ROPER SCIENTIFIC™
BEYOND IMAGING

4411-0048
Version 2.5A
January 5, 2001

Table of Contents

Figures

This page intentionally left blank.

Part 1
Getting Started

This page intentionally left blank.

Introduction

This manual has been written to give new users a step-by-step guide to collecting, storing, and processing data from your Roper Scientific system. The manual is divided into the following three parts:

- **Part 1**, ***Getting Started***, is primarily intended for the first time user who is familiar with Windows-based applications or for the experienced user who wants to review. These chapters lead you through hardware setup, experiment setup, data collection, file handling, wavelength calibration, spectrograph setup and calibration and data display procedures.
- **Part 2**, ***Advanced Topics***, goes on to discuss ancillary topics such as ROI, binning, data correction techniques, printing, gluing spectra, Y:T analysis, processing options, pulser operation and customizing the toolbar. These chapters are more informational and less procedural than those in Part 1.
- **Part 3**, ***Reference***, contains appendices that provide additional useful information, such as
    - commonly used system, controller type and camera type terminology provided in Appendix A,
    - Hg, Ar, Ne calibration spectrum data and graph provided in Appendix B, and
    - data-structure information provided in Appendix C.

  Also included are appendices that address repair and maintenance of the WinSpec/32 software and installation work-arounds for situations where the CD ROM doesn't support long file names.

A software hardware setup wizard guides you through the critical hardware selections the first time you select Setup – Hardware. To properly respond to the wizard's queries, you may have to refer to your ordering information, such as exact detector model, A/D converters, etc. Keep this information handy.

Even though the wizard will assist you in getting started, it will still be necessary to read through this manual to familiarize yourself with the many data-collection and analysis options available.

Note: Throughout the manual references are made to the PI-MAX camera/detector. This camera/detector was previously called the I-MAX and the ICCD-MAX.

Summary of Chapter Information

Part 1, Getting Started

Introduction describes the contents of this manual as well as other information sources including online Help and other documentation files.

Chapter 1 **Installing and Starting WinSpec/32** lists system requirements and describes how to install the WinSpec/32 software.

Chapter 2 **Basic Hardware Setup** provides detailed instructions on how to configure WinSpec/32 for operation with the hardware (detector, controller, and spectrograph) in your particular system. Pulser configuration is discussed in Chapter 17.

Chapter 3 **Initial Spectroscopic Data Collection** provides a procedure for initial spectroscopic data collection, allowing users to gain some operating familiarity before going on to more complex measurements.

Chapter 4 **Initial Imaging Data Collection** provides a procedure for initial imaging data collection, allowing users to gain some operating familiarity before going on to more complex measurements.

Chapter 5 **Opening Closing and Saving Data Files** describes how to open, close and save data files in WinSpec/32.

Chapter 6 **Wavelength Calibration** describes how to calibrate the WinSpec/32 software for one position of the spectrograph grating.

Chapter 7 **Spectrograph Calibration** discuss how to calibrate the WinSpec/32 software for any position of the spectrograph gratings.

Chapter 8 **Displaying the Data** describes the data file display options.

Part 2, Advanced Topics

Chapter 9 **ROI & Binning Options** describes binning, the summing together in hardware of charge from several pixels. Simple or more advanced binning options can be configured easily with WinSpec/32. The chapter also describes how to set a region of interest (ROI), so that data is only collected from the specified portion of the CCD array.

Chapter 10 **Correction Techniques** explains correction options such as background subtraction and flatfield correction.

Chapter 11 **Spectra Math** covers WinSpec/32's mathematical processing features.

Chapter 12 **Y:T Analysis** provides an overview of how to use the Y:T analysis function to track changes in a process with time.

Chapter 13 **Gluing Spectra** discusses gluing existing files or combining the data acquisition and gluing operations under spectrograph control.

Chapter 14 **Post-Acquisition Mask Processes** describes digital mask-operations that can be performed on the acquired data. Discussed are Edge Enhancement, Sharpening, Smoothing, Custom Filter and Morphological functions.

Chapter 15 **Additional Post-Acquisition Processes** describes additional operations that can be performed on an acquired data set. Functions cover include Threshold and Clipping, Cross Section, Binning and Skipping, and Histogram.

Chapter 16 **Printing** describes printing features of WinSpec/32. WinSpec/32 can print directly to almost any Windows printer driver.

Chapter 17 **Pulser Operation** describes the operation of the Pulsers that can be used with WinSpec/32.

Chapter 18 **Custom Toolbar Settings** describes the Custom Toolbar and explains how to add/remove the available buttons.

Chapter 19 **Custom Chip** describes the user-defined chip functionality.

Chapter 20 **Custom Timing** describes the user-defined timing functionality.

Part 3, Reference

Appendix A **System and Camera Nomenclature** provides a cross-reference table for systems, controllers, and cameras/CCD arrays. It also provides brief descriptions of systems and system components. CCD array related abbreviations are also included.

Appendix B **Calibration Lines** contains wavelength tables and a detailed spectrum for Mercury-Argon.

Appendix C **Data Structure** contains descriptions of the data structure for both WinView/WinSpec 1.43 and for 1.6. *The data structure for WinView/32 and WinSpec/32 is the same as that for WinView/WinSpec 1.6.*

Appendix D **Auto-Spectro Wavelength Calibration** discusses the WinSpec/32 wavelength calibration algorithm.

Appendix E **CD Failure Work-Arounds** provides advice on how to successfully complete the installation in situations where the CD ROM doesn't support long file names.

Appendix F **WinSpec/32 Repair and Maintenance** provides information on how to repair, reinstall and uninstall WinSpec/32 components.

Appendix G **Glossary** includes brief definitions of terms used in relation to WinSpec/32 and the system hardware.

Online Help

The WINSPEC.HLP online documentation contains:

- Information that is in this manual,
- Step-by-step instructions on how to use WinView functions,
- Reference information about WinView and its functions, and
- Context-sensitive help, which describes a screen or menu item that is being pointed to or that is active when a Help button is clicked on.

Tool Tips and Status Bar Messages

Placing the mouse cursor on a button and resting it there for a few seconds causes a brief tool-tip message to appear that describes the button's function. Tool tips are also provided for the individual panes of the Status Bar (at the bottom of the WinSpec/32 window). Note that tool tips only appear at the desktop level. Tool tips are not provided for the buttons on the individual dialog boxes and tab pages.

More detailed descriptions for each button at the desktop level are provided at the left side of the Status Bar. Status Bar help messages are also provided for the menu selections.

Additional Documentation

Text files installed with the software contain information of a technical nature. Unless otherwise indicated, these files are found in the \WINSPEC32 directory on the hard drive where WinSpec/32 was installed. Among the text files that *could* be included are:

README.TXT This is a read-me file that contains the latest information on new features, fixed problems, and work-arounds for issues not yet solved.

WINHEAD.TXT This file contains documentation on the header structure for WinSpec/32 or WinSpec/32Data Files.

These TXT files can be opened with any ASCII text editor.

Chapter 1
Installing and Starting WinSpec/32

To ensure that the computer you have can operate the Princeton Instruments equipment, please first read the system requirements below carefully. WinSpec/32's requirements differ from those of previous versions of WinSpec.

After confirming that your computer meets all hardware and software requirements, install WinSpec/32 according to the instructions in this chapter. Do not attempt to run the software until you have read Chapters 2, 3 and 4, which discuss important hardware-setup and data acquisition issues. Also, it is recommended that you install the Princeton Instruments interface board in your computer before running the software. Instructions for installing the interface board are provided in your Princeton Instruments hardware manuals.

Note: If your computer and system were purchased together from Roper Scientific, the Interface card will have been installed at the factory.

System Requirements

The following information lists the system hardware and software requirements.

Hardware requirements

- Roper Scientific camera and, if required by the camera, a Princeton Instruments ST series controller.
- Princeton Instruments or Photometrics high speed PCI serial card or ISA serial card. *Computers purchased from Roper Scientific are shipped with the card installed.*
- Minimum of 32 Mbyte total RAM for CCDs up to 1.4 million pixels. Collecting larger images at full frame or at high speed may require 128 Mbytes or more of RAM.
- Hard disk with a minimum of 80 Mbytes available. A complete installation of the program files takes about 6 Mbytes, and the remainder is required for data storage. Collection of large images may require additional hard disk storage, depending on the Number of Spectra collected and their size. Disk level compression programs are not recommended.
- Minimum is AT-compatible computer with 80486 (or higher) processor (50 MHz or faster); Pentium or better recommended.

ATTENTION

Not all computers are able to satisfy the software and data-transfer performance requirements of Roper Scientific systems. If you purchased a computer through Roper Scientific, it will have already been tested for proper operation with a Princeton Instruments system and will have the Interface card installed.

- Super VGA monitor and graphics card supporting at least 256 colors with at least 1 Mbyte of memory. Memory required will depend on desired display resolution.
- Two-button Microsoft-compatible serial mouse or Logitech three-button serial/bus mouse.

Operating System requirements

Windows 95 (or higher) or Windows NT (ver. 4.0 or higher). WinSpec/32 is ***not*** supported under OS/2. Nor will it run under Windows 3.1 or 3.11.

Your System Components

Take a few minutes and enter the information in the table below. Various pieces of this information will be required when you install WinSpec/32, when the Setup Wizard (see Setup Wizard, page XX) runs, and when you begin entering component information on the dialog boxes and tab pages associated with Hardware Setup, Spectrograph Setup, and Pulser Setup. Other information such as software version and hardware serial numbers may be useful if you ever need to contact Technical Support.

System Component	Your System	Notes
Application Software and Version	WinSpec Version 2.5.____	This information can be found on the installation CD or via the WinSpec Help menu.
PVCAM Driver	Yes / No	The PVCAM driver is used to run Photometrics brand cameras.
Interface Card	PCI , Tucson PCI, ISA, or ECP	For most new systems, the interface is PCI. Tucson PCI is required to run Photometrics brand cameras
System Name		Refer to your order and Appendix A
Controller	ST-121, ST-133, ST-133A, ST-138, ____________________	Refer to your order and Appendix A
Controller Serial Number		Refer to the serial label. Typically, this is located on the bottom of the unit.
Detector/Camera and CCD Array		Refer to your order and Appendix A
Detector/Camera Serial Number		Refer to the serial label. Typically, this is located on the back of the unit.

System Component	Your System	Notes
Shutter Type	Small (≤ 25 mm), Large (≥ 35mm), None	
Spectrograph Type	Acton, Spex, or ____________________	
Pulser Type	DG535, PG200, or PTG	PTG is usually associated with the PI-MAX camera (also known as the ICCD-MAX camera)
Pulser Serial Number		Refer to serial label. Typically, this is located on the back of the unit and in the lower left corner.

Installing WinSpec/32

CAUTION Because WinSpec/32 and WinView/32 contain files with the same name but different content, do not install WinSpec/32 and WinView/32 software in the same directory.

Before installing WinSpec/32:

- Verify that your computer meets the requirements listed on pages 21-22.
- Verify that the interface card has been installed. Note that the interface card is not necessary if the computer will only be used for post-processing data.
- If installing under Windows NT, make sure that you are logged on as administrator of the NT Workstation. Otherwise, the installation will fail because changes cannot be made to the Windows Registry.
- Check to see if WinView/32 has been installed on your system. If it has, note the directory name so you won't accidentally install WinSpec/32 in the same directory.
- Determine how you will be installing the software. WinSpec/32 is provided on a CD shipped with the system or it can be installed from the Roper Scientific FTP site.

During the installation process, you will be given the choice of **AUTO PCI** or **Custom** installation.

Click on ***Custom*** if your system has a different interface (**ISA or ECP**), does not have an installed interface card, or is using a **SPEX** spectrograph.

AUTO PCI: Detects the PCI card installed in your computer and installs the WinSpec/32 application and DLLs, the help files, the PCI interface driver, sample data, diagnostic programs, Acton spectrograph support, pulser support, ASCII and Move Snap-Ins, PI Screen Saver, PI SPE Shell Extension, Visual Basic Interface, and the Imaging option.

Custom: By default, installs the WinSpec/32 application and DLLs, the help files, sample data, PI Screen Saver, PI SPE Shell Extension, and the Imaging option. However, you can change the components for installation by checking and unchecking the boxes associated with the components. Allows you to install the drivers for SPEX spectrographs.

Installing from the CD

1. Exit any software currently running. This will speed the installation of WinSpec/32.
2. Insert the WinSpec/32 CD into your CD drive. Windows will detect the CD and the installation will begin automatically.

   Note: If the auto-start feature has been disabled on your computer, click the desktop **Start** button, select **Run**, key **x:\Setup** (where “x” is the letter designating your CD drive) and press the **Enter** key on your keyboard. The install sequence will begin.

CAUTION

If your CD drive doesn’t support the Windows long filenames, attempting the installation causes the filenames to be truncated and the installation fails, generating an error message like:

An error occurred during the move data process: -113
Component: Application\WinXSystem
File Group: WinXSystem

If this should happen, see Appendix E for workarounds.

