of the encoder.

This relationship is shown below.

Slit Width	Ideal Encoder Step Size
5	1
10	1
50	6
100	13
200	26
400	53
500	66
1000	130

### ***Optional Accessories***

***Shutter: NOT AVAILABLE AT THIS TIME.***

### 3.0 Installing Software

Please close all programs running before installing the SIR software. Do not plug in the USB connection until the software has been installed. When installing software it might be necessary to direct the “New Hardware Found” Wizard to the cyusb.sys file. This file will be located in the C:\WINDOWS\system32\drivers directory.

The SIR software and updates should be downloaded from the Ocean Optics Website. <http://www.oceanoptics.com/Technical/softwaredownloads.asp>

<a href="#">MIR-Plus Spectrometer Control Software</a>	1.0.0.25
No Password Required	
<a href="#">MIR Spectrometer Control SDK</a>	1.0.0.15
No Password Required	

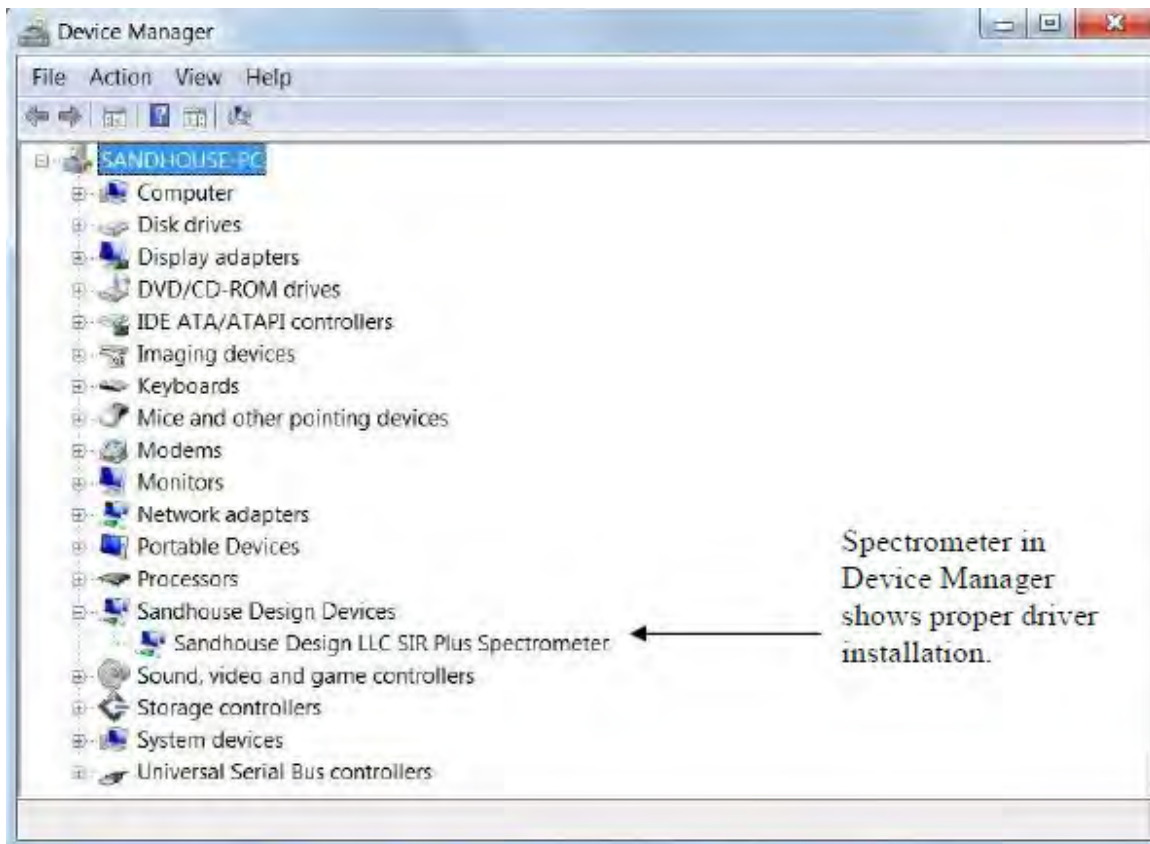


Figure 1:

#### 4.0 Initial Start up of the Software:

Once the software is installed, plug in the USB cable between the spectrometer and the host computer. Then connect the included 5Volt Power Supply. Once the drivers are installed correctly, the spectrometer will show up in the Device Manager as shown in Figure 1.

