Spectrometer Application Software Manual

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Before You Begin

Warning and Caution

WARNING

Disconnect your PC computer's power supply from its AC power source before you install or remove the spectrometer cards from your PC computer. Failure to do this can result in equipment damage. Some circuitry on the PC computer can continue to operate even though the front panel power switch is off.

CAUTION

Electrostatic discharge can damage your spectrometer card. Avoid touching the edge of the spectrometer card, and always handling card by holding the case, **Figure 1.**

Your spectrometer was built with dedicate electronic and optical components. It was precisely calibrated to optimize its performance. Handle your spectrometer with great care to keep your spectrometer trouble-free and other problems in the future.

- Do not shake or hit your spectrometer to any hard objects that may cause damage to the electronic components, and misalignment of the optics inside the spectrometer.
- Always replace the end plastic cap on the fiber optic cable connector to keep it clean and free of dust when not using the spectrometer. See **Figure 2.**
- Do not bump the fiber optic cable connector of the spectrometer to any hard objects that will cause damage to the connector and consequently damage the fiber optic cable that connects directly to the inside optic assembly. See **Figure 2.**

Figure 1: Handling the spectrometer by holding the case

Figure 2: Fiber cable connector with end cap on.

SHIPPING CAUTION

If a spectrometer needs to be shipped to different locations, please follow a simple instruction below to protect the spectrometer from getting damaged.

1. Make sure to use a non-collapsible cardboard box with plenty of peanut and bubble wrap around the spectrometer.
2. Keep the spectrometer in the center of the shipping package to prevent it from moving.
3. Protect the fiber optic cable connector, **Figure 2.** This fiber optic cable connector can easily get damaged during shipment. Follow instruction below to protect it.

    a. First cut strip of cardboard (A) about 6" long and 2" wide. **Figure 3.** Fold the strip of cardboard a couple times so it would make a small loop. Put a piece of tape so it won't unfold.

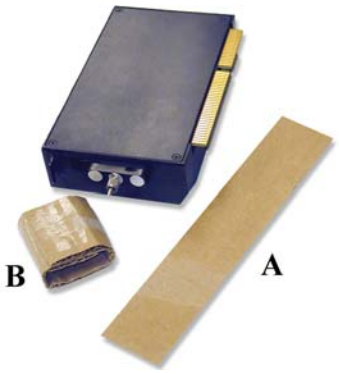


Figure 3: A strip of cardboard (A), cardboard (A) was folded to make small loop (B)

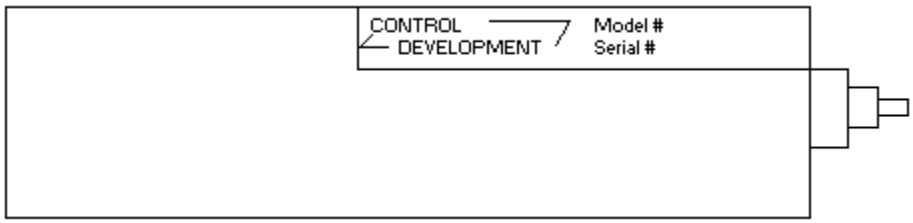
    b. Insert the folded cardboard (B) over the fiber cable connector on the spectrometer to protect it during shipment. **Figure 4.**

Figure 4: Insert the folded cardboard (B) over the fiber optic cable connector to protect it during shipment.

Chapter 1
Installation and Setup

1. Unit Identification

CDI supplies and supports several different types of spectrometers. To help you identify your unit, a label is located on the top of the unit. The following chart should help you make a positive Identification.



Model # card-type-resolution-spectral response-1 stage cooler:-10º-interface type/dispersion/slit size

The model number will give the name of the card, the type of spectrometer, the spectral range in nanometers, 1 or 2 stage cooler in Celsius temperature, the interface type, dispersion, and the slit size used in the construction of the unit. There are four basic units available:

Type	**Description**
MPP	Multi-Pin Phased
PDA	Photo Diode Array
NIR	Near Infrared
RAMAN	Raman

PDA and NIR Plug-in Card
ISA Interface

PDA, NIR, MPP and RAMAN
USB Interface

NIR Plug-in Card
ISA Interface

Portable PDA and NIR

2. Getting Started

The CDI Optical Spectrometer has been designed for ease of installation and use. Since the optic is permanently calibrated, you may begin taking data immediately after installing the instrument. A quick- start installation, which uses the default factory settings, is outlined below.

a. Install the spectrometer card in the PC's ISA slot. If the spectrometer has a Universal Serial Bus (USB) interface connector, plug in one end of the USB cable to the available USB port on the PC computer and the other end of the USB cable to the spectrometer.
b. Install the CDISpec32 software. (See software installation section)
c. Install the correct device driver for the type of interface
d. Click on the Spec32 icon to start the program.
e. Connect the input fiber to the SMA connector and Begin taking data.
f. Press the Auto Configure button to tune in the signal automatically.

3. Hardware Installation

Spectrometer with ISA Interface

The spectrometer card uses only the XT I/O bus for communications with the CPU. No interrupts or DMA channels are used, simplifying installation. The board address is preset at the factory. You may need to check your computer for I/O address conflicts. If another board is already using this address, use the procedure in section on board address for resetting the spectrometer board address.

The optical spectrometer card requires two adjacent ISA slots. Make sure to remove the bulkhead cover from the adjacent slot to allow air intake for heat dissipation.

Spectrometer with USB Interface

Your spectrometer is shipped to you with a USB cable. Plug one end of this cable to a PC computer and the other end to the spectrometer, **Figure 3.1**. The location of the USB port can either be in the front panel, or in the back panel of the computer. The USB interface was designed as a hot swappable interface, which means that the spectrometer with USB interface can be connected to the computer without turning power off of the computer or the spectrometer. (**Note: If your computer does not have CDI Spec32 software already installed, please turn off the power of the spectrometer before plugging the USB cable into the computer).**

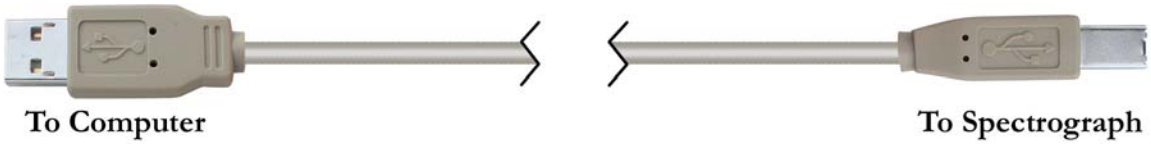


Figure 3.1: USB cable

CAUTION

You need to have Administration Privileges in order to install and modify software and hardware under Windows NT/2000

4. CDI Spec32 Software installation under Windows 9x, ME, XP, NT, and 2000

A CD-Rom disk is shipped with each spectrometer, **Figure 4.**. This CD-Rom disk contains CDI Spec32 software, a Spectrometer Application Software manual in PDF format, (this manual that you're reading), and other useful information. Installing CDI Spec32 software is straightforward and simple. Follow the steps below.

Figure 4. CDI SPEC32 CDI-Rom Disk

4.1. Insert the CDI Spec32 CD into the CD-Rom drive. It will automatically run and a menu comes up, **Figure 4.1.** If the Control Development **Main Menu** does not display, click **Start** button on Windows taskbar, and click **Run.** Type D: autorun.exe (where D is the letter corresponding the CD-Rom drive) in the Run Open box. **Figure 4.2.**

Figure 4.1. Control Development Main Menu

4.2. There are six choices to choose from on the **Main Menu**. You can either click on **View CDI Manual** (this manual you are reading) or **View CDI Catalog** for CDI latest products. Click on **Exit** will close this menu. To install CDI Spec32, click on **Install CDI Spec32 V…** option. Answer "Yes" to install CDI spec32, or "No" to exit to the main menu.

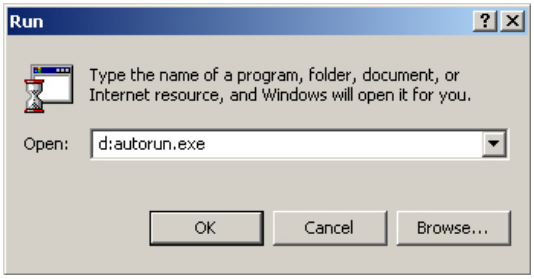


Figure 4.2. Run Open Box

4.4. A software compatibility matrix window displays, **Figure 5.1.** After you finish reading this table to confirm if your operating system is compatible with CDI SPEC32 software, click **OK.** (Please read the section 5 for more information about the software compatibility matrix.)

4.5. It is strongly recommended that you need to exit all Window programs before continuing the installation process of this program. The CDI SPEC32 software setup begins and a welcome screen displays, click **NEXT.** A Software License Agreement Window comes up. If you agree with Software License Agreement, click **YES** to continue the installation.

4.6. After you click **YES,** a software version release note displays. This is the information of the version of the program. If there were any bugs fixed from previous versions, or new features added and new release date of the program, they are listed here on this **Readme Information Window**. You can scroll left, right or up and down to see all information inside of this Window. Click **NEXT** to continue.

4.7. Enter your name and company name in the User Information Window, and click **NEXT.** As a default, CDI SPEC32 is installed in the CDI32 folder in C: drive. You can also install CDI SPEC32 in any folder or directory and drive by clicking on the **Browse…** and then select drive letter and type in or select the folder that will be used to install the program, then click **OK.** Click **NEXT** to continue the installation. **Note:** If CDI Spec32 is installed in a different folder then its default folder, the 8.3 file format rule must be followed. All folders CDI Spec32 is installed in must have 8 characters or less includes the CDI Spec32 folder. **It's highly recommended to use all default settings to simplify the installation and avoid complications.**

4.8. Select a Program Folder or use the default setting "**CDI Spec32**". Click **NEXT** will take you to the next Window where it displays all of the information you have typed in. You can always click on **BACK** button to go to previous pages to fix any mistakes. When you are ready, click **NEXT** and setup program will start copying necessary files to the computer. This process may take up to several minutes, depending on the speed of the computer.

4.9. When the setup program stops, a Setup Devices Windows displays, **Figure 4.3**. Depending on the operating system, this screen might be slightly different. Click **OK** on this Windows, and then click **OK** again to finish the installation. You will then be asked to restart the computer. Please restart the computer before using this program.

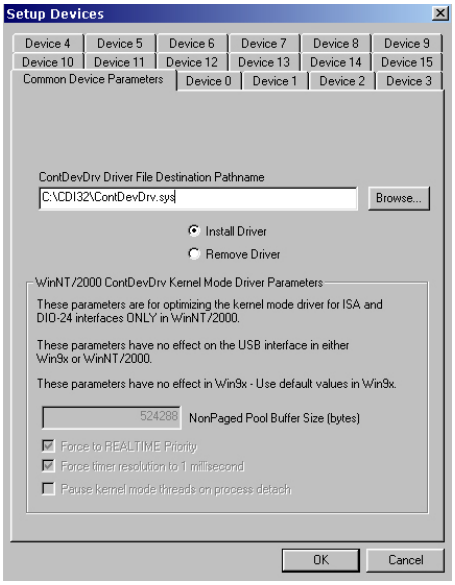


Figure 4.3: Setup Devices display
Up to 16 devices can be setup and run simultaneously

5. CDI Spec32 Software Compatibility Matrix table

Interface	Operating System			
	Windows 95	Windows 98/SE/ME	Windows NT	Windows 2000/XP
ISA Plug-in Card	Spec(16-bit) OR Spec32	Spec(16-bit) OR Spec32	Spec32	Spec32
DaqCard DIO-24 (PCMCIA bus)	Spec(16-bit) and NiDAQ Ver 5 (16-bit) OR Spec32 and NiDAQ Ver 6.x	Spec(16-bit) and NiDAQ Ver 5 (16-bit) OR Spec32 and NiDAQ Ver 6.x	Spec32	Not Supported
PC-DIO-24 (ISA bus)	Spec(16-bit) and NiDAQ Ver 5 (16-bit) OR Spec32 and NiDAQ Ver 6.x	Spec(16-bit) and NiDAQ Ver 5 (16-bit) OR Spec32 and NiDAQ Ver 6.x	Spec32	Spec32
PCI-6503 (PCI bus)	Spec32 and NiDAQ Ver 6.x	Spec32 and NiDAQ Ver 6.x	Spec32	Spec32
USB Interface	Spec32 (Win95 with USB Supplement)	Spec32	Not Supported	Spec32

Figure 5.1: CDI Software Compatibility Matrix Table

CDI Software Compatibility Matrix table, **Figure 5.1** is a chart that shows the compatibility between CDI hardware interfaces, CDI software and the operating systems.

Example 1: If you run a CDI spectrometer with USB Interface in Windows 98, look at the chart where it says **USB Interface** on the first column. Move across to the third column where it says **Spec32**, and the header in the second row of that same column says **Windows98/SE/ME**. That means SPEC32 software will be compatible with USB Interface, and Windows 98/SE/ME operating systems support USB interface.