3. Click on the program that you want to install. If you have clicked on "Install WinSpec/32 or WinView/32" you will be given additional choices on the next dialog box.
4. After selecting the program, follow the instructions provided on the dialog boxes and continue with the installation process. You can abort the installation at any time by clicking on **Cancel** and following the instructions.

Installing from the FTP Site

If you aren’t sure how to access the FTP site, contact Roper Scientific’s Technical Support Department for assistance. Contact information follows.

Roper Scientific
3660 Quakerbridge Road
Trenton, NJ 08619 (USA)
Tel: 609-587-9797
Fax: 609-587-1970
Tech Support E-mail: techsupport@roperscientific.com

For technical support and service outside the United States, see our web page at www.roperscientific.com. An up-to-date list of addresses, telephone numbers, and e-mail addresses of Roper Scientific's overseas offices and representatives is maintained on the web page.

1. Log onto the FTP site and go to the Software/Official/WinX32/V25X (where X is a number)/WinSpec32 directory.
2. Execute the program WinSpec.exe and follow the instructions on your screen. You can abort the installation at any time by clicking on **Cancel** and following the instructions.

WinSpec Installation Choices

Application Files: Loads the actual WinSpec/32 files.

Help Files: Loads the Help System, both general and context-sensitive Help.

PCI Interface: Loads the drivers for the PCI Interface card.

ISA Interface: Loads the drivers for the ISA Interface card.

ECP Interface: Loads the drivers for the ECP Interface card.

Sample SPE Data Files: Creates a directory **Data** containing sample *.SPE files. This directory is located beneath the one containing the WinSpec/32 files.

Diagnostic Program: Loads the diagnostics program pidiag32.exe. It is located in the directory containing the WinSpec/32 application files and can be executed by double-clicking on pidiag32.exe via the Windows Explorer.

Spectrograph Support: Loads drivers for Acton and/or Spex spectrographs.

Pulser Support: Loads the pulser drivers. Currently supported pulsers include the the PTG, the PG200, and the DG535 Timing Generator (drives the PI-MAX pulsing circuits).

Snap-Ins: Loads the selected Snap-In files. When a Snap-In is installed, its button will be added to the Snap-In toolbar.

PI Screen Saver: Loads the PI Screen Saver.

PI Shell Extension: Provides additional SPE file properties pages. *Right-click on SPE file name and select Properties. With PI Shell Extension deselected, only the standard Windows'95 file property page will appear. With PI Shell Extension selected, additional property pages will appear.*

Visual Basic User Interface: Allows DLLs programmed using Visual Basic 5 or higher to be executed from WinSpec/32.

Options: Loads the options that have been purchased.

Changing Installed Components, Repairing, or Uninstalling/Reinstalling WinSpec/32

Refer to Appendix F.

Starting WinSpec/32

Before starting WinSpec/32, follow the hardware interconnection and power up instructions in the hardware manuals supplied with your system. Then, open the Windows Program manager and start WinSpec/32 by clicking on WinSpec32 in the Roper Scientific folder (see Figure 1).

Note: You can start WinSpec/32 even if you have not installed the interface card or if you have not turned on the controller. If there is no interface card, WinSpec/32 will run in "Demo" mode. This mode allows you to look at and post-process previously stored data (such as the sample data installed with the software) and to become familiar with experiment setup and data acquisition. Some features will not be available because the program looks for information from the controller and camera while WinSpec/32 is loading and initializing.

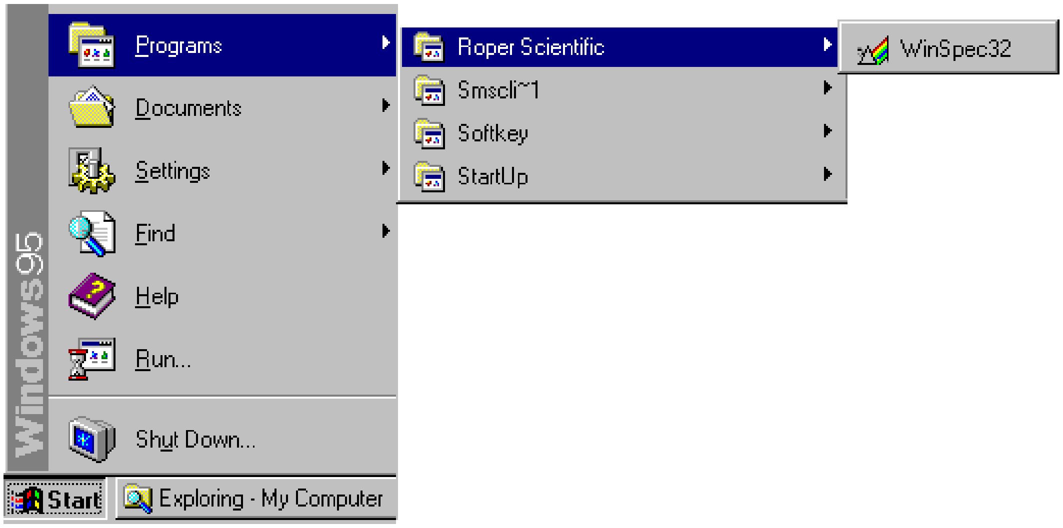


Figure 1. Opening WinSpec/32 from the Program Manager

WinSpec/32 follows the Windows 95 graphical interface conventions. While the software is booting, a splash screen such as the one shown in Figure 2 is displayed until the software has finished loading and initializing. Then, the Main Menu appears as shown in Figure 3. From there, you can access the program's functions through menu selection.

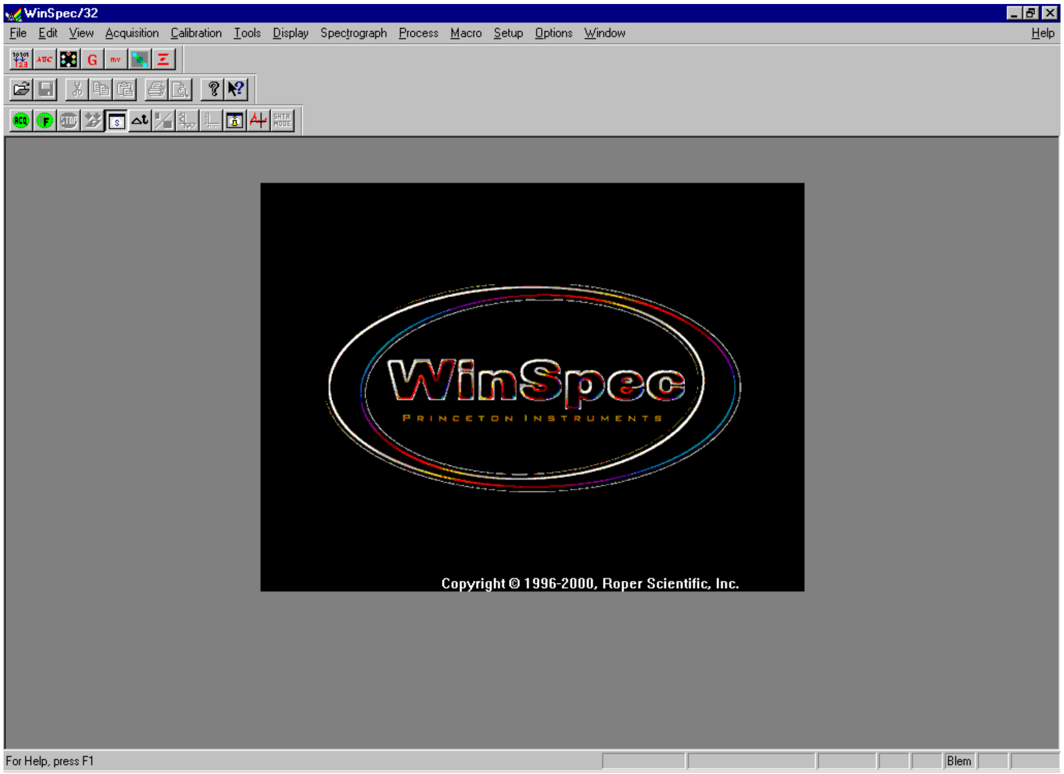


Figure 2. Splash screen

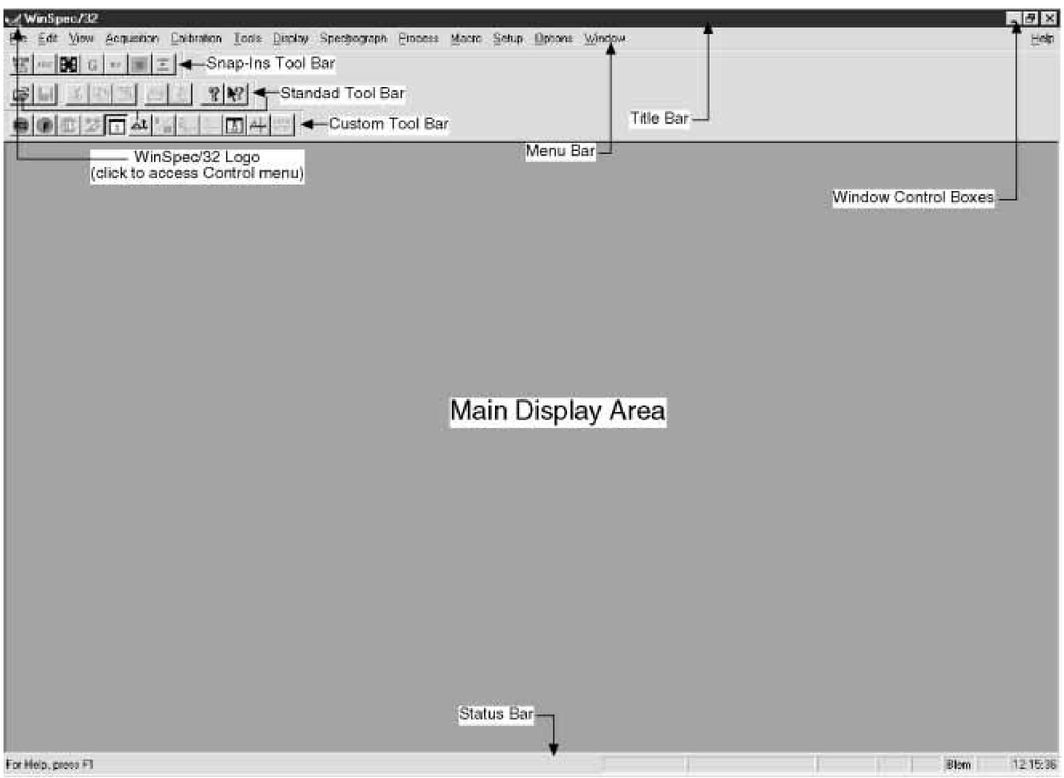


Figure 3. Main WinSpec/32 window

Values, labels, and alphanumeric data are usually entered from the keyboard. Selections and screen control operations are usually done using a mouse or other graphical I/O device, although keyboard selection shortcuts are provided. Mouse selection is typically done by positioning the mouse cursor on the selection item and clicking the left mouse button. In some case, clicking the *right* mouse button will bring up a dialog box with additional information or a special menu that allows additional operations to be performed.

Chapter 2

Basic Hardware Setup

Introduction

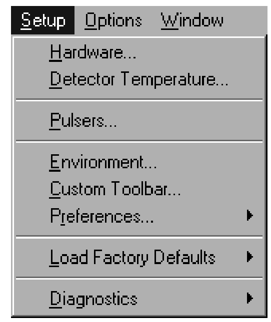


Figure 4. Setup menu

This chapter provides an overview of the relationships between the camera, the controller, and the host computer. This overview is followed by a discussion of the Setup Wizard that runs the first time you select Hardware from the Setup menu (Figure 4). The remainder of the chapter presents the Hardware Setup tab pages so you will be able to make the appropriate selections and entries for your system.

The chapters that follow describe how to configure a spectrograph, set up a pulser, set up experiment parameters, and control array temperature. Initial data acquisition is discussed in Chapters 3 and 4.

Advanced functions such as Post-Processing, User Defined Chip, and User Defined Timing are discussed in Part 2 of this manual.

Basic Hardware Overview

The basic components of a Roper Scientific system are: a camera (or detector), a controller, interconnecting cables, a computer interface card, and the application software (in this case WinSpec/32). Note that other components such as a computer, coolant circulator, and pulser can also be ordered.

The interface card, installed in the host computer, permits communication between the host computer and the controller (often an ST-133). The controller accepts input from the host computer and WinSpec/32 and converts it to the appropriate control signals for the camera. These signals allow you to specify the readout rate, binning parameters, regions of interest, gain, and array temperature. After data is acquired in the camera, it is transmitted to the controller where it is processed, transmitted to the host computer, displayed in the WinSpec/32 window, and can be stored to disk. Figure 5 illustrates possible system configurations (spectrometers and pulsers are not shown). Figure 6 and Figure 7 show the interconnections for a Roper Scientific system, as well as interconnections to an optional coolant circulator, an optional shutter, and spectrometers.