Select the MIR Plus application from the program menu.



**Figure 2:**

At initial startup of the MIR software, the spectrometer will come up and find the home position. This will take a few seconds every time the spectrometer starts up.

After starting the software, and the encoder position has found its home location the software interface will appear.



**Figure 3:**

Figure 3 shows the basic view of the Mid IR Spectrometer Software. The large icons at top are: (listed from left to right).

1. **MIR:** This button accesses all of the settings and control registers for the spectrometer
2. **Reference:** Use this button to imitate a scan and store a reference spectrum.
3. **Dark:** Use this button to scan and store a dark signal.
4. **Spectrum:** Use this button to take a Scan based on the programmed range.
5. **Continuous:** This will tell the spectrometer to continuously scan.
6. **Range Scan:** Use this button to configure the desired scan wavelength range and step resolution of the scan. The practical resolution of this scan will depend on the installed slit size.
7. **Home:** Use this button to force the turntable to return home and re-reference its location.
8. **View Sample:** Changes the spectrum view window to the most recent scan.
9. **Subtract Dark:** This will subtract the dark scan from the current spectra. This control is only active after a dark signal has been taken
10. **View Absorbance:** This button will calculate and display an absorbance spectra based on the stored reference, dark and Sample spectra. This button only becomes active after the respective samples have been taken
11. **View Transmission:** This only becomes active after a dark and reference have been stored.

Prior to using the spectrometer it is necessary to do the following:

1. Turn on the Thermo-Electric (TE Cooler) if it is present and allow the desired temperature to stabilize.
2. The Dark current setting should be verified and possibly adjusted
3. The desired wavelength range must be set.

## 5.0 Configuring the Spectrometer

The first step when starting the spectrometer is to open the MIR control menu as seen in figure 4.