Example 2: If you would like to run a USB interfaced spectrometer in Windows NT, you will find out that your spectrometer with USB interface will not be compatible with Windows NT. By looking at the chart where it says **USB Interface** in the first column. Move across until you get to the fourth column where it says **Not Supported** and the header in the second row of that same column says **Windows NT**. That means there is no CDI software support USB interfaced spectrometers in Windows NT operating system. **Windows NT does not support USB interface.**

6. Setup Device Driver

By this time, you should have already installed CDI Spec32 program on your computer and either installed a spectrometer with ISA, or USB interface or both.

If you installed a spectrometer with ISA interface, you are ready to setup the device driver for that spectrometer. **Note:** If you installed more then one ISA interfaced spectrometers, or have problem with board address confliction, please see section Board Address Setting. If you

installed a spectrometer with USB interface, turn on the power switch of the spectrometer. It may take up to a few minutes for the operating systems to install the USB device driver for the spectrometer. Before we move on to the next step, lets take a look at the LED lights on the front panel of the spectrometer, and what they mean.

6.1. L.E.D. Indicator Lights On The Spectrometer, what do they mean?

There are three L.E.D. (Light Emitting Diode) indicator lights on the front panel of the spectrometer with USB interface: Red, Orange, and Green.

6.1.1 Red LED

The Red L.E.D. is the spectrometer power indicator light. When this light is on, it means the spectrometer main power is turned on.

6.1.2 Green LED

The Green L.E.D. is the USB indicator light. When this light is on, it means the USB cable is connected to the computer and the spectrometer, and the computer is running. This Green L.E.D will stay on regardless if the spectrometer main power is on or off as long as the computer that connects to the spectrometer is on.

6.1.3 The Orange L.E.D. can indicate three different situations

6.1.3.1. When this Orange L.E.D. is off, even if the spectrometer and the computer power are turned on; it means there is no communication between the computer and the spectrometer. **You may not have installed CDI Spec32 program on the computer, or the USB port was not installed properly. Please consult the USB manufacture's instruction manual.**

6.1.3.2. When this Orange L.E.D. is dimly blinking, it means there is communication between the spectrometer and the computer. CDI Spec32 software and device driver for USB were installed properly. Now you can proceed to setup device driver for the spectrometer in the S**ection 6.2**.

6.1.3.3. When this Orange L.E.D. brightly blinking, it means that the spectrometer and the computer are exchanging data. This only happens when you are taking sample with the spectrometer.

6.2. CDI Driver Installer Program

Before a spectrometer can work with CDI Spec32 program, it must have a particular device driver installed. A **CDI Driver Installer** program that was installed together with CDI Spec32 program will simplify this task. By running **CDI Drive Installer** program, you will then be able to setup the device driver and access different parameters of each spectrometer.

6.2.1 Run CDI Driver Installer Program

Click **Start** button on Windows taskbar, then choose **Programs** and look for CDI Spec32 on the slide-out menu, then click on **CDI Driver Installer**. After the **CDI Driver Installer** started, a **Setup Device Driver** screen displays, **Figure 6.2.1.** This screen is slightly different from one operating system to another.

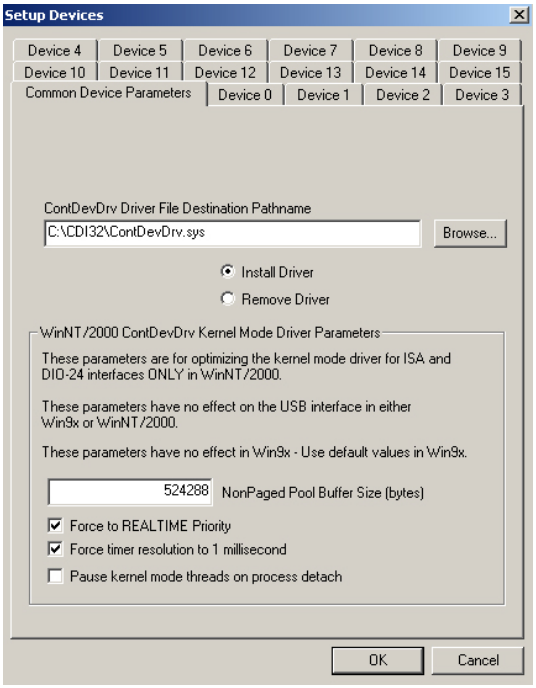


Figure 6.2.1: Setup Devices for Windows NT, XP and 2000
Up to 16 spectrometers can be installed and run simultaneously

6.2.2 Common Device Parameter Screen

The Setup Devices main screen is Common Device Parameters. This is a default screen. Every time the CDI Driver Installer runs, this screen will be displayed. There are also 16 identical Setup Device screens, labeled as Device 0 to Device 15.

These setup device options are where you can specifically choose the correct device driver for the interface types of the spectrometers installed, and other important parameters.

6.2.2.1. ContDevDrv Driver File Destination Pathname

The pathname, C:\CDI32\ContDevDrv.sys, is the default pathname to the ContDevDrv.sys file. This pathname can be different, depending on the location where CDI Spec32 was installed. Regardless of whether the operating systems are running, the pathname to the ContDevDrv.sys has to be displayed in this text box. If this text does not display the pathname to ContDevDrv.sys, you can either type it in or use the **Browse** button next to the text box and locate the ContDevDrv.sys file.

6.2.2.2. Install Driver and Remove Driver

There are two radio buttons below the text box. One labeled **Install Driver**, and the other labeled **Remove Driver**. They mean exactly what they are labeled. When the **Install Driver**'s radio button checked, the device driver will be installed. When the **OK** button is clicked, **Setup Devices** window will be closed, and a small window displays, "Driver successfully installed". The default is **Install Driver** checked.

To remove the device driver, click on **Remove Driver** radio button, and all of the device driver will be removed when the **OK** button is clicked, **Setup Devices** window will be closed, and a small window displays, "Driver deleted from registry". **Note:** If the device driver is removed, all of the spectrometers will not have communication with CDI Spec32 until the **Install Driver** radio button option is checked, and the device driver installed again.

6.2.2.3. WinNT/200 ContDevDrv Kernel Mode Driver Parameters

6.2.2.3.1. Win9x and ME

These parameters are slightly different from one operating system to another. These parameters are grayed out in Win9x, ME, which means these parameters cannot be changed, and default will be used

6.2.2.3.2. WinNT, 2000, and XP

These parameters are for optimizing the kernel mode driver for ISA and DIO-24 interfaces. These parameters have no effect on USB interface regardless of the operating systems. The default values parameters are listed below:

- Text box, **NonPagedPool Buffer Size [bytes] = 524288**
- ☑ **Force to REALTIME Priority, checked**
- ☑ **Force time resolution to 1 millisecond, checked**
- ☐ **Pause kernel mode threads on process detach, unchecked.**

6.2.3 Device 0 to Device 15 Tabs

A total of 16 spectrometers can be installed and run simultaneously by CDI Spec32 as long as the correct device driver is selected and installed for each spectrometer. **Note: The more spectrometers are installed on a computer, the more CPU time they take to run. Take this in consideration when planning on installing more than one spectrometer.**

Different interface types can be installed, mixed and matched in CDI Spec32 if they are installed in the order from Device 0 to Device 15. Device 0 must be installed first before Device 1 can be installed. Device driver can be installed ahead of time without an actual spectrometer plugged in. The reason for this is when a spectrometer is plugged in at the later time, you don't have to install the device driver again

Click on the tab labeled **Device 0** so it will be active, and the setup device screen looked similar to **Figure 6.2.3.** Remember, this screen is slightly different from one operating system to another. There are several parameters on the Device 0 page. Depends on what operating system and the interface of the spectrometer installed, these options are either enabled or disabled.

6.2.3.1. Interface Type

Select the correct interface type of the spectrometer installed. Click on the down arrow to the right of the text box. There are five different interface types to choose from the pulldown list. Depends on what interface type selected, that will enable or disable some of the parameter below.

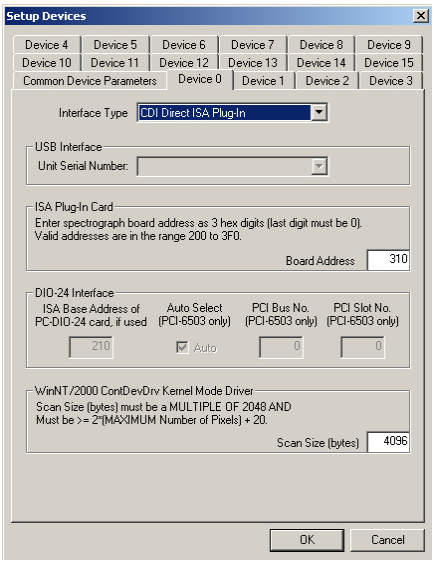


Figure 6.2.3. Device 0 setup screen active in Windows NT/2000

6.2.3.1.1. CDI Direct ISA Plug-in

CDI Direct ISA Plug-in is for spectrometer with ISA interface. This type of spectrometer is normally plugged in the 16 bits bus slot inside the PC computer. If this interface type selected, all of the parameters below it would be grayed out except where it says. **"**ISA Plug-in Card", **Figure 6.2.3.1.1a** and **Figure 6.2.3.1.1b**

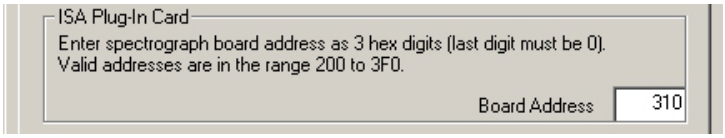


Figure 6.2.3.1.1a: ISA plug-in card board address Option

The default value of the Board Address is 310. Enter the correct board address by to the setting board address of the ISA spectrometer as 3 hex digits. The last digit must be 0. Each ISA interface spectrometer has its own, unique board address. If more than one spectrometer is using the same board address, there will be a board address conflict. Please

refer to Board Address Setting in the next section to find out more about how to set board address for each spectrometer.

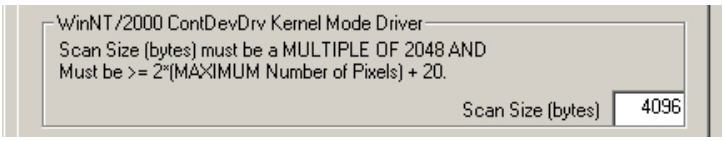


Figure 6.2.3.1.1b: This parameter is only enabled in Windows NT/2000/XP

WinNT/2000 ContDevDrv Kernel Mode Driver parameter is for optimizing memory setting. The default is set at 4096. It is strongly recommended to use this default setting to avoid any complication that might occur.

Note: The WinNT/200 ContDevDrv Kernel Mode Driver parameter is always enabled in Windows NT, 2000 and XP, regardless of the selected interface type. This parameter is always grayed out in Windows 9x,ME, and the default value is used. Always click on **OK** button when you finish.

6.2.3.1.2. Nat. Inst. PC-DIO, ISA

Nat. Inst. PC-DIO, ISA (National Instrument PC-DIP,ISA) is an interface that connects the PC computer to an external spectrometer such as MPP, NIR or Raman spectrometer via a cable. If this interface is selected, the DIO-24 Interface parameter is also enabled, **Figure 6.2.3.1.2**

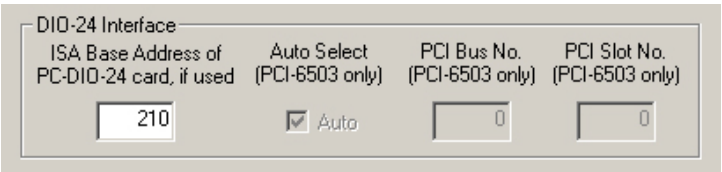


Figure 6.2.3.1.2: DIO-24 Interface ISA Base Address setting enabled

The default Base Address of PC-DIO-24 ISA card is 210. Enter the correct Base Address corresponding to the PC-DIO-24 ISA card that is installed in the computer. Make sure that this Base Address is not being used by any other hardware in the computer, or if more than on PC-DIO-24 ISA cards

installed in the same computer, they should all have different Base Address settings. Please consult the National Instruments instruction manual.

6.2.3.1.3. Nat. Inst. PCI-6503, PCI

Selecting the Nat. Inst. PCI-6503, PCI will also enable the DIO-24 Interface parameter, **Figure 6.2.3.1.3.**

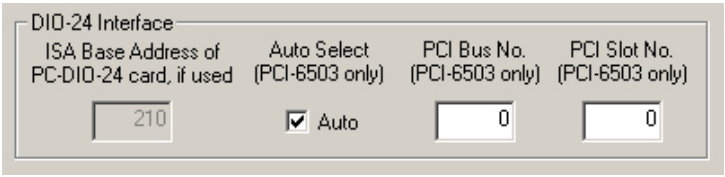


Figure 6.2.3.1.3: Default setting for Nat. Inst. PCI-6503, PCI

When the Auto check box is checked, the Device installer will automatically detect the first PCI-6503, PCI board and assign it as Device 0. There is special a situation where there is more than one board of the same type installed and used for other instruments rather than CDI Spectrometers, then the PCI Bus No. and PCI Slot No. must be given so they can identify which is CDI Spectrometer, and which is not.