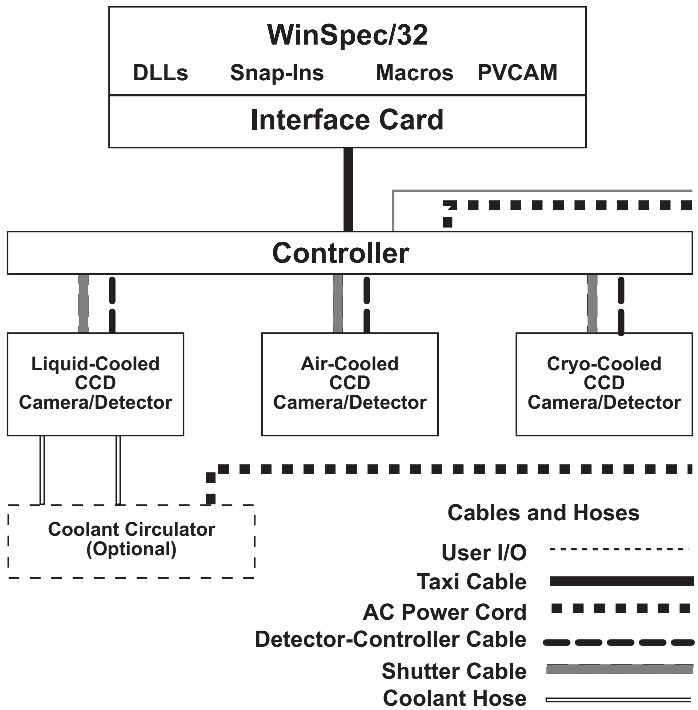


Figure 5. Possible System Configurations

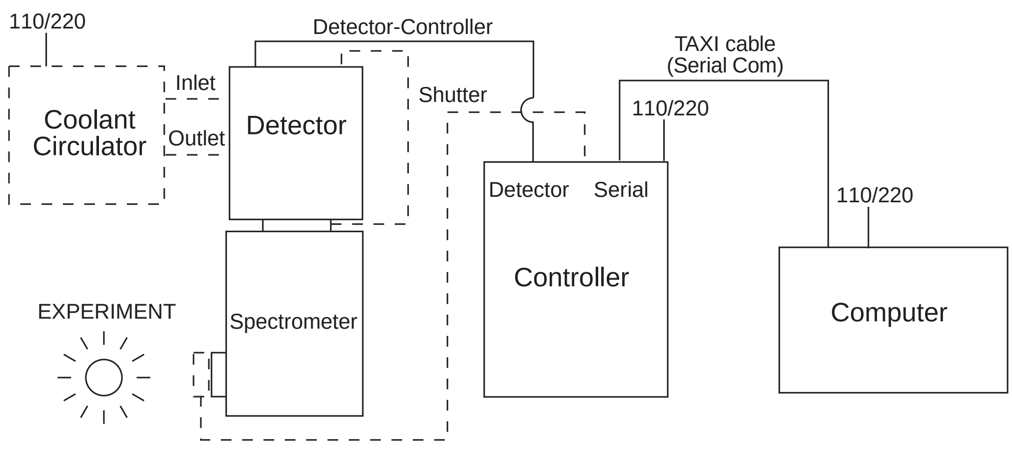


Figure 6. Liquid- or Air-Cooled System Diagram

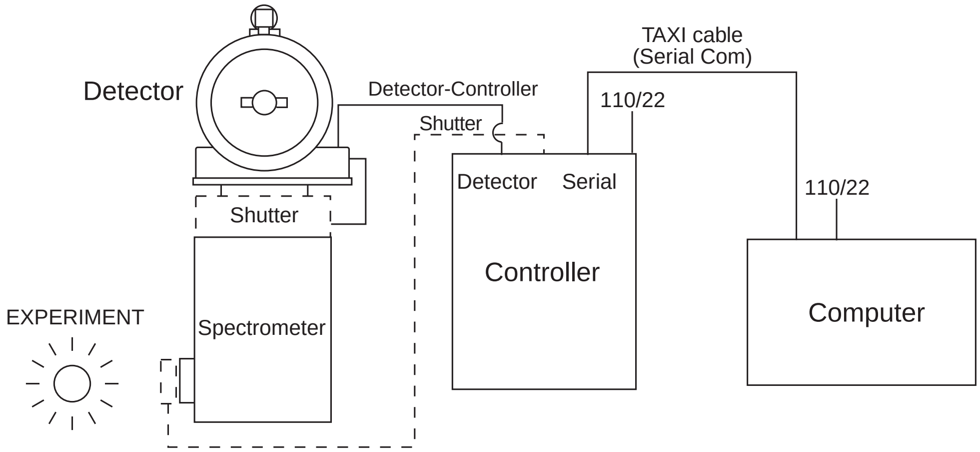


Figure 7. Cryo-Cooled System Diagram

Hardware Setup Wizard

The Setup Wizard runs the first time you select **Setup|Hardware** after WinSpec/32 has been installed on the host computer for the first time or when you are setting up a new controller for running in multi-controller mode. If a PIHWDEF.INI file has been copied to your WinSpec/32 directory, the selections specified in the PIHWDEF.INI will be implemented for the first controller and the Setup Wizard is not necessary.

The wizard leads you through the initial selection of interface, controller type, and Detector/Camera/CCD type. Additionally, it may require you to enter communication parameters if you are using an ISA or ECP interface card. Once you have finished entering information through the wizard, it exits to the Hardware Setup dialog box, where you can make the remaining selections and review those made using the wizard.

The text that follows includes pictures of the dialog boxes you may see and background information about Non-Volatile RAM (NVRAM), interface cards, controllers, and default selections. Wherever possible, the text follows the order in which the dialog boxes will appear.

1. Optional Disk

In most cases you will not be getting a New System Configuration Disk with your system. Therefore, the default selection is "NO". If you do have such a disk, you would select "YES" and follow the directions for loading the information from that disk.

Figure 8. Optional Configuration Disk dialog box

2. Photometrics Brand PCI Card Selection

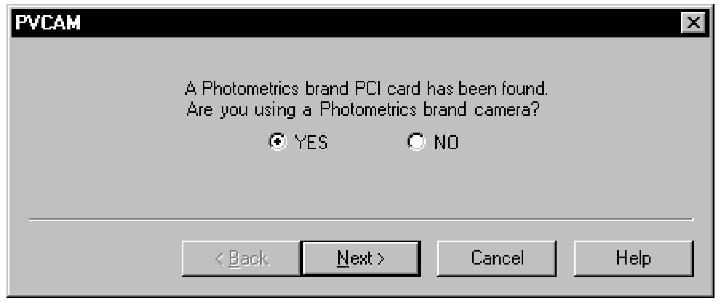


Figure 9. PVCAM dialog box

You will only see this dialog box if the wizard has detected a Photometrics brand PCI card in the host computer. Your response determines which types of cameras/controllers will be available on the Hardware Setup tab pages. (WinSpec/32 supports both Princeton Instruments and Photometrics brand cameras). The default selection is "YES". Clicking on **Next** will open the **Interface** dialog box.

Select "NO" if you are using a Princeton Instruments brand camera. After you click on **Next**, the wizard looks for a Princeton Instruments brand compatible Interface card and opens the **Interface** dialog box.

3. Interface Selection

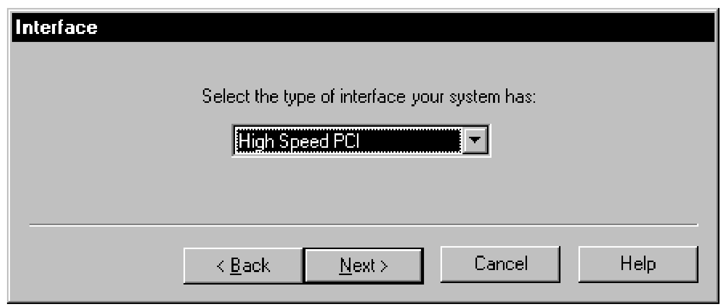


Figure 10. Interface dialog box

If you are using a Photometrics brand camera, the interface will be "Tucson PCI".

If you are using a Princeton Instruments brand camera, the interface will be either PCI, ISA, or ECP. If a compatible PCI card is found, the default will be "PCI Timer" data transfer mode (the other choice is "High Speed PCI").

If an interface card is found but it is not a PCI card, the default will be "ISA" (the other choice is "ECP"). **Only select "ECP" if you are running an MSP-100.** After you click on **Next**, you will asked for the I/O Address for your card and then the Interrupt level. If you have selected "ECP" you will also be asked for the DMA Channel. For more information about these settings see the topics that follow.

3.a. I/O Address Selection

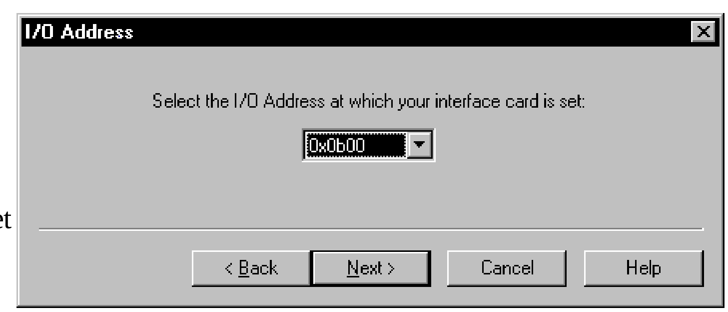


Figure 11. I/O Address dialog box

The I/O address of your ISA or ECP interface card refers to an internal address that program and device drivers use to communicate with the interface card. Select the I/O address that your card was set to when it was installed. WinSpec needs to know this information in order to talk to your card.

3.b. Interrupt Selection

Select the interrupt level chosen when your ISA or ECP interface card was installed. WinSpec needs to know this information in order to talk to the card. An Interrupt level (IRQ) is basically a "stop and do this" message sent to the CPU: an Interrupt ReQuest. Each hardware component communicating with the CPU must have its own IRQ level, so if you set two pieces of hardware to the same IRQ level, your computer will have an IRQ conflict and more than likely one of the pieces of hardware involved in the conflict will not work.

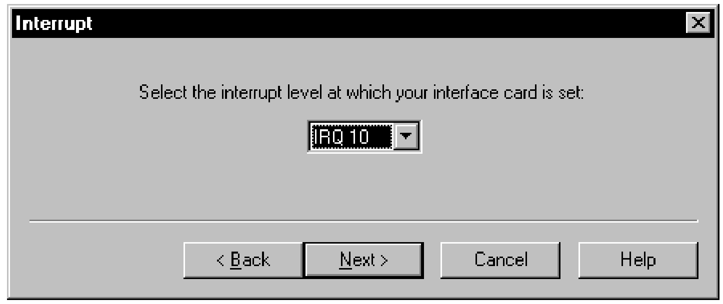


Figure 12. Interrupt dialog box

When you click on **Next**, either the Controller Type dialog box (if your card is an ISA) or the DMA Channel dialog box (if your card is an ECP) will be displayed.

3.c. DMA Channel Selection

If you have an ECP interface card, you will also be asked to select the DMA Channel that your card was set to (via a jumper or a set of dip switches on the card).

DMA (Direct Memory Access) channels, like IRQ levels, are limited in number, and you can't allocate one channel to more than one device.

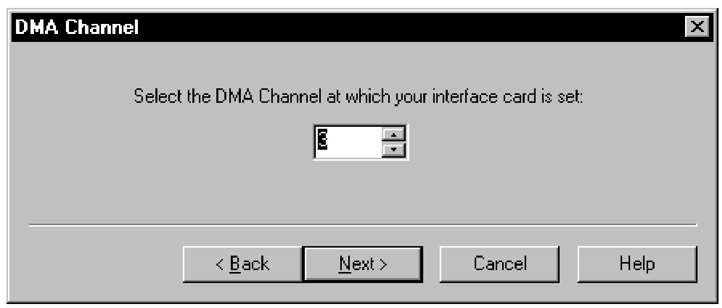


Figure 13. DMA Channel dialog box

4. Controller Selection

After you select the interface card (and finish entering any required communication information), the wizard checks to see if NVRAM is installed in the controller or camera. NVRAM contains detailed information about your system's controller and camera. Note that some controllers and cameras do not contain NVRAM so you will have to select the appropriate entries. See Appendix A for a cross-reference table for systems, controllers, and CCD arrays.

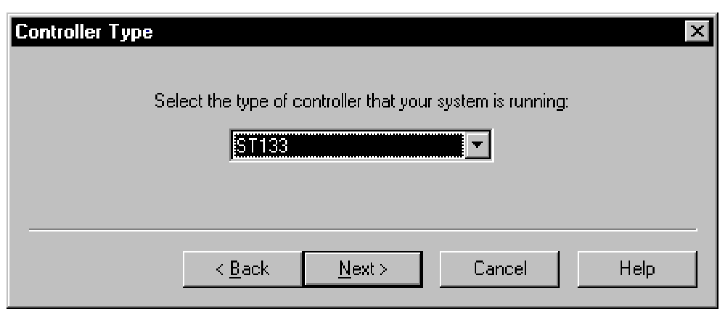


Figure 14. Controller Type dialog box

If the wizard finds NVRAM, the wizard reads the controller and camera information and inserts that information into the Controller Type and Detector/Camera/CCD dialog boxes. If it does not find NVRAM, it enters "ST-133" as the default controller. If you have an ST-121, ST-130, or ST-138 controller, you will have to select it from the dropdown list.