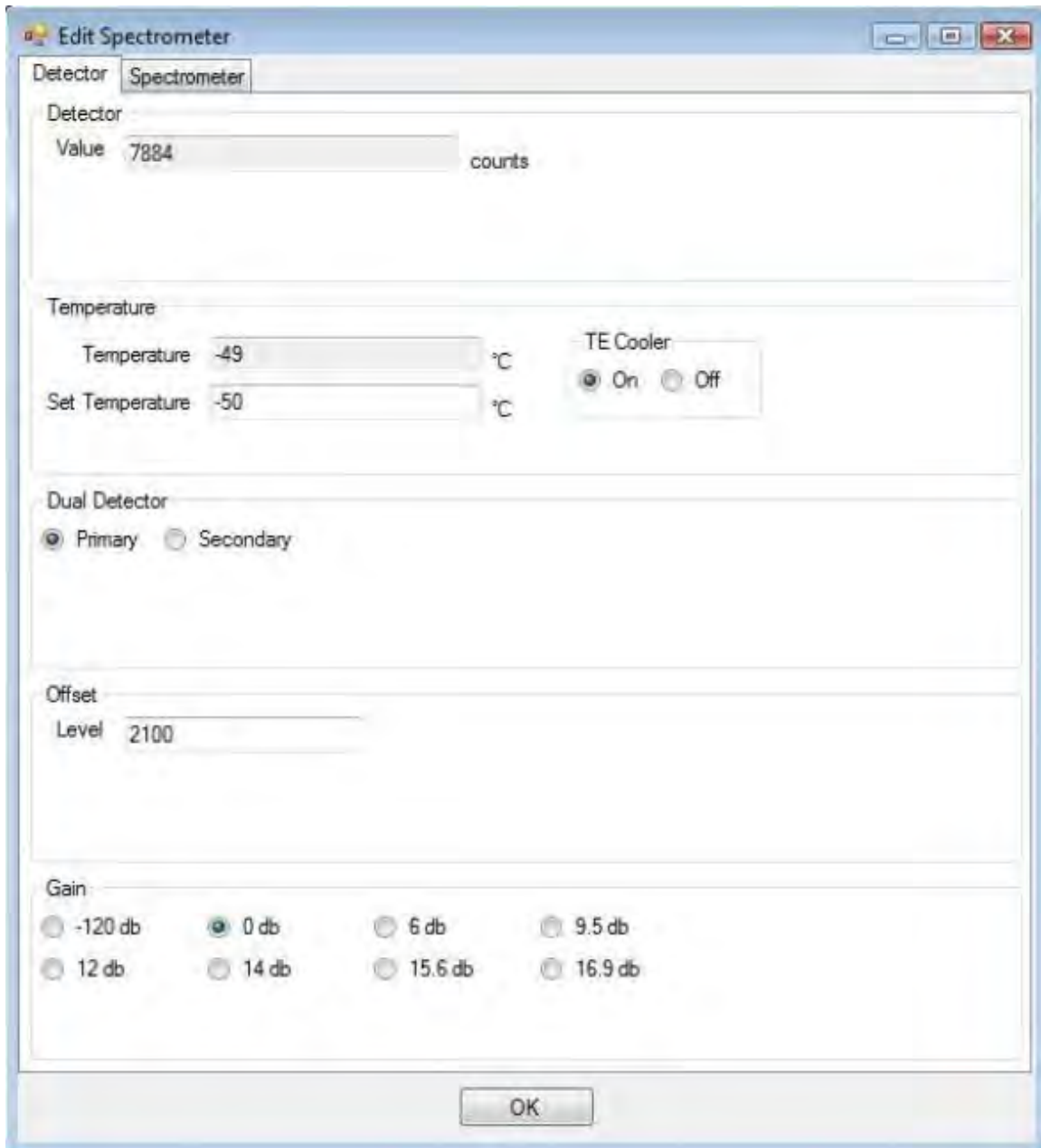


Figure 4: MIR control (Detector Tab).

## **MIR Control (Detector Tab)**

### **Detector**

This is a direct readout from the AD system. This is a 16bit Analog to Digital Converter. If the system is at '0', the detector is under range. If the Analog value is saturated, the value is possibly over range. Try reducing the amount of light into the system, and possibly adjusting the dark offset.

### **Temperature:**

If the SIR system has a TE Cooler, it will be necessary to turn this on. Note that not all systems have a TE-cooler. Please consult the supplied calibration sheet to verify the presence of a TE cooler, and the valid range of operation. It will take up to one minute for the system to reach temperature and stabilize. Please verify that the actual temperature reaches its "Set Temperature". If the system is in too warm of an environment, the detector may not be able to reach its selected temperature. If this is the case, please reprogram the set temperature to a warmer temperature and give the system time to stabilize. Due to slight calibration errors there can be a difference of +/-3 degrees between the set and actual temperature.

### **Dual Detector**

If the spectrometer system does not have a dual detector system, this setting should default to primary. Otherwise, this switch will toggle between the two detectors.

### **Offset**

To account for the large variation possible inherent with infrared detectors, the SIR spectrometer system has a Dark offset Adjustment. This is accomplished with a 12 bit DAC that connects directly to the Analog Preamplifier. Adjusting this DAC value will offset the Dark current to increase the effective analog range of the detector. As the voltage level of the DAC increases, the amount of negative Dark current offset increases. If the AD is reading "65,535" the DAC is too low. If the Analog to Digital Converter is reporting "0", the DAC is too high and should be adjusted down.