6.2.3.1.4. Nat. Inst. DaqCard DIO-24, PCMCIA

Nat. Inst. DaqCard DIO-24, PCMCIA interface is normally a plug-in interface for Laptop computer to operate a spectrometer connected via a cable. There is no editable parameters when this interface is selected. **Note:** Only one Nat. Inst. DaqCard DIO-24, PCMCIA interface can be plugged in and used one at a time.

6.2.3.1.5. CDI USB Interface

Selecting The CDI USB Interface will also enable the USB Interface Unit Serial Number, **Figure 6.2.3.1.5.** Click the down arrow to the right of the text box and select the serial number of the spectrometer that you would like to install the device driver for. When finished, click **OK** to install.

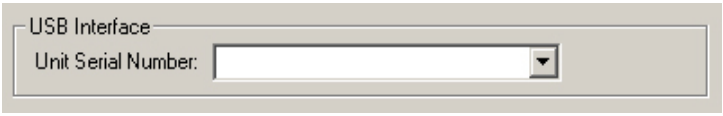


Figure 6.2.3.1.5: This box will only be enabled when a USB Interface is selected

A spectrometer will still be able to work without its serial number selected. Don't select the unit serial number if you plan on using more than one spectrometer in the same Device. If a unit serial number is selected, then only the unit that bears the selected serial will work with that device.

Special note for CDI Interface Kit

If you use CDI Interface kit that either has Nat. Inst. PC-DIO-24, ISA or Nat. Inst. PCI-6503, PCI interface build-in; change the board address of the ISA spectrometer card to 310 before plugging it in the CDI Interface kit. Select the Interface Type in the Setup Devices corresponding to the type of interface that is used in the CDI Interface Kit.

7. Calibration File Installation

Each spectrometer is shipped with a calibration disk. This floppy disk contains permanent wavelength calibration files and reference files. These files are unique and specially created at the factory for each spectrometer. Before a spectrometer can communicate with CDI Spec32, these calibration files have to be loaded to the computer memories. Also each spectrometer has flash memory where calibration file stored. With the new release CDI Spec32, these calibration files will be loaded to computer memories automatically.

7.1. Load Calibration File From Flash Memory

Begin CDI Spec32 version 1.22, there is a build-in feature that will detect and load calibration file from flash memory every time CDI Spec32 runs. Loading calibration file

from flash memory will eliminate the classic way of copying calibration to computer hard disk. But if you still prefer the classic way, please follow the steps below.

7.2. Install Calibration Files For ISA Interfaced Spectrometer

1. Create a folder inside CDI Spec32 or where you have installed CDI Spec32
2. Name this folder same as the spectrometer serial number. For example: If your spectrometer's serial number is SNLC109, name the folder as SNLC109.
3. Insert the calibration disk in the floppy drive, normally drive A:
4. Copy all files from floppy disk to the folder you just created.

7.3. Install Calibration Files For USB Interfaced Spectrometer

1. Insert the calibration disk in the floppy drive, normally drive A:
2. Copy the folder (this folder should be the same as the spectrometer's serial number) from the floppy disk to the CDI Spec32, or where you have installed CDI Spec32.

8. Uninstall CDI Spec32

Uninstall CDI Spec32 is quick and simple. Click **Start** button on the Windows taskbar, and select **Control Panel.** When the **Control Panel** Window opens, select **Add/ Remove Programs**, when the **Add/Remove Programs** Window opens, select CDI Spec32 for Win 9x/NT/2000, and click on the **Remove** button. Follow the instruction given by your Windows operating system. Even though CDI Spec32 program is removed, all of your data that was saved in CDI Spec32 folder will still be safe.

9. Updating CDI Spec32

9.1. Updating CDI Spec32 From CD-ROM Disk.

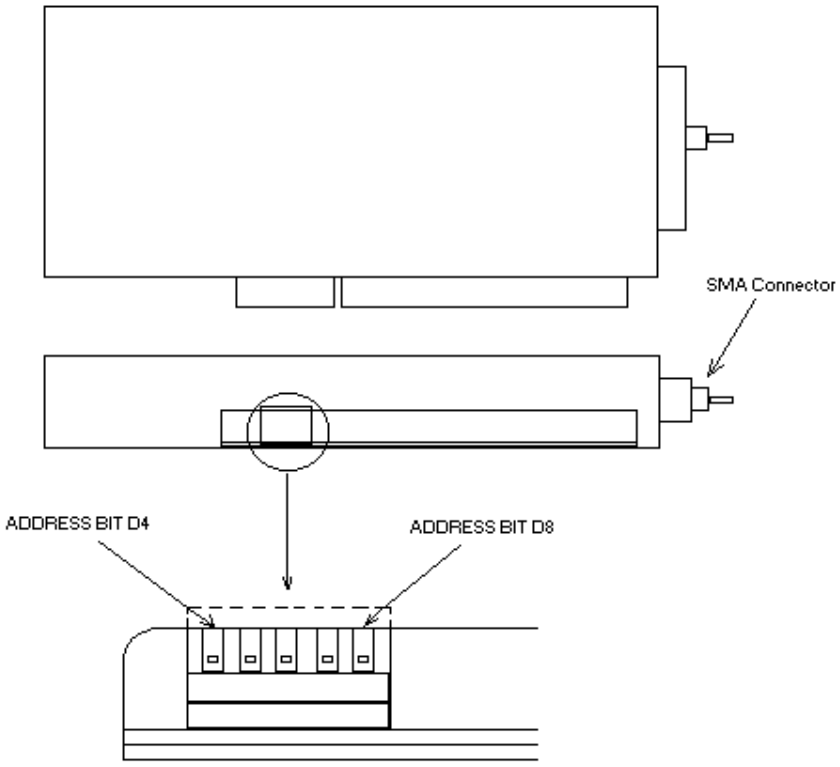
Please read Section 4.1 to 4.9, page 5 to update CDI Spec32 from CD-Rom. If you previously installed CDI Spec32 in a different folder other then the default folder, please remember to browse to that folder to install the updated version. The existing CDI Spec32 version will be over written by the updated version. The CDI Spec32 updated version will use the existing calibration files.

9.2. Updating CDI Spec32 With a Downloaded File From CDI Website

If you downloaded an updated version of CDI Spec32 from CDI Website, browse the folder where the update version CDI Spec32 is saved, double click on the file name and installation process begins. Please read Section 4.5 to 4.9, page 5 for more information. To download the latest update version of CDI Spec32, visit CDI website at http://www.controldevelopment.com/support/cdi_spec32/cdi_spec32.htm

10. Board Address Setting

The spectrometer board address was set at the factory with the default setting of 0310 hex. This should allow for operation on most computers. However should you have an address conflict you can change the board address using the following information.



S1 S5

S5	S4	S3	S2	S1	reserved	Address (hex)
1	0	0	0	0	0000	300
1	0	0	0	1	0000	310
1	0	0	1	0	0000	320
1	0	0	1	1	0000	330
1	0	1	0	0	0000	340

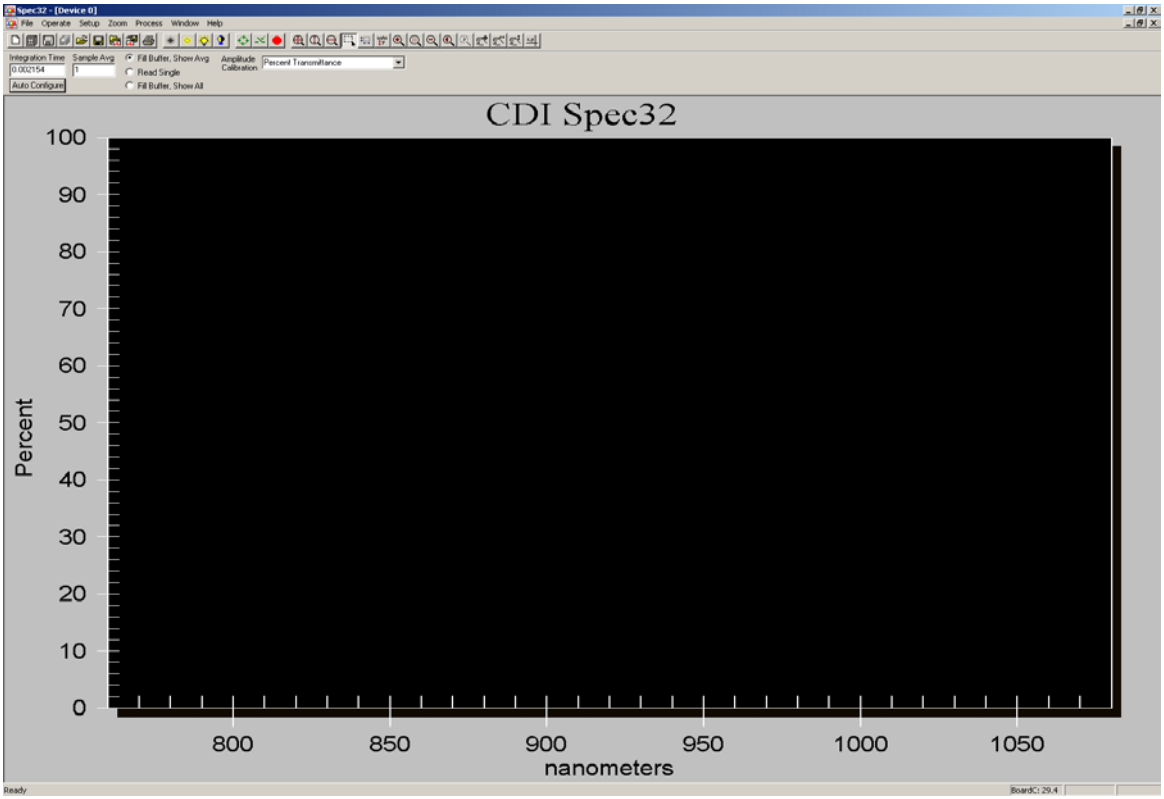
Switch up = on = 1
Switch down = off = 0

Chapter 2
CDI Spec32 Overview

The CDI Spec32 software is designed to give the user control over the instrument settings and the sampling parameters. To do so, many low level commands have been provided. Setting up the instrument for a given measurement, requires some manual adjustments. These adjustments, however only need to be done once for any given test, after that the setup can either be saved as a file for future use or will become the default setup and be loaded the next time the unit is turned on.

The setup files are also compatible with the driver function dynamic link library (DLL), the National Instruments LabVIEW® sub-VI node, and the ActiveX Control. This allows the user to create custom applications without providing complete user interfaces, instead using the SPEC application's GUI to create the instrument setup files.

Below is a sample of the CDI Spec32 screen. The following sections will give detailed descriptions of the different areas of this screen.



1. Menu Description

All available commands may be accessed from the menu. However, the most often used commands also have Toolbar buttons for convenience, and the most frequently used controls are also available from the control bar. The menu has been divided into sections using Windows API design guidelines. A general overview for each main menu entry is given below.

File	Standard file commands such as List Devices Connected, Open, Save, and Create Configuration; Open and Save Setup; Open and Save Setup from Flash; Open and Save Trace; Save and Print graphs; Open Kinetic Date and View Kinetic ASCII; Trace Log and Exit.
Operate	Where you can find spectrometer operating commands such as Scan Single, Scan Continuous, and Abort Scan; Shutter on/off, Store Reference and Background, Acquire BG, Acquire reference, Acquire Ref and BG, Auto Integrate…
Setup	All Setting commands for graphs and hardware are listed here: Trace Display, Trace Legend, Trace Data Table, Delete All Traces, Integration Time, Trigger Mode, Amplitude Calibration, Sample Averaging, Wavelength Interpolation, Graph Settings, Data Cursor On, High Priority GUI.
Zoom	There are all the standard view commands such as Zoom Default, Zoom Fit XY-Axes, Zoom Fit Y-Axis, Zoom Fit X-Axis, Zoom Settings… Zoom In, Zoom Out, Zoom Autoscale Y, Zoom Redo, Zoom Undo, Pan X, Pan Y, Pan XY.
Process	Find process command such as Revert (No Processing), Derivative…
Window	MID commands such as Toolbar, Status Bar, Cascade, Tile, Arrange icons, and List of Devices…
Help	About Spec32…

2. Status Bar Description

The status bar displays messages, which indicate the activity of the instrument and status of the operation. The status bar also provides a convenient real-time text display of mouse coordinates and array temperature. The Status bar panes are described below:

The left area of the status bar is used to display **User Status Messages** and **Command Help Strings**.

2.1. User Status Messages

Include a sample counter, which indicates the status of a multiple sample trace, a count down timer to indicate the time remaining to a completed sample, and the number of samples averaged in Fill Buffer mode.

2.2. Command Help Strings

Describe actions of menu items as you use the arrow keys to navigate through menus. This area also shows messages that describe the actions of toolbar buttons as you depress them, before releasing them. If after viewing the description of the toolbar button or command you wish not to execute the command, then release the mouse button while the pointer is off the toolbar button or menu item.

2.3. BoardC

This box displays the unit ambience temperature of which the spectrometer is operating includes room temperature, and temperature of the computer that the spectrometer is installed in. This temperature has an effect on the Detector Array temperature. The higher ambience temperature is, the more the Detector Array's cooler has to work to keep the Detector Array temperature stabled. Temperature is displayed in Celsius.