The Controller Type selection is critical because it determines the nature and type of the other selections that will be available, including the detector or camera type, display orientation options, cleans & skips, and user defined chip parameters. No single controller provides all possible selections, and only the ones applicable to the selected controller are listed on the Hardware Setup dialog box tab pages.

5. Detector/Camera/CCD Selection

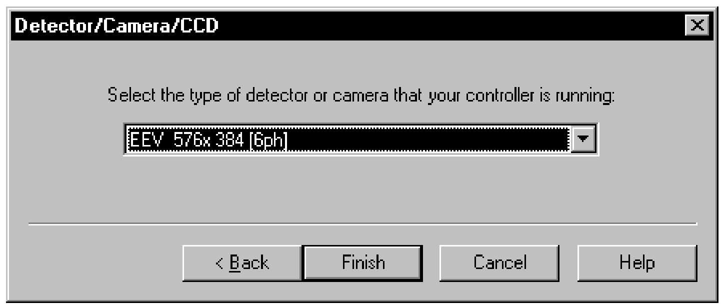


Figure 15. Detector/ Camera/ CCD Setup dialog box

The **Detector/Camera/ CCD** dialog is displayed after you select the controller type. Only the detector, camera, or CCD types associated with the selected controller will be available for selection. If your system has NVRAM, the correct selection will be automatically made. Otherwise, you will need to chose from the list. After you click on **Finish**, the **Hardware Setup** dialog box will be displayed so you can begin entering other hardware information.

Entering Controller and Camera Characteristics

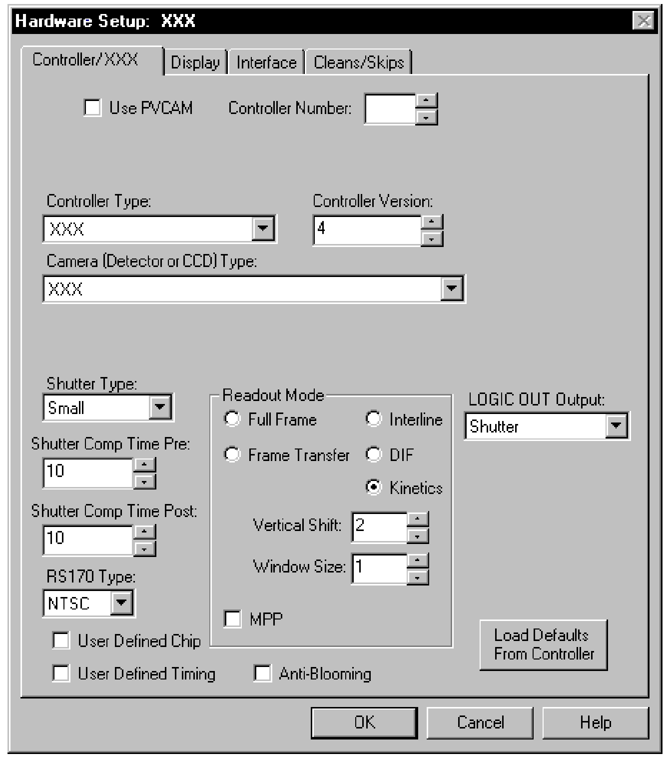


Figure 16. Controller/Camera tab page

The **Controller/Camera** tab page *(may also be named Controller/Detector or Controller/CCD depending on the hardware selections)* is used to enter and update Controller Type, Camera (Detector or CCD, depending on the system) Type and some of the Controller/Camera type parameters, such as Shutter Type and Readout Mode. The Controller and Camera Type selections are perhaps the most fundamental and important of all hardware selection decisions and directly influence the appearance of many other WinSpec/32 screens and the selections provided on them. As a result, setting up the software for use in any system should always begin with the Controller selection.

Figure 16 shows all of the fields and check boxes that exist on the **Controller/Camera** tab page. WinSpec/32 will display and hide features based on the controller, camera, and readout mode selected. All of the features are described in the text that follows.

Use PVCAM: This box will only appear if you have an installed Tucson PCI interface card with its driver. When you activate this check box, a series of dialog boxes will be displayed so you can confirm the settings for the Photometrics brand camera that you will be running.

Controller Number: This field will only appear if you have more than one Princeton Instruments brand PCI interface card installed. If you have a controller connected to each PCI card, you would select the number of the controller that you want to use.

Controller Type: The currently selected Controller Type is displayed in this field. Clicking on the button at the end of the box drops down the selection list so that the selected controller can be changed. Appendix A provides a cross-reference table for systems, controllers, and CCD arrays.

> **Note:** After you have selected the **Controller Type**, you can load the default settings for your controller, camera, and CCD array by clicking on **Load Defaults From Controller**, if this button is present.

Controller Version: In the case of the ST-133, MicroMAX, SpectroMAX, and PentaMAX controllers, different versions have been released having different capabilities. The available software selections will correctly reflect these differences when the proper version number is specified in this box.

Camera Type: The selected Camera Type is displayed in this field. Clicking on the button at the end of the box drops the selection list so that the selected camera type can be changed. Note that the listed camera types depend on the controller selection, requiring that the controller type be specified first.

Shutter Type: There are five selections, None, Small, Large, Remote and Electronic.

None: If the camera has no shutter (frame-transfer or interline CCD array) and is not an Intensified camera, select **None**.

Small: A small shutter is one that is typically 25 mm or smaller in diameter. This setting represents a shutter compensation time of approximately 8 msec.

Large: A large shutter is one that is typically 35 mm and larger. In the case of a camera having a very large CCD, such as the Kodak 2k × 2k, a large shutter may have been installed. This setting represents a shutter compensation time of approximately 16 msec.

Remote: **Remote** is primarily intended for spectroscopy applications where an external shutter would be placed ahead of the entrance slit.

Electronic: **Electronic** only applies to operation with an Intensified camera, which would normally not be equipped with a mechanical shutter. This selection would apply to both the Gate and Shutter/CW modes of the IIC-100, IIC-200, IIC-300 or MCP-100.

Readout Mode: The readout mode is determined by the characteristics of the CCD array and the controller. The possible choices are:

Full Frame: The entire chip can be read out.

Frame Transfer: Only the unmasked area of the chip can be read out. Frame transfer is only available if the camera has a frame-transfer chip such as the EEV 512 × 1024.

Vertical Shift: Determines the speed of the image transfer from the exposed area of a frame-transfer chip to the masked area. Also sets the speed of image transfer when operating in the Kinetics mode. Setting a lower value increases the shift speed. A higher value gives a slower shift. If the shift is too fast, not all of the charge will be transferred. If too slow, image smearing will be increased due to the exposure that takes place while the transfer is in progress. The default value gives good results in most measurements.

Interline: Provides 100% duty cycle operation. Interline is only available with a camera having an interline chip such as the PI 1300 × 1030.

Kinetics: **(ST-138 only)** Kinetics is a special type of operation in which most of the CCD is mechanically or optically masked, leaving a small section open to light. This section is then read out very quickly. See the ST-138 Controller manual for more details on the CCD aspects of this readout mode.

Window Size: Determines the height of the window for **Kinetics** mode. This value must be 1 or greater.

DIF: **(MicroMAX Interline only)** Dual Image Feature (DIF) is a special feature that allows images to be taken in pairs with very short exposure times (as small as 1 μs). This feature is only available for factory modified MicroMAX controller/Interline camera systems. Operating in this readout mode provides three timing modes unique to DIF systems: IEC (Internal Exposure Control), EEC (External Exposure Control) and ESABI (Electronic Shutter Active Between Images). These modes are in addition to Free Run mode.

MPP: This check box may appear if the CCD array is designed for MPP (multi-pinned-phase) operation. When this box is checked, the array will be run in MPP mode. Some MPP-capable arrays can also be run in Non-MPP mode (MPP box is unchecked). Running in Non-MPP mode may result in higher dark current in addition to larger full well capacity.

> **Note:** MPP capability reduces the rate of dark-current generation by a factor of 20 or more, and thus relaxes CCD cooling requirements to the level where a thermoelectric cooler is sufficient for most applications.

LOGIC OUT Output: The choices for the signal provided at the controller's $\overline{\text{SCAN}}$ Output connector vary based on the selected Controller. If the **LOGIC OUT** field doesn't appear on the tab page, the choice of output may be done via an internal jumper (for information on how to set the jumper, contact factory Tech Support.). Depending on your system, the following choices may appear in the drop down list:

Cleaning: This signal is high when an array Clean cycle is in progress and otherwise low.

Logic 0: Establishes a TTL logic 0 at the **Logic Out** connector.

Logic 1: Establishes a TTL logic 1 at the **Logic Out** connector.

> **Note:** LOGIC 0 and LOGIC 1 can be used to control an external device using the application software.

Not FT Image Shift: This signal is low when a frame-transfer shift is in progress and otherwise high.

Not Ready: After a Start Acquisition command, this output changes state on completion of the array cleaning cycles that precede the *first* exposure. Initially high, it goes low to mark the beginning of the *first* exposure. In free run operation it remains low until the system is halted. If a specific number of frames have been programmed, it remains low until all have been taken, then returns high.

Not Scan: Reports when the controller is finished reading out the CCD array. $\overline{\text{SCAN}}$ is high when the CCD array is not being scanned, then drops low when readout begins, returning to high when the process is finished.

Shutter: This signal is low when the shutter is closed and goes high when the shutter is activated, dropping low again after the shutter closes.

Shutter Monitor: In Gated operation, SHUTTER MONITOR is the correct choice and the signal should be applied to the inhibit input of the pulser to prevent pulsing during readout.

Shutter Comp Time Pre: Delays the acquisition until the shutter (if present) is fully open. The setting range is 0 to 30 ms. For single-strip spectroscopic measurements, a setting of “0” is recommended. Pre and Post compensation times are usually the same value.

Shutter Comp Time Post: **(MSP-100)** Delays the readout long enough for the shutter (if present) to close. This prevents the smearing that could occur if the readout started while the shutter was still open. The setting range is 0 to 30 ms. For single-strip spectroscopic measurements, a setting of “0” is recommended. Pre and Post compensation times are usually the same value.

RS170 Type: Selections are NTSC (US video standard) and PAL (European).

User Defined Chip: Advanced feature. See User Defined Chip discussion on page 189.

User Defined Timing: Advanced feature. See User Defined Timing discussion on page 191.

Anti-Blooming: **(THM 1024x1024FT CCD array)** Checking this box activates this CCD array's anti-blooming feature.

Load Defaults From Controller: Pops up the Load Factory Defaults From NVRAM dialog box so you can repopulate the fields and selections with the values stored in the controller's non-volatile RAM.

Entering the Data Orientation

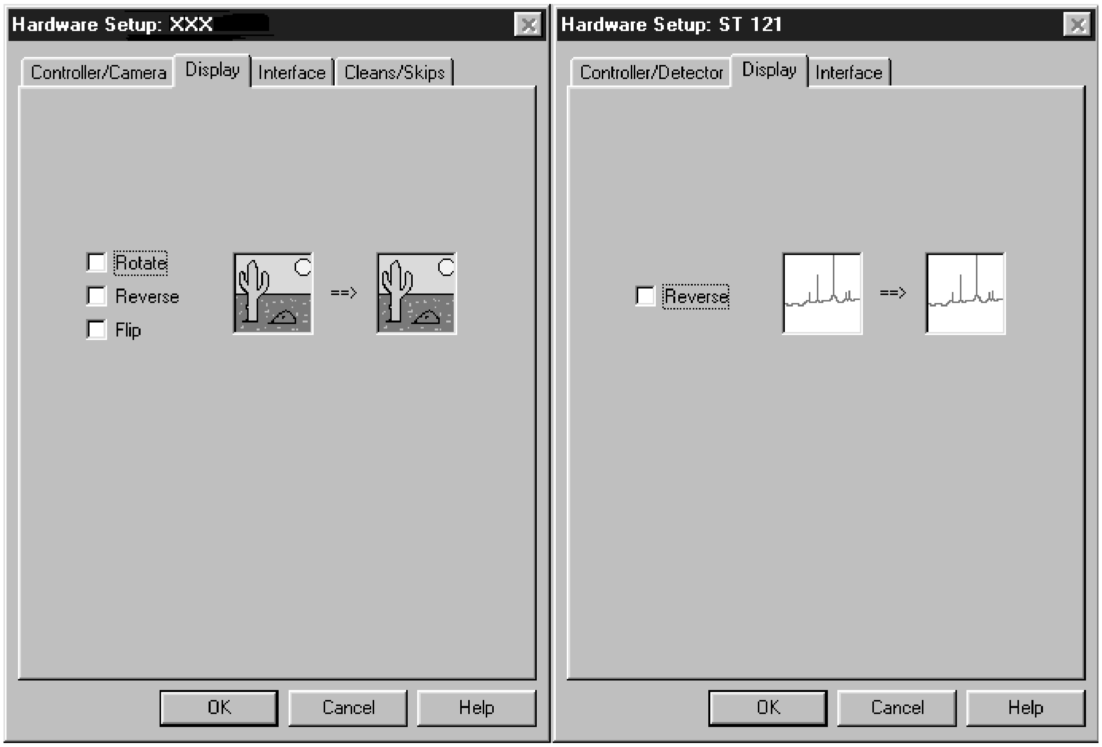


Figure 17. Display tab page; left graphic applies to all controllers except ST-121; right graphic applies to ST-121 only

With the exception of the ST-121, the **Display** tab page is the same for all controllers. Three display options, Rotate, Reverse and Flip, are provided. This feature allows you to compensate for CCD array or camera orientation. Before and after thumbnail illustrations show the effect of each selection. If no option is selected, the thumbnails will be the same. Any orientation can be achieved with the proper combination of Rotate, Reverse, and Flip. In the case of the ST-121, only Reverse is provided.