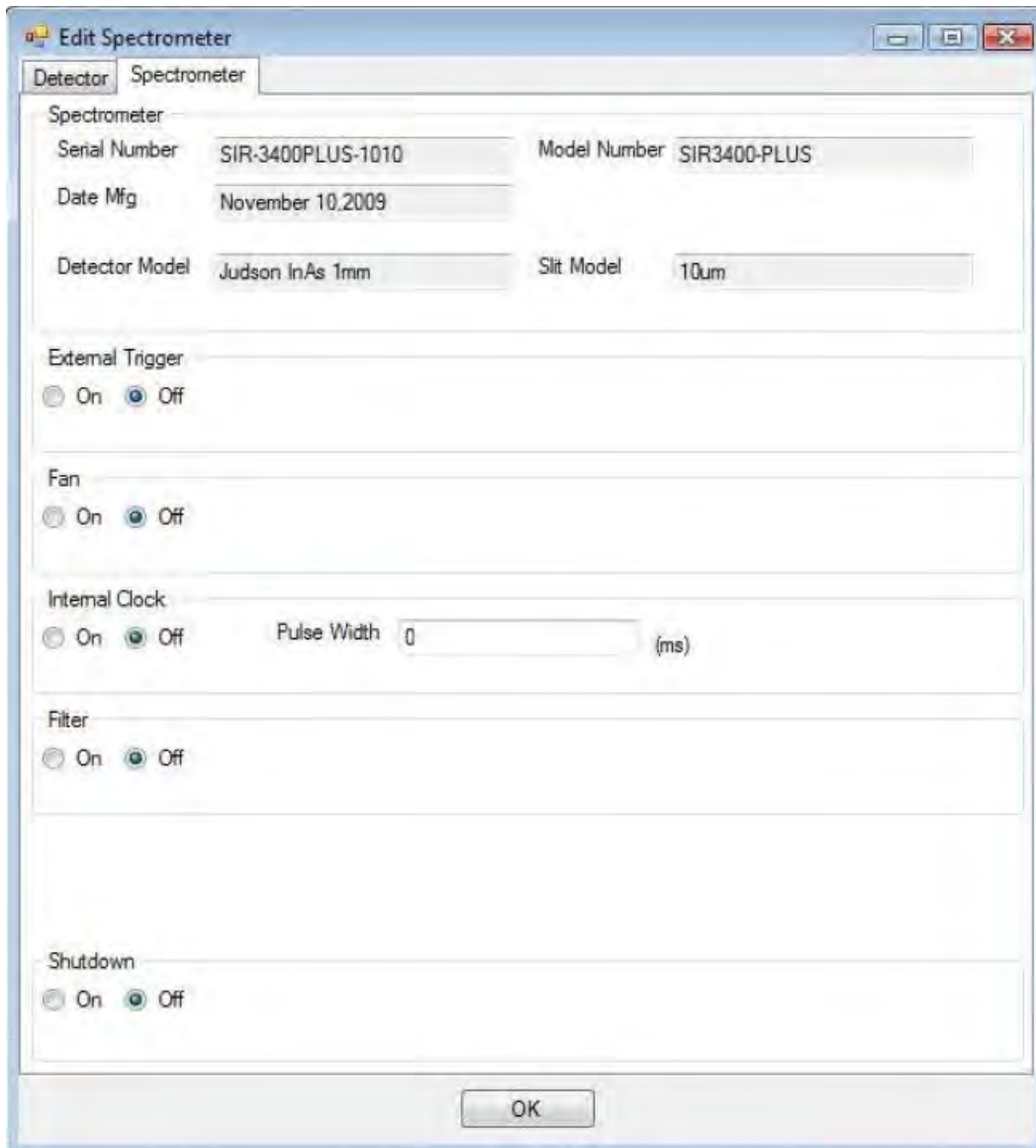
The offset level is set at the time of manufacture, to give optimum performance, but can be adjusted by the user to account for ambient conditions.

After the system has stabilized, Please set the offset level. This is done by

1. Removing all light going into the system.
2. Monitoring the AD value at the top of the Spectrometer Window.
3. The range for AD values is from 0 to 65535. The target for the adjusting the baseline depends on which wavelength region the system is operating in. Systems working up to 2.6um should be set for approximately 1000 to 2000 counts. Systems measuring beyond 2.6um, should have a dark baseline of 2500 to 5000 counts.
4. The correct offset level can be found by incrementally increasing the 12 bit number in the offset location between 0 and 4095 until an optimal setting is found.

## Gain

When detecting weak signals, The SIR system has a programmable gain amplifier that can be addressed to increase the signal level. If it is required to use this, the Offset level must be readjusted. It is recommended for maximum Signal to Noise performance to leave the gain set a 0dB.



The screenshot shows the 'Edit Spectrometer' window with the 'Spectrometer' tab selected. The window contains the following fields and controls:

- Spectrometer**
  - Serial Number: SIR-3400PLUS-1010
  - Model Number: SIR3400-PLUS
  - Date Mfg: November 10, 2009
  - Detector Model: Judson InAs 1mm
  - Slit Model: 10um
- External Trigger**
  - On
  - Off
- Fan**
  - On
  - Off
- Internal Clock**
  - On
  - Off
  - Pulse Width: 0 (ms)
- Filter**
  - On
  - Off
- Shutdown**
  - On
  - Off

An 'OK' button is located at the bottom center of the window.