2.4. ArrayC

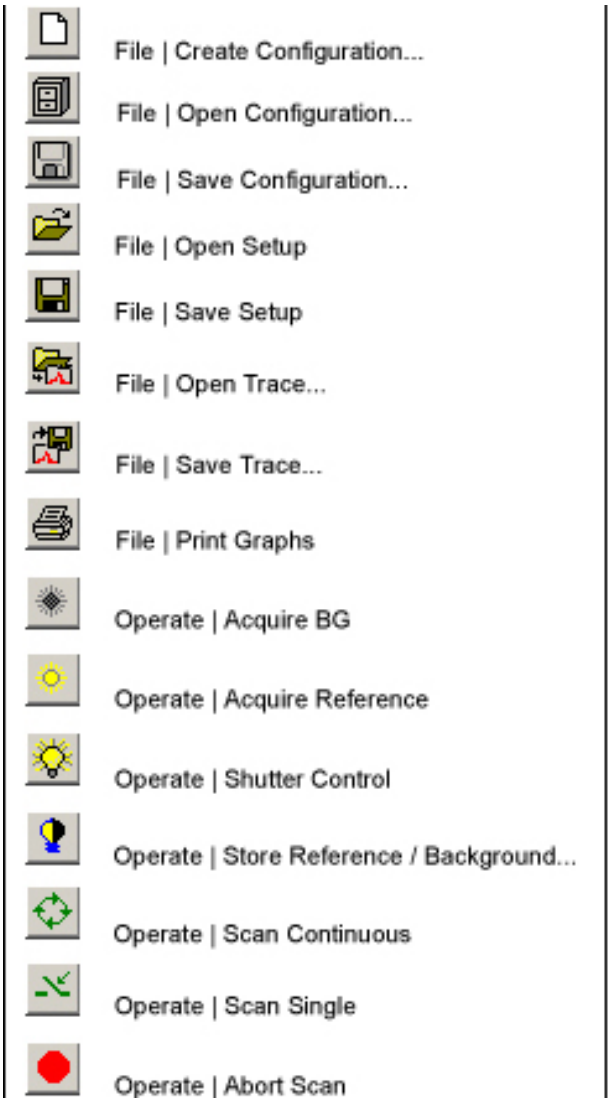
This box displays Detector Array temperature in Celsius. The lower the Detector Array temperature is, the more the Detector Array's cooler has to work, and so more current will be used.

2.5. TECA

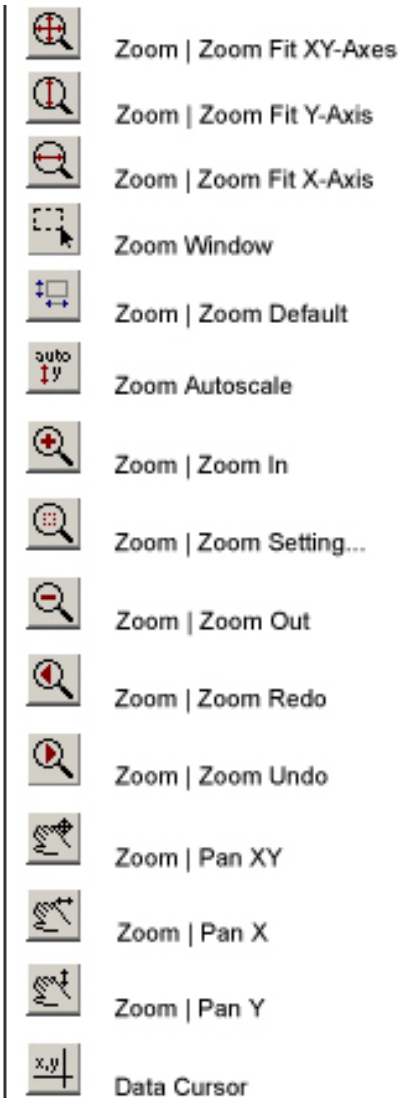
This box displays the current of the Detector Array's T.E. cooler uses to keep the temperature stabled. It's displayed in Amperes. This number will increase as the Detector Array's cooler uses more current. When it gets to its limit, the Detector Array temperature will be out of range, and the spectrometer will not be able to hold temperature. In order to correct this, you either have to lower the ambient temperature, or raise the Detector Array temperature in the Hardware Settings. (See Hardware Settings, Chapter 5, Section 11)

3. Tool Bar Description

The Toolbar provides icons push button control types. These buttons are actually short cut commands to the menu items listed below. When a mouse cursor moves over the button, a short description is displayed in the Control Tip Text box momentarily. The description will tell what the button will do when the cursor is over the button, and the left button is pushed and released.



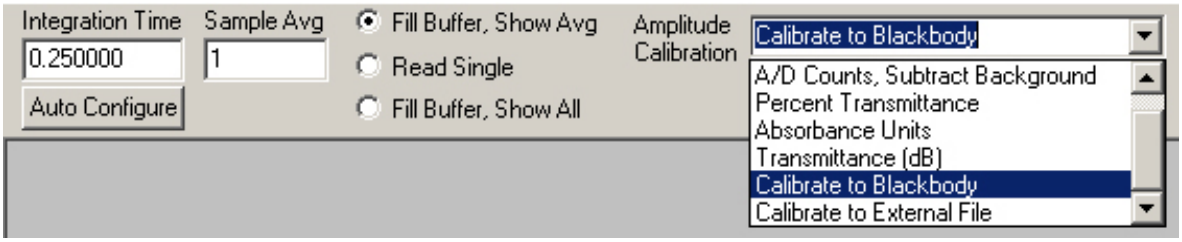
File | Create Configuration...
File | Open Configuration...
File | Save Configuration...
File | Open Setup
File | Save Setup
File | Open Trace...
File | Save Trace...
File | Print Graphs
Operate | Acquire BG
Operate | Acquire Reference
Operate | Shutter Control
Operate | Store Reference / Background...
Operate | Scan Continuous
Operate | Scan Single
Operate | Abort Scan



Zoom | Zoom Fit XY-Axes
Zoom | Zoom Fit Y-Axis
Zoom | Zoom Fit X-Axis
Zoom Window
Zoom | Zoom Default
Zoom Autoscale
Zoom | Zoom In
Zoom | Zoom Setting...
Zoom | Zoom Out
Zoom | Zoom Redo
Zoom | Zoom Undo
Zoom | Pan XY
Zoom | Pan X
Zoom | Pan Y
Data Cursor

4. Control Bar Description

Frequently used controls are included in the control bar located at the top of the screen. This control bar allows the user to update control parameters on the fly. The control bar provides all the controls required to quickly tune in the spectrometer to the signal of interest. Items on the control bar are explained below.



4.1. Integration Time

Electronic exposure time of the array. Signal level is proportional to integration time. The longer the integration time, the larger the signal is as shown on the screen.

4.2. Sample Avg.

This determines the number of samples that will be accumulated in an average. The signal to noise ratio increases as the square root of the number of samples averaged. The greater the number of samples you take, the less effect noise will have on the signal.

4.3. Fill Buffer

When this option is selected it causes the on-board FIFO memory to be filled, and the average is displayed on the screen. This can be used for increasing the acquisition rate for integration times shorter that 110-mS. Fill buffer is preferred whenever update time permits.

4.4. Read Single

When this option is selected the data is sent to the screen after each sample is taken. This provides an immediate visual feedback while making adjustments. This mode is almost as fast as the Fill Buffer mode for integration times greater than 110-mS.

4.5. Fill Buffer Show All

This determines the number of samples that will be accumulated in an average. The signal to noise ratio increases as the square root of the number of samples averaged. The greater the number of samples you take, the less effect noise will have on the screen.

4.6. Amplitude Calibration

This pull down menu allows you to select any of the calibration units on the fly. For example, you can switch to A/D counts to optimize the sampling parameters, and then switch back to Percent Transmittance or Absorbance without missing any samples.

Chapter 3
Taking your first Trace

By this time, you should have installed a spectrometer, and correct device driver for it. Lets take your first trace. Start by turning on the computer. If your spectrometer has USB interface, please turn power switch to on position. Look at the LEDs, red and green LEDs are on, and orange LED should be dimply blinking, if not, please correct the problem with USB connector before go on.

1. What else will you need?

You will need a SMA-to-SMA adapter to connect a fiber to the spectrometer if it is an ISA plug-in card, and the proper fiber. If you are looking in the spectral range (<350 nM), you will need a High OH cable, and for spectral range above 350 nM uses Low OH cable. Connect one end of the fiber to the spectrometer and the other end to the sample under test. You will also need a light source. The light source can be one of your own, or purchased from Control Development, Inc.

2. Run CDI Spec32 Program

Click **Start** button on Windows taskbar, then choose **Programs** and look for **CDI Spec32** on the slide-out menu, then click on **Spec32.** CDI Spec32 will try to detect the spectrometer and load the setup file from flash memory. If everything goes well, then the default CDI Spec32 window comes up, **Figure 2.1,** else you will an error window, **Figure 2.2**. Please follow the instructions on the error box and retry again.

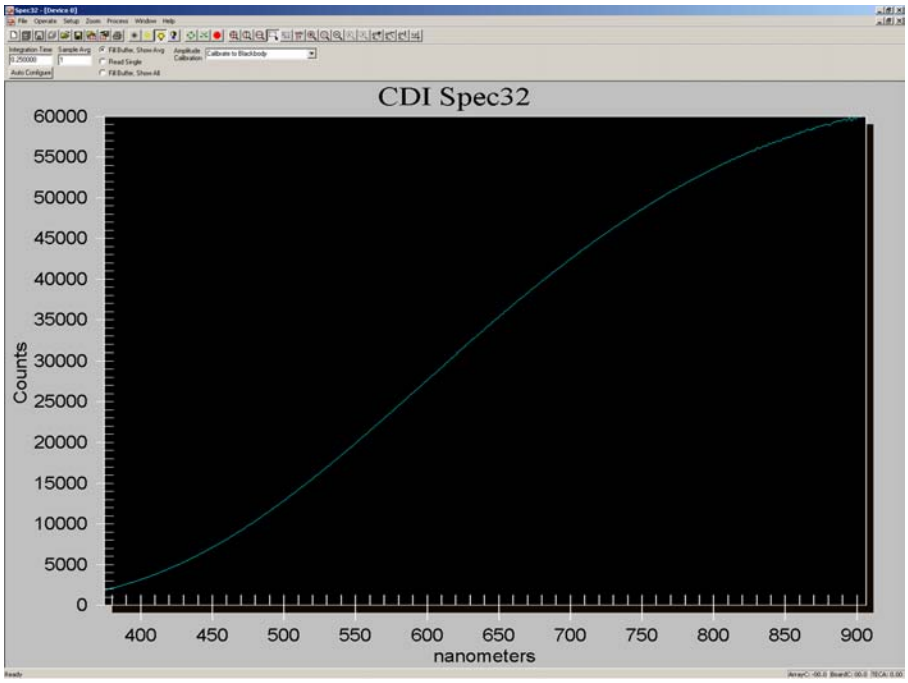


Figure 2.1 Default CDI Spec32 Windows

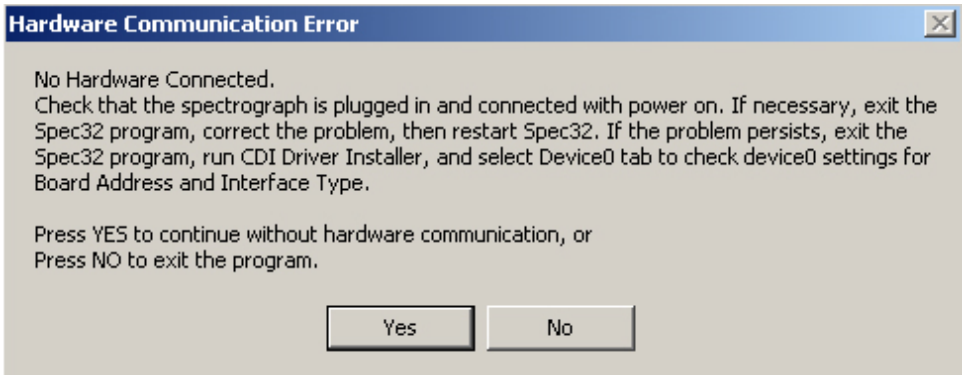


Figure 2.2 Hardware Communication Error

Now you have spectrometer installed, CDI Spec32 program running. **You will need to let the spectrometer runs at this point for 15 minutes so the temperature can stabilize.** The temperature starts to stabilize when the software is started and will remain stabilized until the power to the spectrometer is powered down. You also need the turn the light source on and stabilized it for 15 minutes.

3. Auto Configure

Auto configure button is a shortcut command to a pull down menu command, **Operate | Auto Integrate…** Auto Configure will determine the integration time for the spectrometer by gathering information from intensity of the light source, temperature of the spectrometer. When you click on the **Auto Configure** button, it will prompt you to turn on the light source and then click on **OK** button. It is recommended to use this command to set the integration time. You can also set the integration time manually entering it in the **Integration Time** box.

4. Acquire Background

Now you need to acquire a background, which is used to subtract "Dark Current". This store the zero (dark) level for each wavelength. After clicking on the icon  on the toolbar or access to menu bar, **Operate | Acquire BG,** a **Setup Background** dialog box comes up prompting you to connect the fiber to a dark signal, **Figure 4.1**. Covering the sample end of the optic cable with a cap or some other dark object in order to stop the light from entering the cable, then click **Ok** to continue.