Rotate: Rotates the image 90° counterclockwise.

Reverse: Reverses the image horizontally.

Flip: Flips the image vertically.

Entering the Interface Communication Parameters

The **Interface** tab page allows you to specify the interface card installed in your computer and to enter the I/O addresses (if required) or DMA channel, in the case of the MSP-100. This functionality is particularly useful if you have multiple PCI cards installed in the host computer. Figure 16 shows all of the fields and check boxes that exist on the Interface tab page. WinSpec/32 will display and hide features based on the interface card installed in the host computer. All of the features are described in the text that follows.

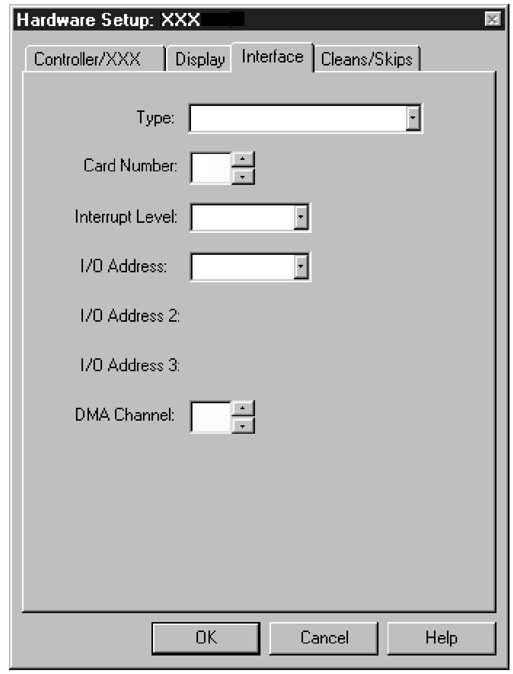


Figure 18. Interface tab page

Type: Select the communications type that will be used to transmit data from the controller to the computer. All communications types are not available for all controllers and computers. The "Demo" selection, which allows the software to be exercised but which doesn't support data transfer to the computer, would not ordinarily be used in the field.

High Speed ISA: Select if a PI ISA high-speed serial Interface card is installed in the computer in an ISA slot.

High Speed PCI: Select if a PI PCI high-speed serial Interface card is installed in your computer and you want data transfer to be interrupt driven. This choice would give the highest performance in most situations.

PCI Timer: Allows data transfer to be controlled by a polling timer if using PCI high-speed serial Interface card. Useful for troubleshooting possible interrupt problems (computer crashes or system fails to return data). Note that data transfer is slower in PCI Timer mode and data overrun more likely. Also PCI Timer cannot be used to continuously acquire small Regions of Interest in asynchronous operation. PCI Timer isn't compatible with **Use Interrupts** operation, a timing mode available when using the ST-138 Controller.

ECP: Provided for the MSP-100 only. Requires that the computer have an ECP (Extended Capability Port), which is a type of enhanced-performance parallel port.

Demo: Allows the software to be exercised without being connected to a controller. This mode is used primarily for demonstration purposes or post-processing of acquired data and cannot be used in an actual measurement.

High Speed Type B: Select if PI ISA high-speed serial Interface card is installed in the computer in an ***EISA slot***. *Type B is not available for all controllers.*

Interrupt Level: Can only be changed with High Speed ISA or ECP interface. The selected interrupt level ***must*** correspond to that set by the jumpers on the High Speed ISA card or assigned to the parallel port (ECP). The default for the High Speed ISA card is IRQ 10. In the case of a PCI interface, the interrupt level is reported but cannot be changed.

Card Number: This field only appears if more than one PCI card has been detected in your computer. This field allows you to set up the communications parameters so each card is uniquely addressed.

I/O Address: Can only be changed with High Speed ISA or ECP interface. The selected address ***must*** correspond to that set by jumpers on the High Speed ISA card or assigned to the parallel port (ECP). The factory default address for the High Speed ISA card is 0A00. In the case of a PCI interface, the I/O Address is displayed but cannot be changed.

I/O Address 2 and 3: **(High Speed PCI only)** These addresses are reported but cannot be changed; address selection is automatic and under computer control. With other interfaces, these addresses are not displayed.

DMA Channel: **(MSP-100 only)** The DMA Channel selection must match that assigned to the ECP parallel port at the computer.

Entering the Cleans/Skips Characteristics

CAUTION

For most applications, the default settings will give the best results.We advise contacting the factory for guidance before changing these parameters from their default values. ***Exception:*** With a PI-MAX camera, we suggest settings of Cleans 1 and Strips per Clean 4, Minimum Block Size 16 and Number of Blocks 32.

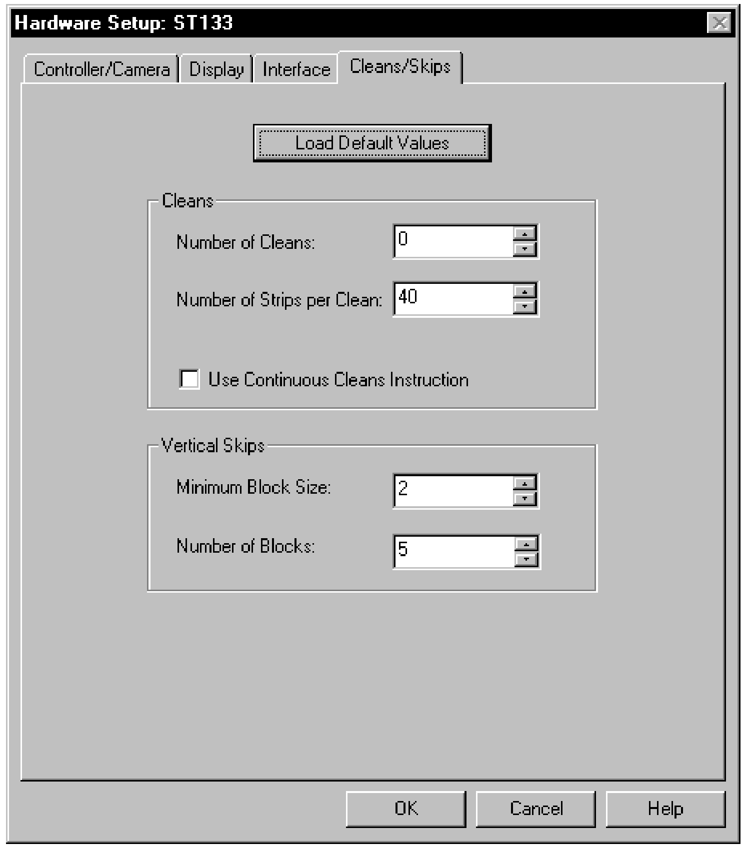


Figure 19. Cleans/Skips tab page

The **Cleans/Skips** tab page allows you to change the clean and skip parameters from their default values or to reload the default values. Figure 19 shows all of the fields and check boxes that exist on the **Cleans/Skips** tab page. WinSpec/32 will display and hide features based on the controller version. All of the features shown are described in the text that follows.

Load Default Values: Reloads the factory defaults from the NVRAM.

Cleans

Cleans are applied to the entire CCD array and remove charge that has accumulated on the array while waiting for data acquisition to begin.The charge on the CCD chip is transferred to the shift register and discarded to prevent charge buildup from occurring. On completion of a setup, successive clean cycles occur normally. The **Number of Cleans** and **Number of Strips per Clean** parameters allow you to program additional clean cycles that will be performed after initiating the run but before any data is taken.

Number of Cleans: For most applications the default value should be used. Clicking on the **Load Default Values** button and then selecting **Yes** will install the default value. Values other than the default can be directly entered in the field or selected via the spin buttons.

Number of Strips per Clean: Sets the number of CCD data strips to be transferred and discarded during each clean. The maximum valid setting is limited by the chip size. The default value will generally give good results.

Use Continuous Cleans Instruction: This feature is supported by Version 3 (and higher) ST-133 and MicroMAX controllers. This instruction does horizontal shifts while doing vertical shifts for a faster continuous clean. To use the special continuous cleans instruction, check in this box.

Note: Older versions of the ST-133 and MicroMAX controllers, as well as other controller types and cameras, do not support this instruction.

Vertical Skips

Vertical skips are associated with regions of interest (ROIs) that are smaller than the full chip. This feature allows you to bin and quickly traverse the rows that precede and follow the ROI. The rows to be processed and discarded are binned into blocks, each containing a number of rows, with the Number of Blocks parameter determining how many blocks there will be before and after the ROI.

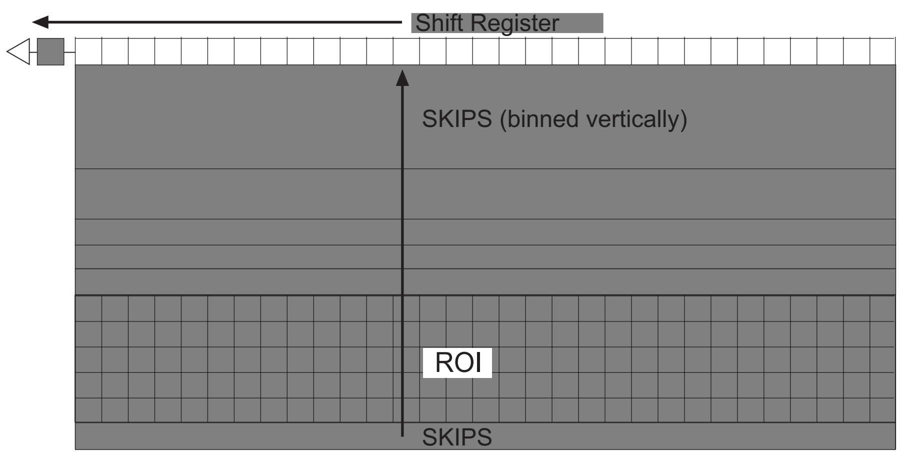


Figure 20. Vertical Skips

The block size determines how quickly the region preceding and following the ROI will be traversed. If the blocks are large, the region will be traversed quickly but there is the possibility of overloading the shift register and causing blooming. With small blocks, the risk of blooming will be minimized but the time to traverse will be large. WinSpec/32 uses an exponential algorithm to simultaneously achieve rapid traversing with minimal risk of blooming. The first block, specified in rows, is as large as possible. Each successive block is a factor of two smaller than the one preceding until the minimum block size is reached. All remaining blocks are the minimum block size. By making the first block as large as possible and subsequent blocks increasingly smaller, the region preceding and following the region of interest is traversed as rapidly as possible while minimizing risk of the shift register saturation.

Minimum Block Size: Sets the size, in rows, of the skip blocks that immediately precede the data. The default value will generally give good results.

Number of Blocks: Sets the number of binned “skip” blocks preceding and following the region of interest. The default value will generally give good results.

Setting up a Spectrograph

WinSpec/32 allows you to control several types of sepctrographs. More than one spectrograph can be installed in the system at one time. The total number of spectrographs is limited only by the number of free communication ports.

The following spectrograph operations can be performed after you define your spectrograph:

- Moving a spectrograph grating
- Automatic calibration of acquired data according to the spetrograph position.
- Changing to a different grating for some spectrographs.
- Changing the entrance slit size and/or the selected mirror for some spectrographs.

The following steps explain how to set up a spectrograph. You must correctly install a spectrograph before you can control any of its functions through WinSpec/32.

1. Make sure that the spectrograph is correctly connected to a host computer COM port.
2. Turn on the host computer and the spectrograph.
3. Wait for the spectrograph to finish initializing and then boot WinSpec/32. If this isn't done, although you will be able to install the spectrograph, it will not be possible to establish communications and an error message will result.
4. Select **Define** on the Spectrograph menu (Figure 21). This will open the Define Spectrograph dialog box (Figure 22).
5. On the **Main** tab page, note the Active Spectrograph text entry box. If spectrographs have previously been installed, the active one will be indicated. If no spectrograph has been previously installed, the box will be blank. Note there is a checkbox that allows you to designate a particular spectrograph as the one that will be used for doing an Auto-Spectro Calibration.