## Edit Spectrometer (Spectrometer Tab)

### Spectrometer

This is pertinent information on the instrument. This includes information such as the factory installed slit size, Date of manufacture, model and serial number of the system.



**External Trigger:** This selects if the spectrometer will deliver an external trigger. This is only necessary when working with non-continuous sources or trying to synchronize with external events.

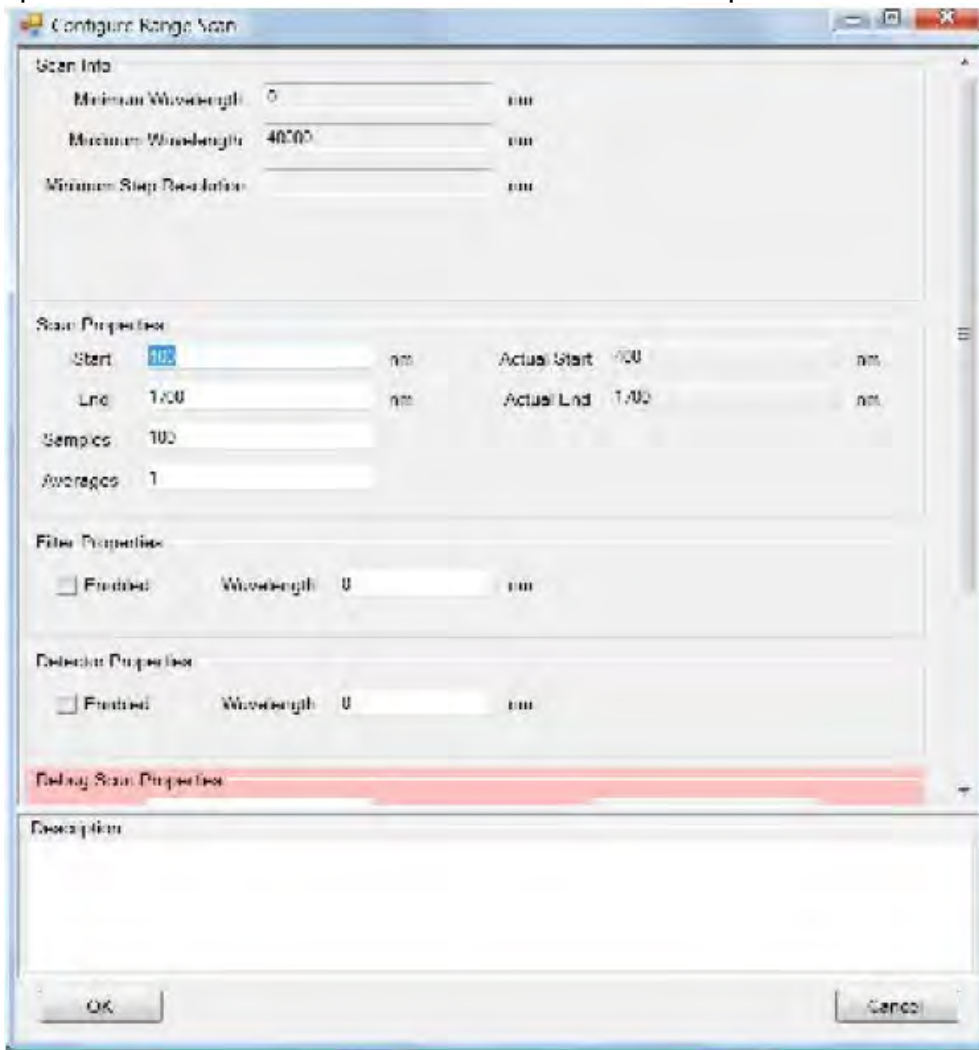
**Internal Clock:** This programs the spectrometer to deliver a selected pulse of programmed width, with each acquisition trigger of the Analog to Digital converter.

**Fan:** This will turn the fan on or off, generally it is OK to leave the fan off, when operating in warm environments the fan is recommended to keep the system cool.

**Filter:** This setting is on or off and this will actively switch the position of the internal filter wheel if it is present.

### Shut Down:

This controls the shutdown state of the internal power supply for the spectrometer. This should be set to off for normal operation.