Note: If you are using a CDI light source that has a trigger cable connected to the spectrometer, you can check the Check box in the **Setup Background** dialog box where it says, "Automatic shutter control, don't not show this message again." This will automatically turns the light source on and off when acquiring the background or acquiring reference.

The acquiring background process will take a few seconds. When it's done, it will return to CDI Spec32 windows. Now, you will need to save the background that you just acquired. Click on the icon  or access to menu bar, **Operate | Store Reference / Background…** then a small window will display. Select the radio button where it says, **Store Internal Background,** see **Figure 4.2**, and click **OK.**

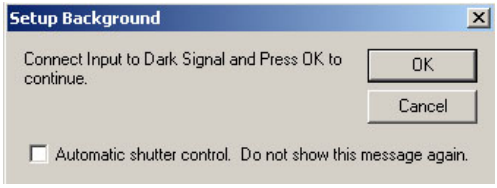


Figure 4.1. Setup Background

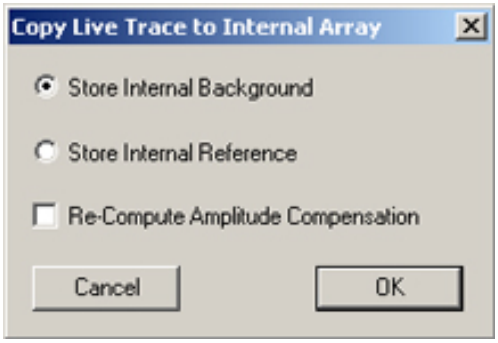


Figure 4.2. Save Internal Background.

5. Acquire Reference

Next you will need to store a Reference. To do this uncover the fiber and expose it to the maximum light that will be available to the sample. Click the icon  or go to menu bar and select **Operate | Acquire Reference.** A dialog box comes up, check the check box, **Automatic shutter control, do not show this message again**, if you have Stablamp light source which has automatic shutter control built in, **Figure 5.1**. Acquiring a reference will take a few seconds. When it is done, it will return to CDI Spec32 window. Now you will need to store the reference that you just acquired. Click on the icon  or to go to the menu bar and select **Operate | Store Reference / Background**. A small window displays. Select the radio check boxes where it says, **Store Internal Reference.** By the default, the check box, **Re-Compute Amplitude Compensation** will also be checked, see **Figure 5.2**. Click on **OK** to finish.

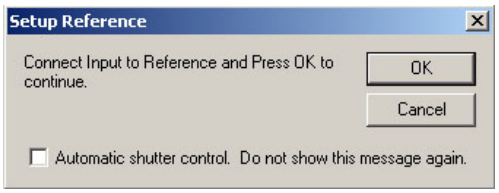


Figure 5.1 Setup Reference

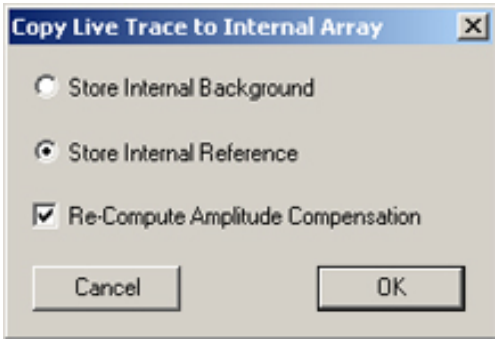


Figure 5.2. By the default, the Re-Computer Amplitude compensation check box is also selected when Sore Internal Reference check box is checked.

6. Automatic Procedure for Acquiring Reference and Background

All CDI Spectrometers come with a RJ45 connector on the front panel or on the end of the spectrometer cards. This connector provides a way to interface CDI Spectrometers to external accessories using CDI Spec32, see **Pinout** section in **Appendix B, Pinout**. If purchased a light source from Control Development, Inc. that has this interface built in, connect the light source to the spectrometer via a RJ45 cable that was shipped with the light source. Next select **Operate | Acquire Ref and BG** from menu bar. This will take a few seconds. When it finishes, it will return to the main window. The Reference and the Background were acquired and saved without user intervention.

Now it is ready to look at a sample.

7. **Taking a Sample**.

Assuming that the fiber is still connected to the spectrometer, and the light source is still on. Place the sample under test and click on the icon  from toolbar or access to menu bar **Operate | Single Scan** and observe the spectrum displayed on the screen. To enlarge the spectrum so that it fills the screen, click on the **Zoom Fit XY** icon  and the graph will be scaled accordingly. It should be noted that setting the view using the zoom commands would not cause a change in the spectral range of the spectrometer.

If a change occurs and the spectrum is too large for the screen then select the **Zoom Out** command from the Zoom menu or click on the icon  on the toolbar to reduce the size of the graph.

8. **Saving Data**.

Saving data is simple and can be done a couple ways. The easiest way is simply click on the save icon from toolbar  which is the same as **File | Save Setup**, and choose the location where you would like to save the file to. The File Save Menu is described in detail in the next chapter.

Chapter 4
Using File Command Menu

Select **File** from the menu bar, you will be able to access file commands. The capability to store and retrieve complete instrument setups tailored for various test and applications are some of the most powerful commands of CDI Spec32.

1. File | List Devices Connected

Use this command when you would like to know what type of the spectrometer or how many spectrometers are currently connected. The detector, interface type, unit serial number, and the board address can be found by using this command, **Figure 1.1.**

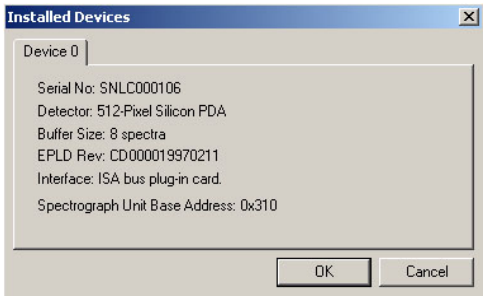


Figure 1.1

Information of Devices Installed

2. File | Create Configuration…

Use this command to create special setups of spectrometers and have that configuration opened automatically every time when the CDI Spec32 program runs. When run the **Create Configuration…** command, a **Create Configuration File** dialog box displays, **Figure 2.1.** If there is more than one spectrometer connected to the same computer, they will be shown in this dialog box, labeled from Device 0, Device 1 and so on.

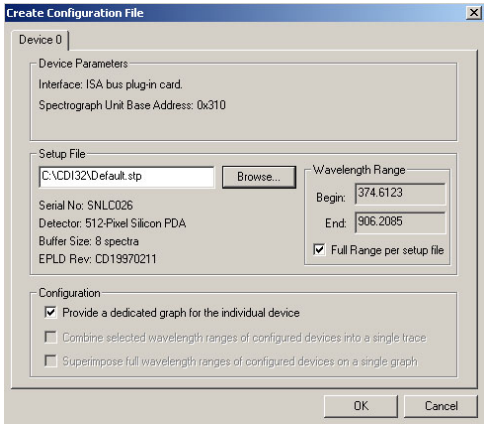


Figure 2.1. Create Configuration File

2.1. Device Parameter

This tells you the type of the interface and the unit base address or (Board Address)

2.2. Setup File

Click on the **Browse** button to go to setup file location to select it and click open. After the setup file is opened, the actual wavelength range is displayed in the text box under **Wavelength Range**. Click on the check box where it says, **Full Range per setup file**. Check this if you want to use the actual wavelength range or uncheck it to edit the **Begin** and **End** wavelength range.

2.3. Configuration

If there is one spectrometer connected, only the first option will be enabled, and the other two options will be grayed out.

☑ Provide a dedicated graph for the individual device.
When this option is selected, each graph will be given to every spectrometer that is currently connected and run in CDI Spec32.

Note: This option has to be checked if only one spectrometer connected.

If you run multiple spectrometers, the two following options will also be enabled.

☐ **Combine selected wavelength of configured devices into a single trace.**
When this option selected in multiple units mode, CDI Spec32 will combine all traces of all spectrometers that currently connected, and run in CDI Spec32 into a single trace one graph. This is useful when you want to display a graph with the wavelength that is beyond the capability of a single spectrometer.

☐ **Superimpose full wavelength ranges of configured devices on a single graph**
When this option selected in multiple units mode, CDI Spec32 will superimpose all traces of all spectrometers that currently connected, and run in CDI Spec32 into one graph.

Note: All three options can be selected at the same time when running multiple spectrometers.

Click **Ok** button, you will be prompted to enter file name in the Save File dialog box to save the configuration that you have just created. Enter the file name and click **Save** button to finish.

Note: The default configuration file name is **setup$1.txt**. Please do not use this file name to save your configuration. CDI Spec32 overwrites this file name regularly. Use a descriptive file name that has something to do with the sample you are taking or serial number of the spectrometer that you are using.

In order to open the configuration automatically when CDI Spec32 runs, you have to use the **File | Open Configuration…** or **Ctrl + O** command and browse to the folder of your configuration file and open it manually at least once.

3. File | Open Configuration…

Use this command to load a configuration that you have created and saved. Click on **Open Configuration** from menu bar, you will be prompted to enter the file name. Configuration file has the extension txt. Select the appropriate configuration file from the **Open Configuration File** dialog box and click **Open**.

Note: CDI Spec32 detects the unit serial number from flash memory every time it runs, and if you try to open a wrong configuration file, you will get an error message. Click **OK** and open a configuration file that is known to you.

4. **File | Save Configuration…**

   Saving configuration will save everything about the spectrometer that currently connected and run, including unit serial number, setup file, graph. Click on **Save Configuration** from menu bar, and you will be prompted to enter file name with extension **TXT. Note: Do not use the default file name "setup$1.txt file. CDI Spec32 overwrites this file regularly.**

5. **File | Open Setup**

   Open setup file with extension **.STP** will load all the setup information of a particular spectrometer that was previously saved. The last instrument setting and the last data sampled, including the Reference and Background, Integration Time will be loaded into the computer memory. In the **Open Device0 Setup File** dialog box, select the setup file and click **Open.** If you try to open a setup file that was saved under a different spectrometer, you will get an error message.

6. **File | Save | Save Setup**

   This command saves only the STP file and the associated binary files. No Graphs or ASCII Trace files. This command does not save the display, only the instrument setting and the last data sampled, including the Reference and Background. This is the most compact (in terms of disk space and number of files) form for the setup file.

7. **File | Open Setup From Flash…**

   The spectrometer is shipped with permanent wavelength calibration files and reference files for each spectrometer input. A quickest way to restore this factory calibration setup is to load the setup file from flash. Open a setup file from flash by accessing to file menu and select **Open Setup From Flash**. A window comes up prompting you to select the Factory calibration file location, **Figure 7.1.** There are four radio buttons labeled from Factory Calibration 1 to Factory Calibration 4 and User Calibration 1 and 2. By default, Factory Calibration 1's radio button is always selected. Selecting Factory Calibration 1 will let you load the calibration setup file that was saved at the factory before the spectrometer was shipped to you. All other options are empty. These locations can be used to save your own setup. Select the radio button of the calibration you would like to load then click **OK**. This will take a few seconds to load the setup file to your computer memory.

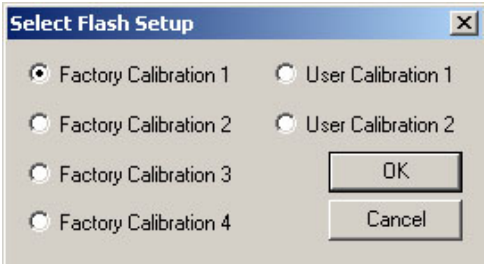


Figure 7.1. Open or Save Setup From Flash.

8. File | Save Setup To Flash…

One of many good features of CDI Spec32 is the ability to save instrument setup to flash memory. This flexibility gives you quickest way to retrieve your spectrometer instrument setting anywhere you go. Access to file menu bar, and click on **Save Setup to Flash**, you will be prompted to select the location where you would like to save the setup, **Figure 7.1.** It will take a few minutes to write to flash memory. It will prompt you when it finishes. By default, Factory Calibration 1 is write-protected, and so you cannot save to Calibration 1 location. If you want to retrieve the factory setting, you can load from flash by selecting Factory Calibration 1.

9. File | Open Trace…

Trace file has the extension .DAT or .G00. Trace file with extension .DAT are ASCII files, which contain completely processed spectral data in two columns: The left column contains the wavelength, and the right column contains the spectral data for that wavelength. Optional ASCII headers may also be stored inside the Trace file containing Instrument Setting or the trace headers may be stored without the spectral data. **Figure 9.1.** is an example of the "sampling Parameters" header and some spectral data.

```
**Header1 Sampling Parameters**
TraceFile    C:\CDI32\snlc0106\Device 0_Trace 0.dat
Comment
Date   08/16/02
Time   14:56:59
DeviceNum    0
SerialNo     SNLC0106
SetupFile
BoardDegC    0
ArrayDegC    0
TECA   0
ExtV   0
DacOffset    1027
IntTime      0.399999
Processing
CalUnits     Counts
TrigMode     TM_SynchRead
SampleAvg    1
WaveUnits    nm
WaveStart    600
WaveEnd      1100
WaveStep     0.5
**HeaderEnd**
600    -7474.793
600.5  -7292.662
601    -7118.225
601.5  -6948.744
602    -6823.884
```

Figure 9.1.