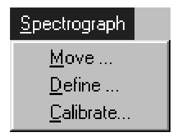


Figure 21. Spectrograph menu

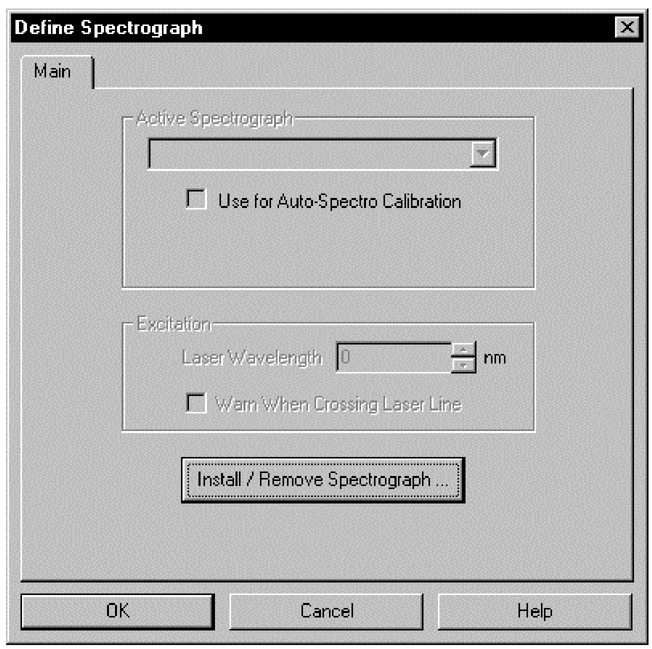


Figure 22. Define Spectrograph dialog box

6. Click on **Install/ Remove Spectrograph**. This will open the Install/Remove Spectrographs dialog box (Figure 23). The lower window lists the supported Spectrographs. The upper window lists those installed. To install a spectrograph, select it from the list in the lower window, select the Communications Port (Auto, COM1-COM8, or DEMO) and click on **Install Selected Spectrograph**. The installed spectrograph will then appear in the upper window. In the case of the example shown in Figure 23, the selected spectrograph is an Acton SP300i.

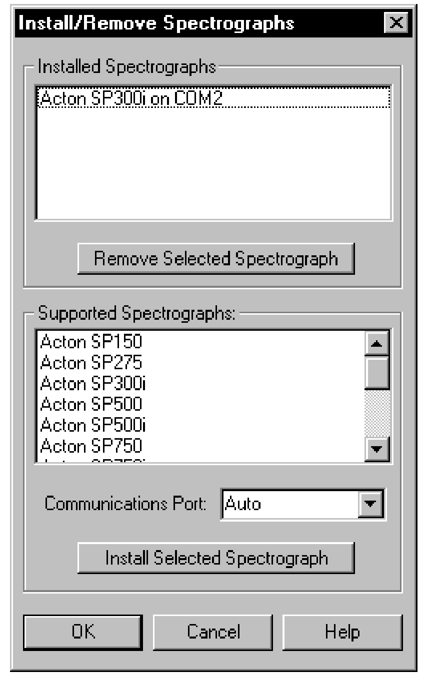


Figure 23. Install/Remove Spectrographs

Notes:

1. When you click on **Install Selected Spectrograph** to install the spectrograph, WinSpec/32 will try to connect the spectrograph to the selected communications port. If you select "Auto" as the port, the system will assign the spectrograph to the first available COM port. If the spectrograph is not found, an error message is displayed. Even if communication is not established, the spectrograph and its assigned port will be added to the list (for example, *Acton SP300i on COM2*).

2. To install another spectrograph, repeat the installation procedure.

3. To remove a spectrograph, select it in the upper box and click on **Remove Selected Spectrograph**. The spectrograph's name will then disappear from the upper window.

4. More than one spectrograph can be assigned to a port. However, only one spectrograph can be active at a time. If you have multiple spectrographs assigned to a port, make sure that the active spectrograph (refer to the Active Spectrograph field on the Main tab page) is the one that is (or will be) physically connected to the port.

5. If you plan to install more than one spectrograph for a COM port, it would be a good idea to make sure that the connection preferences are the same for all of the spectrographs assigned to that port.

7. Click on **OK** to close the **Install/Remove Spectrographs** dialog box.

8. If the newly installed spectrograph is the only installed spectrograph, the **Use for Auto-Spectro Calibration** box will be checked by default. If more than one spectrograph is installed, you need to check in the box for the spectrograph that is attached to the active detector. The checked status indicates which spectrograph can be automatically calibrated using the Spectrograph Calibration function which requires that the controller take data (see Chapter 7 for more information).

Ports and Comm Parameters

If the spectrograph is not connected to COM2 or if there was an error message during installation, specify the communications parameters and then assign a COM port to the active spectrograph. These steps are done as follows.

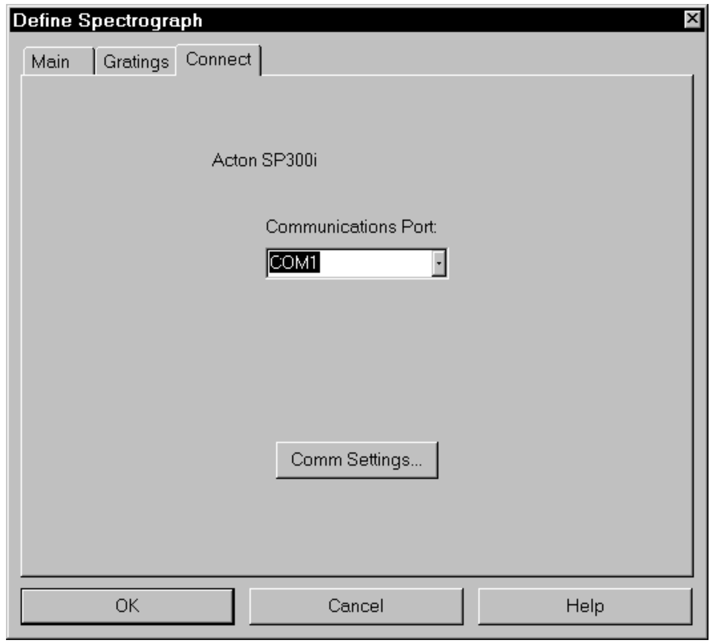


Figure 24. Connect tab page

1. On the **Main** tab page, select your spectrograph as the "Active Spectrograph".
2. Click on the **Connect** tab .
3. Note the COM port named in the **Communications Port** field. If it is not the one you want to use for the active spectrograph, select the correct port from the drop down list. The choices are COM1 through COM8 and Demo.
4. Click on **Comm Settings** (Figure 24). This will open the Comm Settings dialog box as shown in Figure 25.
5. Set the connection preferences *according to the requirements of your spectrograph. For Acton Spectrographs, use the settings shown in Figure 25.*
6. Click on **OK** to close the Comm Settings dialog box. All parameters will be stored and automatically restored whenever WinSpec/32 is booted.

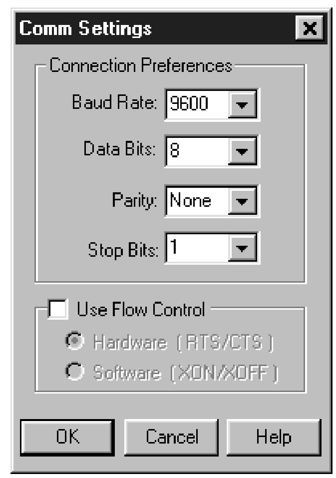


Figure 25. Comm Settings dialog box

Notes:

1. Set the COM parameters separately for each COM port that has an installed spectrograph.
2. Only one spectrograph at a time can be active at each COM port. However, multiple spectrographs can be installed for each COM port. If you plan to install more than one spectrograph for a COM port, it would be a good idea to make sure that the connection preferences are the same for all of the spectrographs assigned to that port.

Specifying the Active Spectrograph

If you have installed more than one spectrograph, you need to define the Active (controlled) Spectrograph. If there is only one spectrograph, that one is the active one. If there is more than one, than you must designate the active one. This can be done via the Define Spectrograph Main tab page, the Move Gratings tab page (to access, click on Move in the Spectrograph menu) and via the Calibrate Spectrograph dialog box (to access click on Calibrate in the Spectrograph menu). On the Define Spectrograph Main page the selection is called **Active Spectrograph**, on the Move Gratings tab page it is called **Spectrograph to Move**, and in the Calibrate dialog box it is called **Spectrograph to Calibrate**. In all three locations the function is simply to specify the active spectrograph, and changing the selection in one location is equivalent to changing it in all three. If only one spectrograph has been installed, the box won't appear in the Move or Calibrate dialog boxes, but the spectrograph model will be reported.

Entering Grating Information

Once you have installed a spectrograph, you may need to enter the grating information for the spectrograph if the spectrograph can't supply them automatically. This is information that WinSpec/32 needs to move and calibrate the spectrograph correctly. *Grating information is supplied automatically for automated Acton spectrographs, as stored in the spectrograph's electronics..*

Grating parameters

The grating values are required for the dispersion calculation and for the selection of the active grating. Some spectrographs have interchangeable grating turrets, each able to mount up to 3 gratings. Where this is the case, the grating information may have to be separately specified for each turret that may be installed. These parameters are specified on the **Gratings** tab page (Figure 26) of the Define Spectrograph dialog box. *In the case of automated Acton spectrographs, the grating information is automatically supplied .*

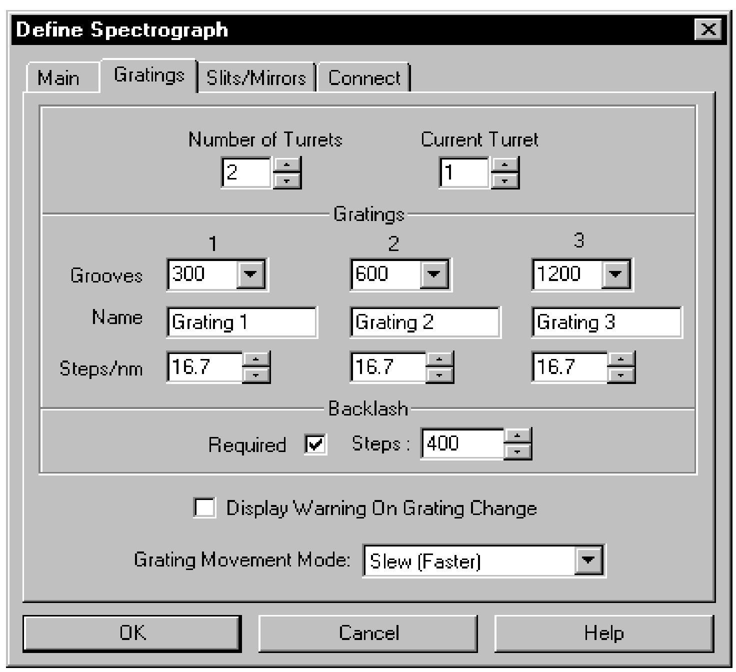


Figure 26. Gratings tab page
Setting the grating parameters

1. If there are two or more turrets, enter the number of the turrets.

2. Then from the **Current Turret** field, select the turret whose grating parameters will be defined.

3. If entries are missing or incorrect, select the correct grooves/mm value for each grating. Make sure that the gratings are listed in the proper order, Grating 1 listed first, etc.

4. You can also enter a Name for each grating. This option is required if you are using two gratings with the same groove density. If, for example, you have two gratings with 300 grooves/mm, one blazed at 300 and one blazed at 500, you could enter BLZ300 and BLZ500 in the Name boxes as identifiers. *These are the Acton default names.* Then, when you subsequently go to the Move Spectrograph dialog box to select the active grating, they would then be listed as 300/BLZ300 and 300/BLZ500 and there would be no possibility of confusing them.

5. If significant backlash occurs when moving the selected grating, check in the **Required** box and then enter the number of steps required to correct for the backlash.

6. If your spectrograph has more than one turret, replace the turret, change the Current Turret value and enter the new grating information. WinSpec/32 will store and recall the different sets of grating information for each turret.

7. Note that there is a check box for displaying a warning during a grating change. Since the time to change a grating can vary widely, depending on the spectrograph, this message could be very helpful.

8. If two rates are available for your spectrograph, you can also choose the rate, either faster (slew) or slower (scan). The actual rate will depend on the spectrograph. Depending on the spectrograph manufacturer and model, there may be a difference in wavelength setting accuracy for the two speeds.

Selecting and Moving the Grating

Once the required groove and turret information has been entered on the **Define Spectrograph Gratings** tab page, the next step is to select and move the grating. These operations are performed using the Gratings tab page (Figure 27) of the Move Spectrograph dialog box. The procedure follows.

1. Open the **Move Spectrograph** dialog box by selecting **Move** from the Spectrograph menu.

2. On the **Gratings** tab page, verify that the indicated active spectrograph is the correct one.

3. Select the grating to be moved. The available gratings were previously entered on the Define Spectrograph Gratings tab page.