Configuring the range:

**Configure Range Scan (Scan properties):**

**Start:** (This is the Starting Wavelength entered in nm) and based on the calibration.

**End:** (Ending Wavelength) This is the ending wavelength of the scan

**Samples:** This is determined based on the resolution of the system. If the system has a resolution of .1nm, and the sample bandwidth is 100nm, then 1000 samples should be taken. The software will calculate how often to take the samples.

**Filter Properties:** If a filter/shutter wheel is installed, this selects the appropriate wavelength for it to switch over

**Detector Properties:** If a hybrid detector is present, this will program the appropriate wavelength for the system to switch over.



**Other User interface features:**

1. **Overlays:** The software has the ability to overlay saved data from previous scans into the current graph view. This feature is accessed from the Overlays Menu
2. **Graph Zoom:** It is possible to zoom in on features of the graph by right clicking on the mouse button and dragging a box around the desired area
3. **Graph Pan:** Panning is achieved by clicking the left mouse button and dragging the graph in the desired direction.
4. **Extent Zoom:** Double Clicking the mouse button will zoom the graph out to the far extents of the data.
5. **General Graph Zoom:** Scrolling the mouse wheel will zoom in and out of the center of the currently viewed graph window.
6. **Cursor:** By clicking on the graph, a cursor will appear and show the corresponding wavelength location and analog value.

## 6.0 External Triggering and interfacing:

The SIR spectrometer can support several modes of synchronization with external events. The default mode of operation is a free running mode and requires no external interfacing. In cases that require external synchronization, such as with optical chopping or triggering a laser or optical source, the spectrometer can provide a 50% duty cycle clock which can be programmed in .1ms increments. The spectrometer can also be synchronized with an external trigger input. To accommodate the fact there is a finite amount of time between when a trigger activates, and the external source reaches full power, a phase delay option is available to adjust the amount of time between the rising edge of the trigger, and when the spectrometer takes a sample.

To Access the trigger option menu, go to the MIR Control Menu.

### **The External Interface Tab is used to configure triggering options.**

**Phase Delay:** This is used to adjust the time between an incoming trigger and the Analog to Digital Converter taking a sample. This can be adjusted in 0.1ms increments. The time entered is one half of the period of the clock. In this example the phase delay is set to 10ms.

**Internal Clock:** This is a clock that can be used to drive the external lamp clock output. It can be adjusted in 0.1ms increments. The value set determines one half of the period of the clock. In this example the clock will be high for 100ms and low for 100ms, for a total clock period of 200ms, or a frequency of 5hz. (1/200ms). The sample clock can be adjusted independent of the A/D speed described earlier, but will only sample when it has completed it's previous cycle. The maximum is....

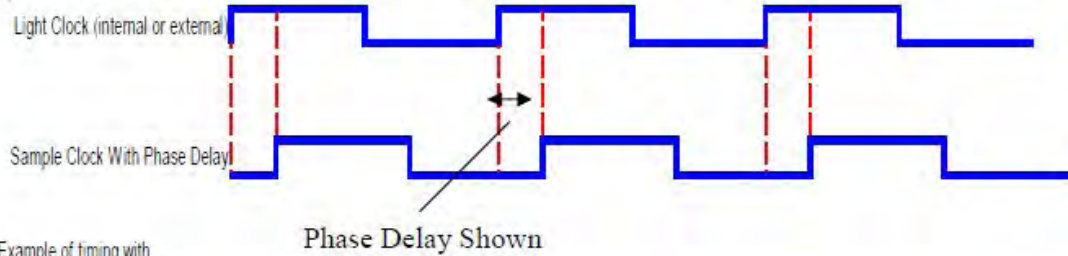
**External Enabled:** This field has a setting of True or False. A value of true in this field tells the spectrometer to use the external input clock (plus phase delay) as the trigger source. A value of false tells the spectrometer to use the internal clock (plus the phase delay) as the trigger source.

**Invert Phase:** A value of false in this field makes the trigger source a rising edge. A value of true here will enable the trigger source to be a falling edge.