9.1. Open ASCII Trace File

Access the menu bar and click **File | Open Trace…** or tool bar  to open a trace. When open Trace dialog box comes up, select the trace that you want to open and click **Open**.

9.2. Open Binary Trace File

Trace file with extension .G00 is a Binary file, where 00 is an incremental number begins with 00. To open a Binary trace file, access the menu bar **File | Open Trace…** or  . When the Open Trace dialog box comes up, click on the arrow-down on the right of the **Files of Type** text box and scroll down until the file type **G0*** appears. Select G0* type, and the Binary trace files will be listed in the open trace file dialog. Select the Binary trace file that you would like to open and click **Open**.

10. File | Save Trace….

To save a trace, access to menu bar and click on **File | Save Trace…** or click on the icon  on the tool bar, a Trace Display dialog box comes up, **Figure 10.1.**

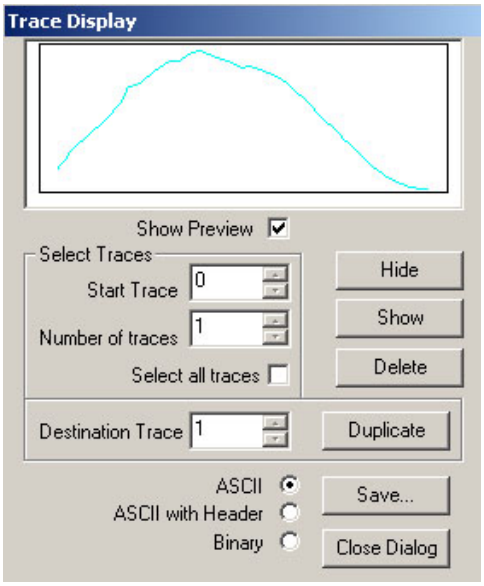


Figure 10.1. Save Trace.

10.1. Show Preview

If you don't see any trace displayed in the **Trace Display** window, click on the **Show Preview.**

10.2. Select Traces

10.2.1. Start Trace

Select the trace you want to display by clicking on the small up or down arrow on the right of the text box, then click **Hide** button to hide a trace, or click on **Show** button **to** show a trace. You can delete a trace by selecting **Delete** button.

10.2.2. Number of traces

Select the number of traces to be displayed at the same time by using the up or down arrows on right of the text box.

Note: If you have only one trace opened by using the command **File | Open Trace…** or the icon  from the tool bar, then the options **Start Trace** and **Number of traces** are grayed out (disabled).

10.2.3. Select all traces

This will select all traces currently opened in CDI Spec32 windows. Click on **Hide** button will hide all traces. Click on **Show** button will show all traces, and click on **Delete** button will delete on traces.

10.2.4. Destination Trace

Select the trace number in the **Destination Trace** text box then click on **Duplicate** button. An identical trace will be copied.

10.2.5. Save…

There are three options to select to save a trace.

10.2.5.1. ASCII

Selecting this radio button and click **Save** button will save the trace in ASCII file, see **Figure 9.1,** with file extension DAT.

10.2.5.2. ASCII with Header

Selecting this radio button and click **Save** button will save the trace in ASCII file including header of the trace and instrument setting. See **Figure 9.1.**

10.2.5.3. Binary

Selecting this radio button and click **Save** button will save the trace in Binary with file extension G00, where 00 will be incremented. A trace that was saved in binary cannot be edited with a text editor. The file size of trace that was saved in binary is much smaller than saved in ASCII

11. File | Trace logging…

Trace logging saves the traces automatically. This is useful when you are taking samples and want all traces saved automatically. Click on **Trace Logging** from the file menu, and a window comes up, **Figure 11.1.**

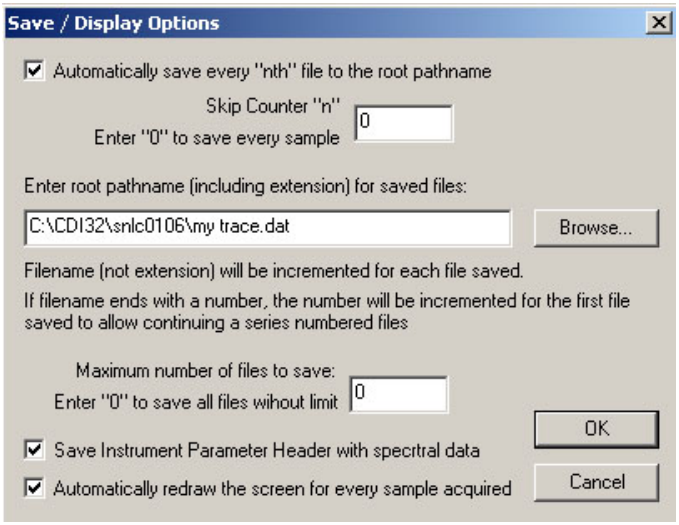


Figure 11.1. Trace logging windows.

Select the check box where it says, "**Automatically save every "nth" file to the root pathname".** Type in the number in the **Skip Counter** text box to skip or leave it at the default value of "0" to save every sample. **Note:** You need to check this box again every time you finish taking the samples and the stop button is pressed.

Enter the pathname where to save the traces or click on **Browse…** button and select the folder in the file dialog window. The filename will be incremented for each file saved. If filename ends with a number, that number will be incremented for the first file saved.

Type in a max number of files to be saved, or enter "0" to save all files without limit.

If you want to save **Instrument Parameter Header with spectral data**, check this box.

Check the box "**Automatically redraw the screen for every sample acquired"** to redraw the spectra on the screen (normal operation).

12. Save Graph…

Saving a graph is exactly the same as saving a trace, except the graph is saved in binary only, and saved with extension .G00 where 00 will be incremented by 1. Please see Section 10 for more information. You can use the command **File | Open Trace…** to open graph.

Chapter 5
Using Setup Command Menu

Select **Setup** from the menu to access all the setup commands that let you change the setting of how your spectrometer takes samples and to change the Hardware Setting of the spectrometer. You can use these setup commands to change the colors a trace, label a trace or delete a trace.

1. **Setup | Trace Display…**

   Trace Display works exactly the way as **File | Save Trace…** It will give the ability to display multiple traces, delete traces or save a trace. Please refer to Section 10. **File | Save Trace…** for more information of how to use Trace Display dialog box.

2. **Setup | Trace Legend…**

   Trace Legend will let you label a trace. Click on **Trace Legend** from the setup menu and a Trace Legend dialog box will display. Select a trace number from the **Select Trace** text box. Enter the name for that in the **Enter Legend Text** box. Click on **Show** button and it will display the legend text on the screen, or click on **Hide** button to hide the legend. Click on the arrow down to the right of the **legend Location** and select various locations for the legend text to be displayed. Click **Close Dialog** to close this window.

3. **Setup | Trace Data Table**

   Click on **Trace Data Table** to open a small window that displays data of the trace that is currently opened in CDI Spec32 window. This is useful when you would like to examine the data of the trace. Tables consisting of at least two columns are shown. The first column is labeled Nm, and the second column is labeled with the trace legend text if you have previously given one, otherwise; the default trace with label " Trace 0" will be displayed. The more traces you have in the memory, the more trace columns will be displayed in the table. You can copy all of the data from the table and paste it to your favorite spreadsheet programs, or some programs for special manipulation process.

4. **Setup | Delete All Traces**

   Click on **Delete All Trace** will delete all traces that are currently stored in the computer's memory.

   Warning: All traces will be permanently deleted from the screen without warning.
   To delete a single trace, use **Setup | Trace Display** and select a trace you want do delete, and click on delete button.

5. **Setup | Integration Time…**

   Integration time is an electronic exposure time of the array. Signal level is proportional to integration time. The longer the integration time is, the larger the signal is shown on the screen. Click on **Integration time** from the setup menu, an Integration Time dialog comes up. Enter the integration time in second(s) in the box and click **OK**. Enter 0 and click **OK** will set to the lowest exposure time you can set. If the spectrometer is getting saturated at the minimum time because of the intensity of the light source, you need to reduce the brightness of the light source by using the Neutral Density filter or some other means.

It is recommended that you should use the **Auto Configure** to determine the **Integration Time**.

6. **Setup | Trigger Mode…**

   Click on **Trigger Mode** command from menu bar, a **Linear Array Trigger Mode** dialog window displays, **Figure 6.1.**

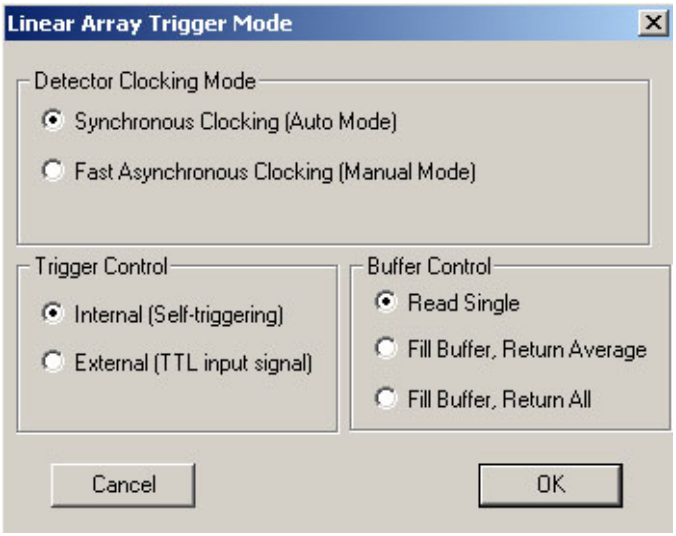


Figure 6.1 Trigger Mode Dialog Box

6.1. Detector Clocking Mode

6.1.1. Synchronous Clocking (Auto Mode)

Synchronous clocking is a sampling rate and controlled by hardware built in the spectrometer. This sampling rate is constant. This mode is good for fast repetitive sampling with short integration time. By default, this mode is enabled.

6.1.2. Fast Asynchronous Clocking (Manual Mode)

Asynchronous Clocking is a manual sampling rate that's controlled by the software or external signal. That means the spectrometer doesn't start taking sample until the **Scan Single** button is pressed or triggered by an external signal. This mode is good for taking samples by using external triggers, on-line processing or where precise timing is critical.

6.2. Trigger Control

6.2.1. Internal (Self-trigger)

This is the software-controlled mode. No external signal is required.

6.2.2. External (TLL Signal)

In this mode, the trigger signals come from an external device.

In this mode, the detector is held in reset until the external trigger is received. Then the exposure starts when the trigger is received..

The advantages of this mode are:
Fast triggering on events, with all samples stored in the FIFO's. The sample timing can synchromized to an external device.

6.3. Buffer Control

6.3.1. Read Single

When this option is selected the data is sent to the screen after each sample is taken. This provides an immediate visual feedback while making adjustments. This mode is almost as fast as the Fill Buffer mode for integration times greater than 110-mS.

6.3.2. Fill Buffer, Return Average

When this option is selected it causes the on-board FIFO memory to be filled before any spectral data is updated to the screen. This can be used for increasing the acquisition rate for integration times shorter that 110-mS. Fill buffer is preferred whenever update time permits.

6.3.3. Sample Averaging…

Averaging multiple samples increase the signal to noise ratio. The improvement is proportional to the square root of the number of samples, e.g. A 100 – sample average improves the signal to noise ration by 10 dB. The sample averaging controls are located in the Control Bar.

The **Sample Avg**. count is saved in the setup file (*.STP) and is automatically initialized form the setup file on startup..

7. Setup | Wavelength Interpolation

Wavelength interpolation is the linear interpolation of the data points to provide evenly spaced data in the wavelength axis. Most data processing algorithms require evenly spaced points for the input data. The interpolation algorithm is simply a linear interpolation. That is, all the output points lie on lines, which connect adjacent input points.

To use wavelength interpolation, select **Setup | Wavelength Interpolation**. Enter the spectral range and resolution required. Check the box " **Enable On – Wavelength Interpolation**" to interpolate the spectrum in real time. The box "**Apply to all traces**" is optional – it will interpolate any other traces visible on the graph at the time the dialog box is closed. If not checked, only Trace 0 will be linearly interpolated on closing the dialog box.

8. Setup | Amplitude Calibration

The amplitude calibration dialog box contains all the controls for spectroscopic calculations. Although the radio buttons for selecting "Amplitude Calibration Units" are also represented in the "Amplitude Calibration" list box of the control bar, the options described below must be selected in this window.

8.1. Select Background

This group controls Background options.

8.1.1. Internal Background

This selection causes only the sampled and stored background signal to be subtracted from the Sample in the calculation of spectroscopic units.

8.2. Select Reference

This group controls Reference options.

8.2.1. Current Internal Reference

This selection causes only the sampled and stored reference signal to be used in the calculation of spectroscopic units.

8.2.2. Binary Reference File Data

The selection causes the binary reference file entered in the provided edit control to be loaded from disk into the internal Reference table. The existing internal Reference table is replaced with the selection.