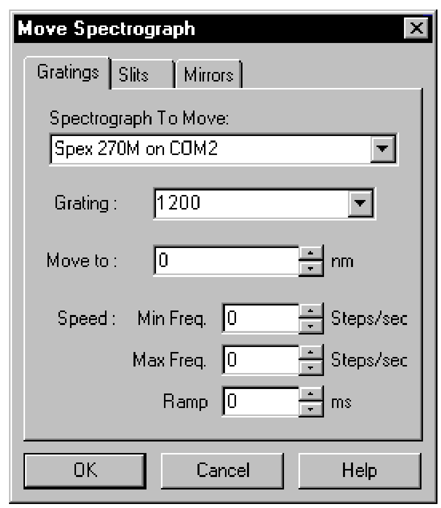


Figure 27. Move Spectrograph Gratings tab page

4. Enter the new position (in nm) in the **Move to** field.

5. Enter any speed settings and click on **OK** to execute the selections. The grating will come to rest with the selected wavelength at the center of the CCD array.

Note: There may well be some finite error in the final position. This error can be measured and compensated for using the Spectrograph Calibrate procedure.

Entering Information for Software-Controlled Slits and/or Mirrors

Some spectrometers allow you to control the slit width and/or do mirror selection under software control. Where this is the case, the Slits/Mirrors tab page (Figure 28) in the Define Spectrograph dialog box is used to specify the controllable slits and selectable mirrors. Actually setting the slit width and specifying which mirror to move is accomplished via additional tab pages provided in the Move Spectrograph dialog box as shown in Figure 29. Once the selections are made, simply press **OK** to execute them.

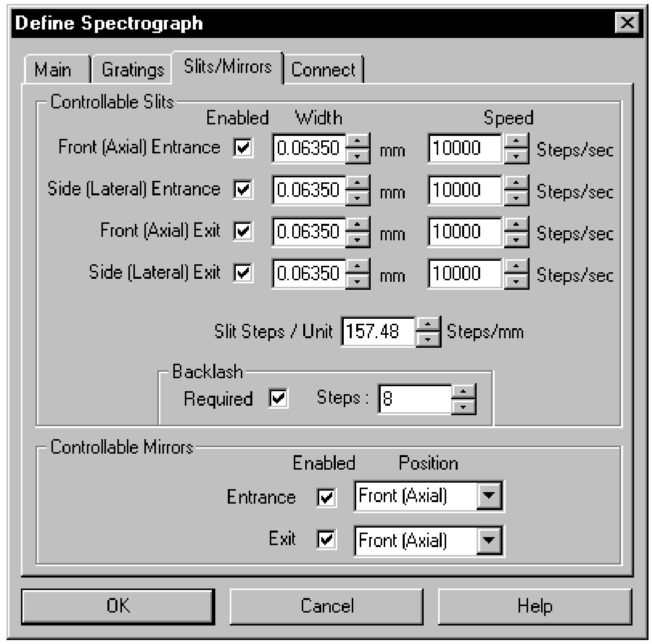


Figure 28. Define Spectrograph Slits/Mirrors tab page

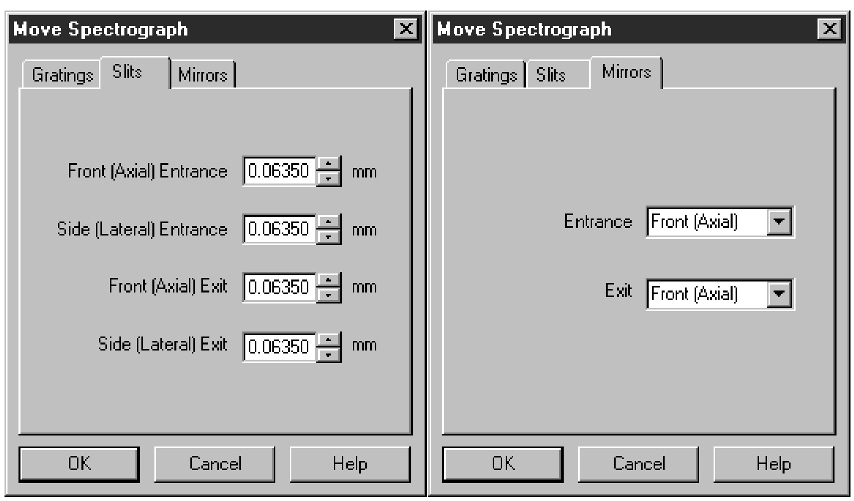


Figure 29. Slit width and Mirror selection tab pages - Move Spectrograph dialog box

Entering Laser Excitation Information

If you want to be warned if the laser will shine directly on the CCD, you need to enter the Laser Wavelength. This is done via the Main tab page in the Define Spectrograph dialog box as shown in Figure 30. The **Warn When Crossing Laser Line** selection tells WinSpec/32 to display a message whenever the grating is moved to where the laser light would be visible to the detector. This is critical for detectors that could be damaged if exposed to high light levels. Also, it will be necessary to enter the laser wavelength if you plan to work with units of relative wavenumbers.

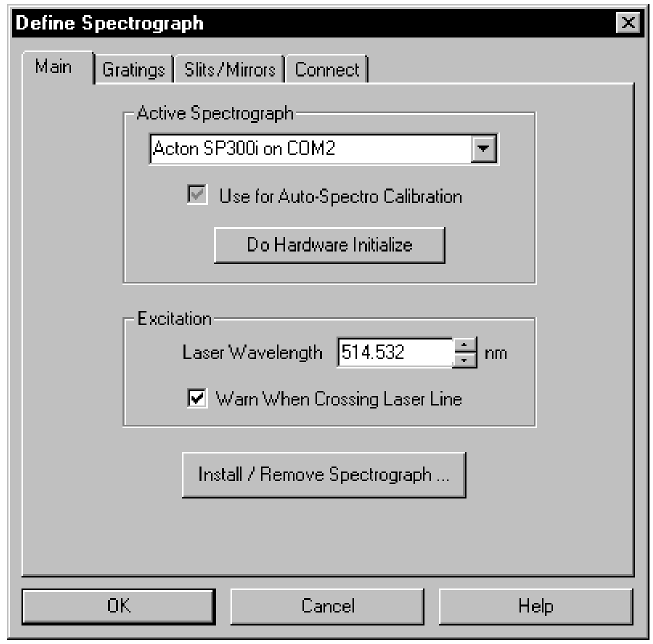


Figure 30. Entering the Laser Line Define Spectrograph Main tab page

- To allow WinSpec/32 to display in units of relative wavenumbers, enter a Laser Wavelength in nanometers, to as many significant digits as desired.
- If you have a bright laser line, check the **Warn when Crossing Laser Line** box and enter the Laser Wavelength in nm. WinSpec/32 will display a warning message whenever the wavelength range viewable by the detector might fall on or pass through the laser line.

WARNING

The **Warn When Crossing Laser Line** is no guarantee that the detector will not be damaged by overexposure. The correct display of the warning depends on all calibration parameters being set correctly. ***Changing or moving gratings*** may cause the laser to shine on the detector. Always block the source when moving or changing the grating to avoid damage.

Chapter 3

Initial Spectroscopic Data Collection

Introduction

The procedure in this chapter will enable you to begin collecting real data promptly. Minimum requirements are assumed. If your system is more complex, e.g., requiring consideration of complex timing and synchronization issues, you will have to carefully study the other chapters of this manual as well as the manuals provided for the system hardware components before data acquisition that addresses those needs will be possible. Nevertheless, it is a good idea to begin with the simplest possible operating mode. This approach will give you operating experience and familiarity that will prove very valuable when you go to make more complex measurements. For additional information about the various menus and dialog boxes, refer to the online Help topics. Note that controllers and cameras ordinarily used for imaging are not discussed in this chapter, but rather in the next chapter, *Initial Imaging Data Collection.*

Underlying assumptions for the following procedure are that the hardware installation, including mounting the camera to the spectrograph, has been completed. A further assumption is that the hardware and spectrograph setups as discussed in Chapter 2 have been completed. The last assumption is that a suitable spectrographic source is available. The mercury lines produced by ordinary fluorescent lights can be used. However, it will be better to begin with a low-pressure gas-discharge lamp such as neon, mercury, or mercury-argon, if one is available.

There are two data collection modes, ***Focus*** and ***Acquire***:

- In ***Focus*** mode operation, no frames of data are stored until **Start Storage** is selected. This mode is particularly convenient for familiarization and setting up. For ease in focusing, the screen refresh rate should be as rapid as possible, achieved by operating with axes and cross-sections off.
- In ***Acquire*** mode, every frame of data collected is stored. This mode would ordinarily be selected during actual data collection. One limitation of Acquire mode operation is that if data acquisition continues at too fast a rate for it to be stored, data overflow will eventually occur. This could only happen in Synchronous (Full Speed) operation.

The following data collection procedures are done in the ***Focus*** mode.

WARNING

If using an intensified camera, note that data collection in the following procedure will be done in the **Shutter(CW)** mode, in which the camera can be damaged if exposed to light overload. Before powering the controller and camera, reduce the room light to reduce the risk of damage. Note that intensifiers are particularly at risk in pulsed laser operation, where overload spot damage can occur without raising the average current to where the overload detection circuits will be activated. It is far better to be careful than sorry. *Before proceeding, take the time to carefully read the manual for your intensified camera.*

Also, take particular care that your intensified camera is connected properly for shutter-mode operation. Cabling and peripheral considerations for intensified cameras are more complex than for unintensified cameras. *Again, read your camera manual.*

Temperature Control

Before continuing, the array temperature should be set to some easily achieved value in the operating range and Temperature lock should be established. The way this is done depends on the controller.

Temperature Control for a system using an ST-133 or a MicroMAX

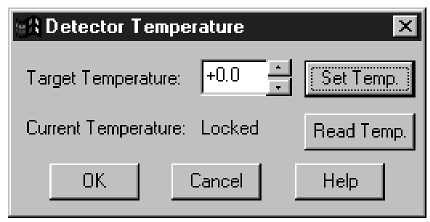


Figure 31. Temperature dialog box

1. Open the WinSpec/32 Setup menu and click on **Detector Temperature**. This will cause the Temperature dialog box to appear as shown in Figure 31.
2. Set the **Target Temperature** to the desired value (0° suggested for initial data acquisition).
3. Click on the **Set Temp.** button. When the **Current Temperature: Unlocked** message changes to **Current Temperature: Locked**, temperature lock will have been established.

Note: Both the MicroMAX and the ST-133 additionally have a **Temp Lock** LED on the Analog/Control module (at the rear of the controller) that visually indicates when temperature lock occurs.

Temperature Control for Other Systems

ST-121, ST-130 or ST-138 Controller: Change the dial setting on the front panel of the Controller.

PentaMax: Set the temperature on the front panel of the Temperature/Power Supply unit.

MicroView: Not user-settable. Temperature is solely under software control.

Cleans and Skips

With some controllers, specifically the PentaMAX, ST-130, ST-133 and ST-138, there is a Cleans/Skips tab page in the Hardware Setup dialog box. Cleans are used to reduce charge buildup on the CCD array while waiting to begin data acquisition. Skips are used when the Region of Interest (ROI) is smaller than the full chip; they allow binning and quick traversing of the rows that precede and follow the ROI. For the procedures that follow, load the default values for these parameters by bringing the **Cleans/Skips** tab page to the front, and then clicking on **Load Defaults** followed by **Yes**.

Exception: With a PI-MAX camera, Cleans should be set to 1 and Strips per Clean to 4.

Spectrograph

Before a spectrum can be acquired, it is necessary that the spectrograph be powered and properly installed as described in Chapter 2. It is not necessary to *calibrate* the spectrograph. The default settings will be close enough for initial familiarization purposes. However, it will be necessary to ***install*** the spectrograph. This is the procedure whereby the WinSpec/32 software is informed of the spectrograph model, communications port, selected gratings, slit-width and mirror selections if applicable. It is also necessary to establish successful communications between the host computer and the spectrograph. These considerations are all discussed in Chapter 2. Additional information for the individual spectrometer setup and dialog boxes is provided in the online Help.