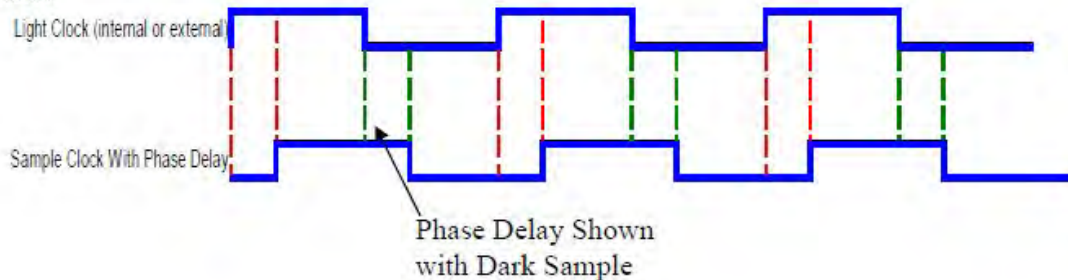
**Lamp Synchronize:** A value of true in this field activates the synchronization of the spectrometer. The source of the trigger is determined by the "External Enabled" button above.

## Timing Examples

Example of timing with Spectrometer as master



Example of timing with Spectrometer as and Dark enabled



### Main Spectrometer configuration page:

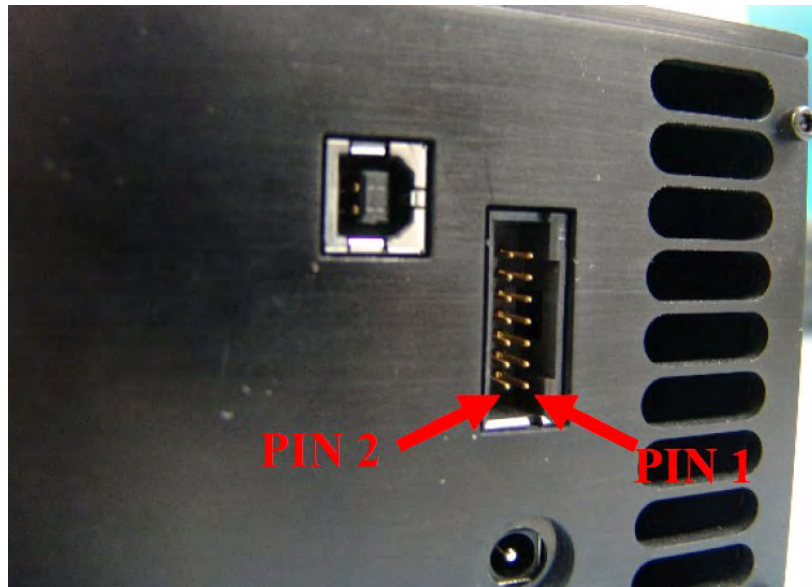
The fields pertinent to external triggering on this tab are "External Lamp Active".  
External Lamp Active: A value of true in this field turns on a TTL level signal to activate an external light source. This is a continuous output. It is not modulated or synchronous to any internal A/D sampling.

Fast Pulse Lamp Sync: If a quick pulse is desired instead of 50% duty cycle pulse is desired on the Lamp output, set this field to "True".

Internal Dark: When this value is set to "True". The spectrometer will alternate sampling from the rising edge of the pulse to the trailing edge of the pulse. The software will automatically subtract the two samples from each other. This will accommodate drifts in the background of the spectrum.

External Interface Port:

Pin #	Description
1	I2C SCL
2	I2C SDA
3	3.3V 10mA Max
4	3.3V 10mA Max
5	Gnd
6	Gnd
7	External Trigger (output) 3.3V logic. 50% duty cycle user adjustable clock to drive external chopper or light source synchronized to AD sampling.
8	Gnd
9	Lamp Synchronization (input) 5Volt tolerant input to trigger the spectrometer and sample synchronously with external events.
10	Lamp Enable. Output to enable external Lamp.
11	USER I/O-1
12	USER I/O-2
13	USER I/O-3
14	USER I/O-4



View of Back Panel of SIR Spectrometer

The back panel connector of the SIR spectrometer is manufactured by Tyco Electronics. The part number is 5-103167-4. The part number for the external mating plug is 87922-3. The pins for this connector are purchased separately and are part # 5-103171-5.

**Revision 2.1** Added information on external Synchronization options. 7/26/2009

**Revision Plus:** Upgraded all graphs and menus to reflect the new PLUS system  
12/18/2009