9. Calibration External File Data

The complete filename for the file containing the calibration data may be entered directly into the edit control provided, or the "File…" button may be pressed to browse for the file. Whenever the "Calibrate to External File Data" option is selected for Calibration Units using either the control bar Amplitude Calibration list box or the Amplitude Calibration dialog box. The file data specified in the edit control will be used in the calculation of spectroscopic units.

10. Setup | Graph Settings…

Graph settings are customization options where you can change the windows settings for the look and feel of the CDI Spec32 windows. You can change the font size, background color, or turn grids on or off… **Figure 10.1.**

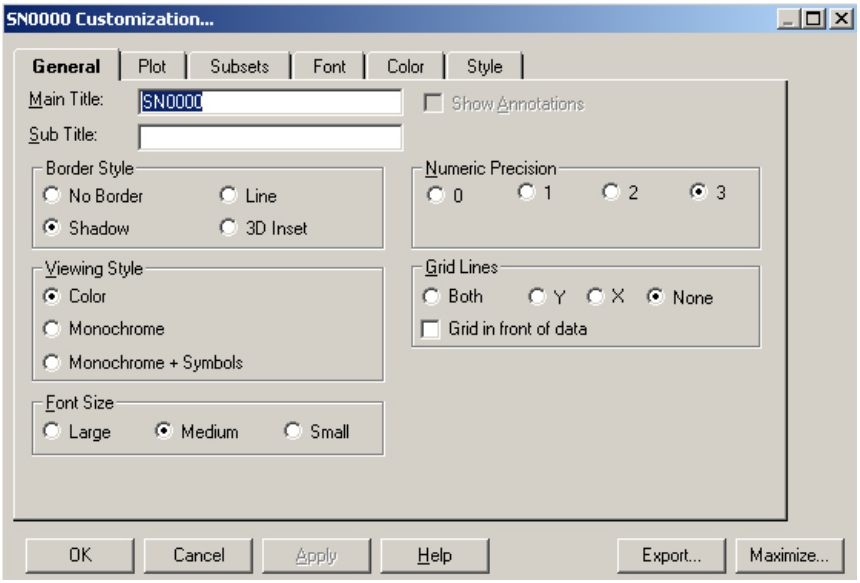


Figure 10.1. Graph Settings…

To use this command, click on **Setup** on menu bar, and select **Graph Settings.** A small windows dialog comes up. There are six tabs on the top of the windows. The **General** tab is a default screen and enabled. **Note**: Double click on the graph will also have same effect as using **Graph Settings** command.

10.1. General

10.1.1. Main Title and Sub Title

These two edit-boxes allow adding, editing, and deletion of main and sub titles. If no title is present, entering one will add one. If you remove all the characters from a title it will be deleted from the image.

10.1.2. Border Style

There are four radio buttons in this group, and only one can be selected at a time.

(a) No Border: No border will be drawn on the graph
(b) Shadow: A line will be drawn a round graph with drop shadow that will give the impression that graph is floating.
(c) Line: A line will be drawn around the graph.
(d) 3D Inset: A sunken border will be drawn around graph that gives a three dimensional look.

10.1.3. Viewing Style

The Graph Object supports three viewing styles.

Color

Monochrome

Monochrome with Symbols

This customization allows you to quickly adjust the image to best suite printing on a monochrome printer. If fewer than four subsets are to be included in a graph, then the Monochrome setting will probably be the best choice. If four or more subsets are to be included in the graph, then Monochrome with Symbols will help distinguish the different subsets.

10.1.4. Font Size

The Graph Object supports three font sizes, Large, Medium, and Small. Depending on the size of the graph, the user can select the font size that is most readable. When printing the graph, a font size of Medium or Small is suggested.

There are occasions, (mainly when attempting to generate an image for a highly rectangular graph) the graph may automatically reduce the size of the font in order to produce a higher quality image.

10.1.5. Show Annotations

If the object contains annotations, this check box allows you to remove/add the annotations from the image.

10.1.6. Numeric Precision

When placing information into a table, or exporting Text/Data from the Export Dialog, the number of decimal positions can be between 0 to 7. Depending on the implementation, the maximum precision may vary.

10.1.7. Grid Lines

The Graph Object can contain vertical grid lines, horizontal grid lines, both vertical and horizontal grid lines, or no grid lines.

10.1.8. Grid in front of data

By checking this option, the graph's grid is placed in front of the data graphics. Otherwise, the data graphics are drawn on top of the graph's grid.

10.2. Plot

10.2.1. Plotting Method

The Graph Object has many possible plotting methods for the primary plotting style;

Area
Bar
Line
Point
Points plus Best Fit Curve
Points plus Best-Fit-Line
Points plus Spline
Spline

Depending on the implementation, some plotting methods may not be available. Also, many but not all of these plotting styles can be set for a secondary comparison plotting style.

If the graph has multiple y-axes, then you can control plotting and comparison plotting styles for each individual axis by selecting the axis in the axis-button group.

The Histogram plotting method displays a histogram of the data that is currently selected. The Histogram is most meaningful with larger data sets (at least 15 data points). If the Histogram is for only one subset, then bars represent the number of occurrences. If the Histogram is for multiple subsets, then lines will represent the different frequency distributions.

10.2.2. 3D

This feature allows you to adjust 3D effects added to plotting methods. Possible values are:

None No 3D effect is added.

Shadows Draw shadows behind bars, points, and the area of an area graph.

3D Bars and area charts are drawn in a 3D fashion.

10.2.3. Mark Data Points

Checking this checkbox will cause little circular marks to be placed at data point locations.

10.3. Subsets

10.3.1. Subsets to Graph

This group allows you to view subset information is a variety of ways.

1. If nothing is selected in the listbox and Scrolling Subsets equals zero, then the object will display all subset information (14 subsets graph maximum, and no limit on the amount of subsets tabled.)
2. If there are selections in the listbox and Scrolling Subsets equals zero, then the object will display only those subsets selected.
3. If nothing is selected in the listbox and Scrolling Subsets is non-zero, then the object will scroll through subset information by the amount defined by Scrolling Subsets.

4. If there are selections in the listbox and Scrolling Subsets is non-zero, then the object will maintain those selected subsets as permanent subsets and revolve through the remaining subsets in increments of Scrolling Subsets.

The following table summarizes the Subsets to Graph variations.

Selected Subsets	Scrolling Subsets	Result
no	no	Display all subsets.
yes	no	Display only those selected subsets.
no	yes	Scroll through all subsets.
yes	yes	Permanent selected subsets & scroll through remaining subsets.

10.4. Fonts

The Scientific Graph Object only supports True Type fonts (because their scaleable). Your can select fonts for the:

Main Title
Sub Title
Labels Including , X axis label, Y axis label,
X axis grid numbers or point labels,
Y axis grid numbers.
Tabled Data Data labels included into the graph.

For the Main Title, Sub Title, and Labels, you can also select font attributes of Boldness, Italics, and Underline.

10.5. Colors

The Scientific Graph Object supports two sets of color parameters. A Monochrome color set and a Color color set. Depending on the Viewing Style, the Colors Dialog will customize the appropriate set.

To adjust colors:

1. Select the desired object attribute in the Graph Attributes section. The corresponding color for that attribute will be highlighted in the color selection grid.

2. To change the color, either use the mouse to click an alternate color, or use the keyboard arrow keys to move to adjacent colors. As the highlighted color selection changes position, the sample image will be updated with the newly selected color.

3. Finally, Pressing the OK button will update the color parameters of the object.

10.5.1. Desk Background

This is the color that surrounds the bounding rectangle of the graph's grid.

10.5.2. Desk Foreground

This is the color that is used when placing text onto the Desk Background. This includes the main title, sub title, subset labels, grid numbers, and axis labels.

10.5.3. Shadow Color

The rectangle that make up the graph's grid is bounded at the bottom/right edges with shadows. To remove the shadows, choose the same color as the Desk Background.

10.5.4. Graph Background

This is the color used as the background color of the graph's grid.

10.5.5. Graph Foreground

This is the color used for the bounding rectangle of the grid, and the grid-lines.

10.6. Style

The Style tab allows the control of subset color, subset line style, and subset point style.

1. Select the desired subset in the Subsets list box. The corresponding color and possible line and point styles are then highlighted in their respective controls.

2. To change the color, either use the mouse to click an alternate color, or use the keyboard arrow keys to move to adjacent colors. Adjust the subset line and point styles as desired.

3. Finally, Pressing the OK button will update the object’s image.

10.7. Customization Dialog Buttons

10.7.1. Customizations

All objects have their own individual customization dialogs. The customization dialogs allow you to adjust visual, and functional attributes of the object as well as gain access to the Export and Maximization dialogs.

Custom and Original Parameters

All objects store two sets of customization parameters. The first set is known as the Original set. The Original set is programmed into the control and you cannot adjust these parameters. The second set is called the Custom set. The Custom set can be adjusted through the customizations dialog. While the object has the input focus, PRESSING T will toggle between the Original and Custom parameter sets.

Showing the Customizations Dialog

DOUBLE-CLICKING the MOUSE over the object, or PRESSING SPACEBAR while the object has the input focus will show the customization dialog.

How to

When the customization dialog is shown, the parameters it shows reflect the current state of the object. By making adjustments to the customization dialog and then pressing the **OK** Button, the user updates the Custom set of parameters controlling the object. By pressing the Original Button the object will show the object with the Original set of parameters.

The **Apply** button is similar to the **OK** button but does not close the customization dialog.

The Color Tab and Font Tab allow adjustment of color and font attributes. To change colors or fonts, press the tab to show the dialog, make your adjustments and then press the **OK/Apply** Button to update the image.

Note, the customization dialog cannot be used to toggle between the Original and Custom set of parameters. This is because pressing the **OK Button creates a new Custom set of parameters. To toggle between Original and Custom sets of parameters, press the T key while the object has the input focus.

10.8. Exporting

All objects have the same exporting capabilities. Objects can export the following formats to the listed destinations.

FORMAT	DESTINATIONS
Metafile	Clipboard, File, and Printer.
Bitmap	Clipboard, and File.
OLE Object	Clipboard. (16 bit only)
Text / Data	Clipboard, and File.
JPEG	File.

How to

By Pressing 'X' when the object has the focus, or selecting the Export button from the Customizations Dialog.

1. Select the type of export desired.
2. Select the destination of the export.
3. If available, select the size of the image to export.
4. Press the Export/Print button.

10.8.1. File Destination

If information is to be exported to a file, then you must enter a target filename. Click the mouse over the **Browse** button to show the **File Save As Dialog**. Enter a filename and select **OK** to close the **File Save As dialog.**

10.8.2. Printer Destination

If you're exporting a metafile to the printer, pressing the **Print** button will show the **Print Dialog**. Use the Print Dialog to make changes to the selected printer, orientation, paper bin, and other printer options.

10.8.3. Exporting an OLE Object, 16 bit

When exporting an OLE Object, you paste the object into an OLE container. The object is supported by the OLE-MiniServer PEGRPSVR.EXE.

10.8.4. Exporting Text /Data

When exporting Text/Data, pressing the Export button launches the **Text/Data Export Dialog.**

10.9. Maximization

Maximization is the process of resizing the object to use the entire video display. All ProEssentials objects support maximization (if available.) When maximizing the object, the object is actually copied to a maximized dialog. The dialog (maximized object) can be closed by pressing 'Escape' or by using the mouse to Click the title bar. Making customizations to the maximized object will not effect the original (non-maximized) object.

11. Hardware Setting…

11.1. Hardware Setting | Temperature Setpoint…

Selecting this command will let you set the temperature for spectrometer with build-in array cooler. Temperature setting is in Celsius. To set the temperature, enter the degree in the text box and click on Cooler on check box to enable the cooler. Click on **OK** to finish.

Note: The lower the temperature you set, the more current will be drawn to operate the cooler. Setting the temperature too low will cause the spectrometer unstable.

11.2. Set DAC Baseline

Use this command when you run the spectrometer, and it is saturated low. What the software does is to check for saturation levels, and set the analog baseline to maximize the usable A/D converter range by adding 2000 counts to the baseline.

11.3. NIR High Gain Mode

This option will enable the spectrometer runs in high sensitivity mode. It will make the spectrometer takes samples 16 times faster than in low sensitivity mode. On the downside, it is very non-linear. By default, this mode is always turned off.

Note: Only use this mode when speed is more important.

Chapter 6
Using Process Command Menu

1. **Process | Derivative…**

   Derivative is Savitsky-Golay smoothing algorithm. To use this command, click on **Process** from the menu bar and select **Derivative** and a dialog box comes up. Enter the number of points in the text box. Click on the arrow down to the right side of the **Savitsky-Golay Method** and select the method that you would like to use. Click on **OK** button to proceed. It will take a few seconds to process this command. To undo the Savitsky-Golay process, do the following:

2. **Revert (No Processing)**

   This will do exactly what it says. This command will undo the **Derivative** process. Click on **Process** and select **Revert** to proceed.

Appendix A
Calculating Spectroscopic Units

A spectroscopic unit is represented by the y-axis scale of the Graph and is shown in Counts, Percentage, Absorbance Units, Decibels, depending on what amplitude calibration is selected.

The calculation of spectroscopic units requires the calibration of each photo detector for wavelength, offset, and sensitivity. The photo detector wavelengths of the CDI spectrometer are permanently calibrated; requiring only that the proper wavelength calibration file is loaded. However, the offset and sensitivity must be calibrated for the measurement conditions and for the individual instrument in use to provide optimal performance. The values required for this calibration are discussed in this section.

1. Background

The Background is the zero light level, which consists of the array's thermal current and DC bias. The Background level is strongly dependent on the array's temperature and the array's integration time. Of course, the analog bias provided by the offset DAC must also be taken into account. The background trace is stored in raw analog to digital converter counts, or A/D counts. To see how this reading is obtained during a test please review chapter 4 of the manual.

2. Reference

The Reference, or 100 percent light level, is sampled for the maximum light level to be measured. The Reference level is strongly dependent on the light source, the array integration time, and the optical response of the instrument including the input fiber and sample fixture. The Reference trace is stored in raw A/D counts with the Background subtracted. The Reference minus the background is needed to calibrate the sensitivity of each photo detector.

When a Reference is taken (absolute Reference), the Integration Time used to take it, is stored along with the Reference. If you want to change the Integration Time, a new Reference is calculated so that sensitivity remains the same. The software does this so it is a seamless operation for the operator.
All spectroscopic units are computed with respect to the absolute Reference linearly scaled for changes in the integration time:

$Rn = (Ic/Ir)*Ra$

Where:
Rn = New Reference Ic = Current Integration Time
IR = Reference Integration Time Ra = Absolute Reference

As the integration time is increased after the Reference is stored, the multiplier is proportionately decreased. The result is that the signal level in the spectroscopic unit does not change when the integration time is increased, although the signal raw A/D counts are increased. However, the signal to noise ratio may be increased with increased integration time.

3. Calibration Units

The Calibration Units are the units that the Y-axis of the graph is in with relation to the real world. For example it could be in Percentage of light, counts dB or Absorbance Units. These units are represented as a percentage of the Reference (100 percent).

For example, for Calibration Units in Percent, the Calibration Units will consist of the value of 100 percent for each photo detector. (Depending on which spectrometer you have, it could have anywhere from 256 to 1024 photo detectors in its array) The Calibration Units table may be any arbitrary mathematical quantity.

4. Spectroscopic Units

To compute Spectroscopic unit, the Sample to be measured must be sampled in A/D counts. The sample matrix is then converted to spectroscopic units.

$S=(1/r)*(Sc-Bc)*C$

Where:
S = Spectroscopic Units r = Reference Counts Sc = Sample Counts
Bc = Background Counts C =Calibration Units

Percent Transmittance (Reflectance)

Percent transmittance and reflectance are the simplest and most often used units. The calibration units are a constant 100 for each photodetector:

$\% = [(Sc-Bc)/r] * 100$

Where:
r = Reference Counts Sc = Sample Counts
Bc = Background Counts

5. Absorbance (Optical Density)

Absorbance units are the same as Optical Density, which is the log 10 (1/ Transmittance):

AU = LOG10 [r/(Sc-Bc)]

Where:
r = Reference Counts Sc = Sample Counts
Bc = Background Counts AU = Absorbance Units

6. Calibration to a Blackbody Source

This calibration is used to compensate out the sensitivity variation due to the optical response and the photodector response, effectively flattening the overall instrument response. The color temperature does not need to be exact to accomplish this objective. For this calibration, the Blackbody Calibration Units are relatively scaled intensity counts computed from the color temperature (°K) and the wavelength (λ) using Planck's blackbody equation:

Bu = Sf *(C1/(λ/1000)^5.0)/ exp (C2/(λ*°K/1000)-1.0)

Where:
Bu = Black Body Calibration Units Sf = Scale Factor (selected by the user)
C1 = 37415.0 C2 = 14387.9
Note: C1 and C2 have been re-scaled for calculation using λ in nanometers.

The output is then:
RIC = [(Sc-Bc)/r]*Bu

Where:
RIC = Relative Intensity Counts r = Reference Counts Sc = Sample Counts
Bc = Background Counts Bu = Black Body Calibration Units

7. External Amplitude Calibration File Format

The calibration data file must be an ASCII file, with two columns in the following format:
<Wavelength in nm><whitespace><amplitude><optional whitespace><newline char>

Where whitespace includes all characters NOT in the string "0123456789+-eEgG".
An example of a single line of the file is shown at the right: 400.0\t99.8\t\n
Each line must be terminated with the new line character. This is the standard spreadsheet compatible ASCII formats. This file may be generated from Excel by saving a text format file.

The wavelengths must be in ascending order. The data will automatically be linearly interpolated for use in the calibration.

8. Sampling the Reference and Background

There are two commands available to sample and store the Reference and Background data: an automatic procedure and a manual procedure. These procedures are provided to ensure that the Reference and Background are stored in the proper units. It does not matter what Amplitude Calibration Units are selected, since these commands work on raw counts and may be performed at any time in any units to update the reference of background**.**

9. Automatic Procedure

Select the **Operate | Acquire Ref and BG** command. This command tests the sample-to sample variation of the Background and Reference, requiring three consecutive samples within the Noise Limit setting in the setup file (default = 2 counts) prior to acquiring the sample to be stored. Then a complete sample (including averaging if active) is sampled and stored.

This command will prompt the user to make the input dark, will acquire and store the Background, then will inform the user that the Background has been stored. After the Background has been stored, another message box appears to prompt the user to connect the input to the reference, and the software will then acquire and store the reference. Finally, another message box appears to prompt the user to connect the signal to the input to be sampled.

The Background or Reference may be acquired separately with the same prompts and the same results using **Operate | Acquire BG** and **Operate | Acquire Ref**, respectively.

10. Manual Procedure

Connect the input to the spectrometer to the dark (0%) input. Disconnecting the fiber from the spectrometer input and covering the input connector may do this. However, it is preferable to shutter the light source. Do not turn off the light source, since it will usually need to stabilize for a few minutes after being turned on. Acquire a complete average, paying close attention to the status bar messages and watching the plot to determine stability. Then select **Operate | Store Reference / Background…** and check "Store Internal Background". The background has now been stored.

Connect the input to the spectrometer to the Reference (100%) input. Re-connect the fiber or open the shutter on the light source. Acquire a complete average paying close attention to the status bar messages and watching the plot to determine stability. Then select **Operate | Store Reference / Background…**, and check "Store Internal Reference". Make sure "Re-compute

Amplitude Compensation" is checked upon storing the Reference. The Reference has now been stored.

The "Re-compute Amplitude Compensation" check box updates the Reference by subtracting the existing Background from the new Reference, and updates the Reference Integration Time. If the Reference is stored first, then checking "Re-compute Amplitude Compensation" when the new Background is stored will use both the new Reference and the new Background for subsequent calculation of spectroscopic units.

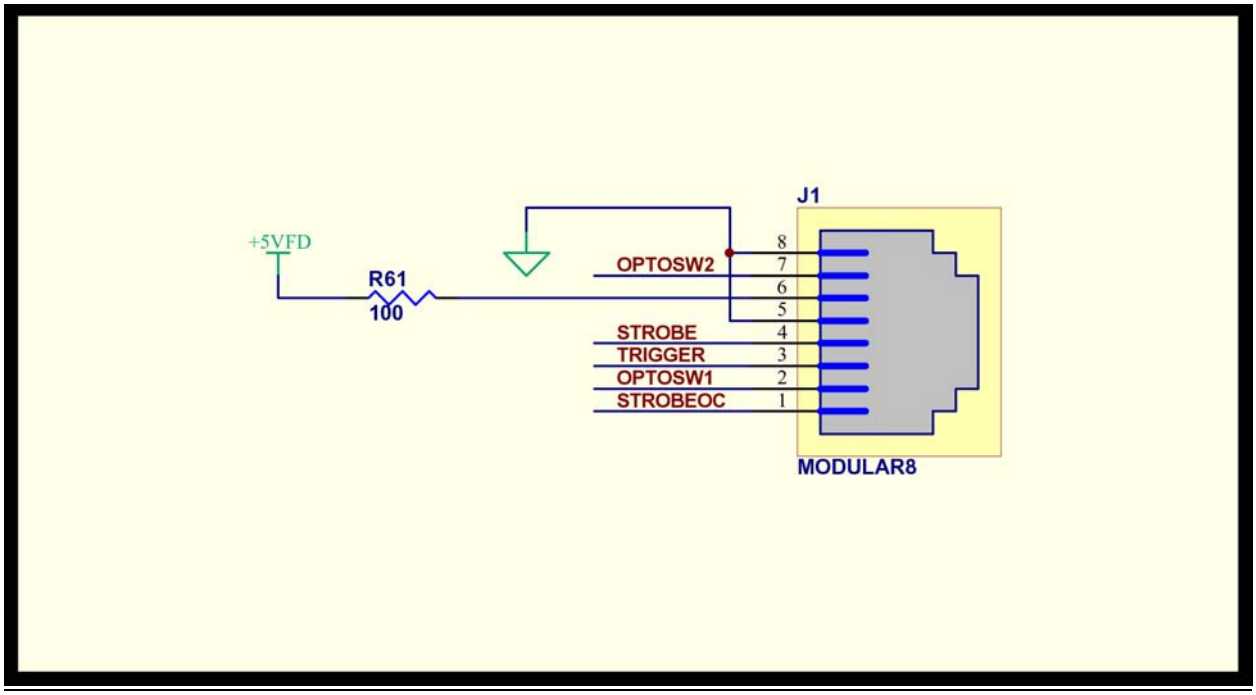
To update the Background without affecting the Reference, do not check the "Re-compute Amplitude Compensation" box when the Background is stored. This is the default behavior of the **Operate | Acquire BG** command.

It is often desirable to select "Internal Background" from the Select Background group in the **Setup | Amplitude Calibration** dialog box if you use the manual procedure. Using the Zoom | Fit (autoscale) command facilitates verifying the stability and noise on the Background and reference signals.

Appendix B
Pinout

1. Modular Electrical Connector Pinout

All spectrometers provide an I/O interface via a RJ45 connector. The user can connect to this interface by using a cable with a cable mount plug with the part number: AMP P/N 5-554739-3.

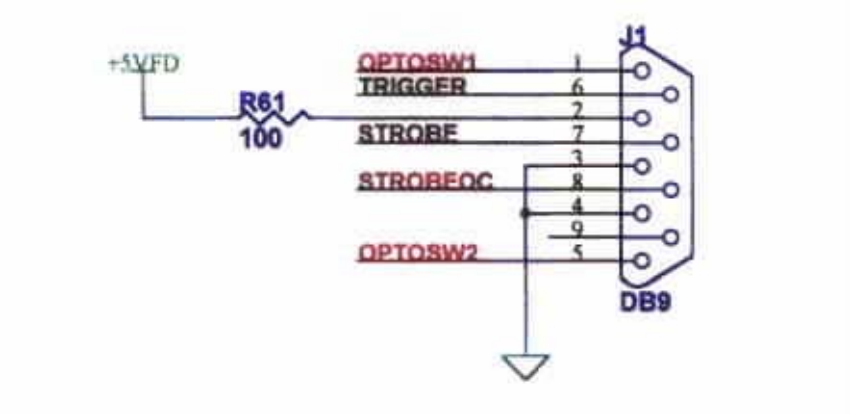


The following is a pin out description for this connector.

PIN	NAME	FUNCTION
1	STROBEOC	Output – Active during sampling, open collector output
2	OPTOSW1	Output – Engages / disengages a single fiber optic switch, 5V – 300mA Inductive load driver.
3	TRIGGER	Input – Initiates a sample in manual mode, defines arrangement of sampled spectra in auto mode, +10V/-5V max. Input, +5V/0V nom.

4	**STROBE**	**Output _ Active during sampling, TTL output.**
5	**GND**	**Ground – Return for all signals**
6	**PULL – UP**	**Power – 100 OHM resistor from internal +5V**
7	**OPTOSW2**	**Output – Engages / disengages a single fiber optic switch, 5V – 300 mA Inductive load driver (not available on CCD models)**
8	**GND**	**Ground – Return for all signals**

All Spectrometers can be fitted with a DB9 Electrical connector as shown below (order CDI TRIGGER CABLE). This utilizes a male DB9 connector and mates with a AMP P/N 747904-2 connector.



The following is a pin out description for this connector.

PIN	NAME	FUNCTION
1	**OPTOSW1**	**Output – Engages / disengages a single fiber optic switch, 5V – 300mA Inductive load driver. (NOTE: Tied to pin #2 on CCD adapters.)**
2	**PULL-UP**	**Power - 100 OHM resistor from internal +5V**
3	**GND**	**Ground – Return for all signals**

4	**GND**	**Ground – Return for all signals**
5	**OPTOSW2**	**Output – Engages / disengages a single fiber optic switch, 5V – 300mA Inductive load driver.(Not available on CCD models)**
6	**TRIGGER**	**Input- Initiates a sample in manual mode, defines arrangement of sampled spectra in auto mode, +10V/-5V max. input, +5V/0V nom.**
7	**STROBE**	**Output - Active during sampling, TTL output**
8	**STROBEOC**	**Output – Active during sampling, Open collector output**
9	**No Connection**	