Experiment Setup Procedure

1. Open the Experiment Setup dialog box (Figure 32) from the Acquisition menu.

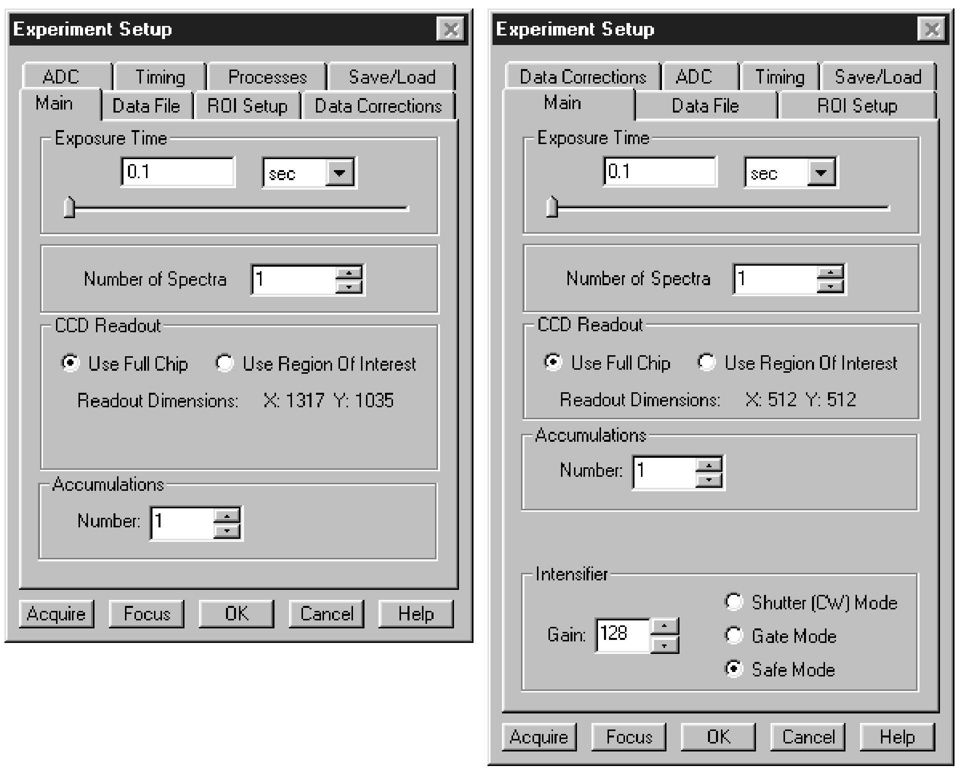


Figure 32. Experiment Setup dialog box Main tab page; left, all but PI-MAX; right, PI-MAX

2. On the **Main** tab page, set the following parameters.

   Exposure time: 0.1 seconds ***(For PI-MAX system using PTG, enter 0 sec)***
   Number of Spectra: 1
   Use Full Chip: selected

Accumulations: 1
Gain (PI-MAX only): 128
Preamplifier Node (PI-MAX with Thsomson 512 only): High Speed
Camera State (PI-MAX only): Safe (the photocathode is biased OFF)

WARNING

Intensified Cameras: If working with an intensified camera, the room light should be subdued so as to allow *safe* **Shutter (CW)** mode operation of the camera. *Intensified cameras are quite susceptible to damage from light overload in Shutter (CW) mode operation and particularly subject to damage from light overload in Gated mode operation with high-intensity pulsed light sources. See your camera or system manual for detailed information.*

Also, take particular care that your intensified camera is connected properly for Shutter (CW) mode operation. Cabling and peripheral considerations for intensified cameras are more complex than for unintensified cameras. *Again, read your camera or system manual.*

3. On the **Timing** tab page (Figure 33) set the following parameters.

Note: Not all of these parameters are provided for every controller model. Ignore parameters that don't apply to your system.

Timing Mode: Free Run ***(For PI-MAX system: Ext.Sync. for DG535; Int.Sync. for PTG)***
Triggered Mode: not checked
Continuous Cleans: not checked. ***(For PI-MAX system: checked for DG535; unchecked for PTG)***
Shutter Control: Normal. ***(for PI-MAX system: Disabled Opened for PTG)***
Pre Open: Not checked. ***(For PI-MAX system: check Pre Open for DG535 or PTG)***
Safe Mode: selected
External Trigger: not checked
Edge Trigger: + edge
Delay time: 0
Use Interrupt: not checked

Note: Not all of these parameters are provided for every controller model. Ignore parameters that don't apply to your system.

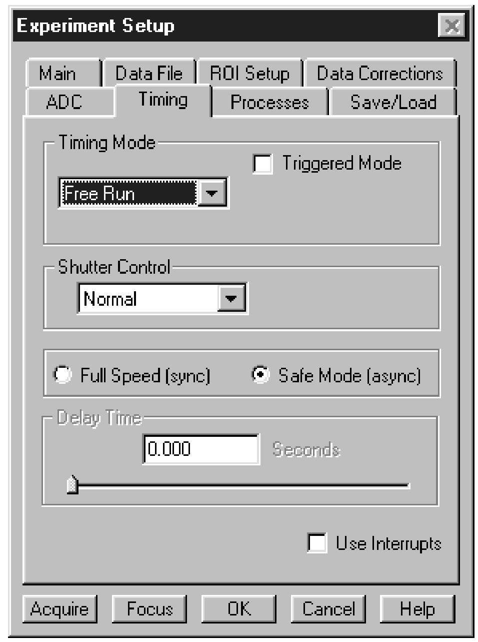


Figure 33. Experiment Setup dialog box Timing tab page

4. On the **Data Corrections** tab page (Figure 34) all of the correction functions should be OFF.

5. On the **ADC** tab page (Figure 35), set the parameters as they apply to your particular system. Parameters that might be listed, depending on the controller type, include:

   Rate: ADC converter rate. Only those rates available for your A/D controller will be displayed, making it necessary to designate the A/D type first. Select the maximum speed allowed by the converter. If the camera is a PI-MAX with a Thomson 512 CCD, select FAST. ST-130 owners must confirm that the internal hardware jumpers of their controller are properly set for the desired speed. *See the ST-130 manual for details.*

   Type: For systems having more than one A/D converter, both FAST and SLOW will be available. Make this selection before selecting the rate or resolution.

   Controller Gain (PentaMAX only): Set to Gain 3

   Resolution: Number of bits. Choices limited by A/D type selection.

   Bit Adjust (ST-138 only): Set to No Clip

   ADC Offset (5MHz MicroMAX only): Use the default setting.

   Analog Gain (ST-133): Medium 2x.

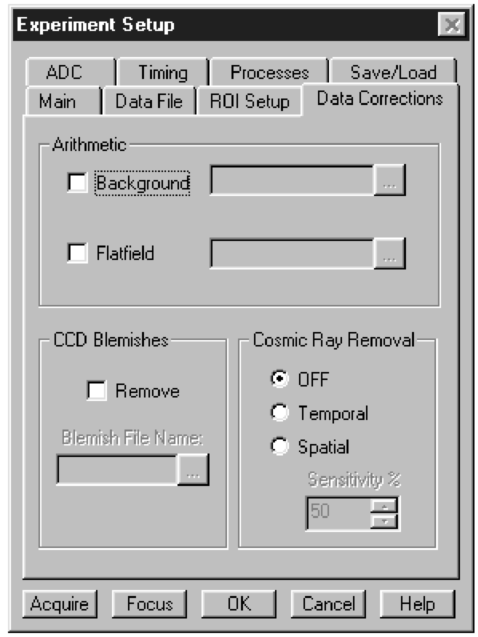


Figure 34. Data Corrections tab page

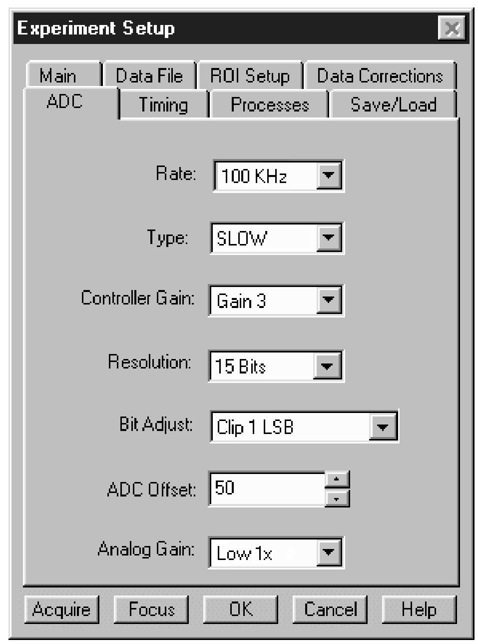


Figure 35. Generic ADC tab page

Note: Not all of these parameters are provided for every controller model. Ignore parameters that don't apply to your system.

6. On the **ROI** tab page select **Spectroscopy Mode** as shown in Figure 36. The **Use Full Chip** selection on the **Main** tab page overrides any ROI settings that may be present.

   Note: The choice of Spectroscopy or Imaging is only provided if the WinSpec/32 Imaging option has been installed. If this choice isn't present, the default state is Spectroscopy.

7. No **Processes** tab page functions should be selected.

8. On the **Data File** tab page, make the following selections.

   Auto Increment File Name Enable: should be OFF.

   Overwrite/Append Existing Files: Select Overwrite (data file will overwrite an existing file having the same name).

   Overwrite Confirmation: Check this box so that you will be warned that the specified file name is already in use. If not checked, the old data file will be overwritten by the new one. No warning is provided.

   Data Type AutoSelect: Should be selected.

   Auto-save and prompts: Select **Don't auto-save or ask to save**. With this selection, you won't receive a prompt when a file is closed as a result of starting a data collection A prompt will still be issued if you close the file explicitly and it has not been saved since being collected.

   Use a New Window for each run: Leave unchecked.

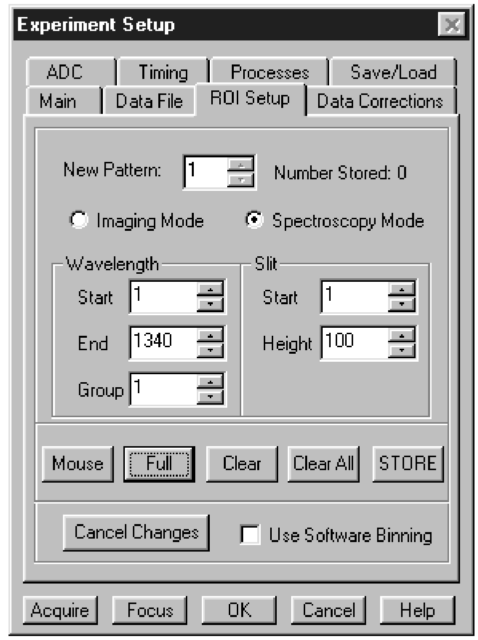


Figure 36. ROI dialog box

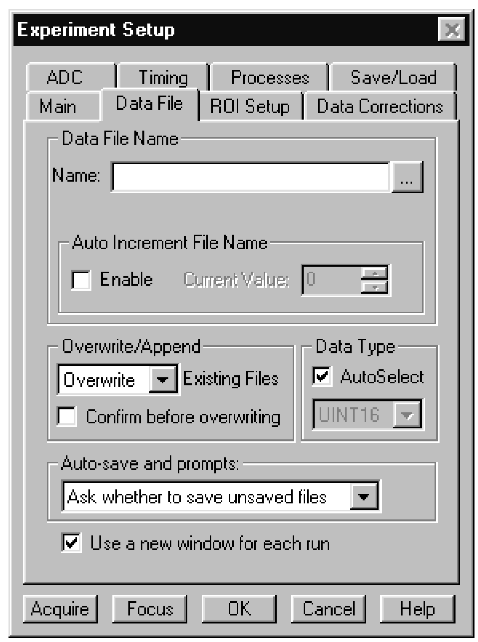


Figure 37. Data File dialog box

9. Click on the button to the right of the **Name** field. This will open a browse box. Select the directory where you want the stored file to go. In the example illustrated, the file name is TESTFILE1 and it will be stored in a directory named Data. *If the filename doesn't automatically appear in the browse box, type it in.* The file type should be WinX Data (*.spe).

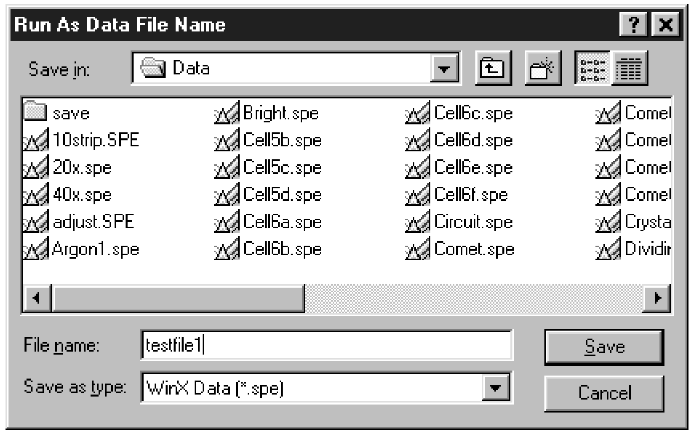


Figure 38. File Browse dialog box

10. Click on the **Save** button to save the entered information and return to the Experiment Setup dialog box.

11. Click on **OK**. This will close the Experiment Setup dialog box.

Data Collection

The following data collection procedure works for all controllers. An underlying assumption is that a suitable light source is available. Although fluorescent room lighting may be adequate, it will probably prove more instructive to use a standard lamp, such as a mercury-argon lamp that provided the spectrum illustrated in Figure 40.

WARNING

> **Intensified Cameras:** If working with an intensified camera, the room light should be subdued. *Intensified cameras are quite susceptible to damage from light overload in Shutter (CW) mode operation and particularly subject to damage from light overload in gated operation with high-intensity pulsed light sources. See your camera manual for detailed information.*

Figure 39. Acquisition menu

1. If running a PI-MAX system, turn the room light down or off and switch the **Camera State** to **Shutter (CW)** mode on the Acquisition|Experiment Setup|Main tab page.

2. Select **Focus** from the **Acquisition** menu (Figure 39) to begin collecting data. An acquisition can also be started by clicking on the **Focus** button in the Experiment Setup dialog box or by clicking on the **Focus** button on the **Custom Toolbar**. Data will be continuously acquired and displayed.

3. While observing the displayed data, adjust the system optics for the best possible spectrum (lines as high and narrow as possible). Figure 40 shows a typical mercury-argon spectrum. Your results could appear different depending on the spectrograph grating used.

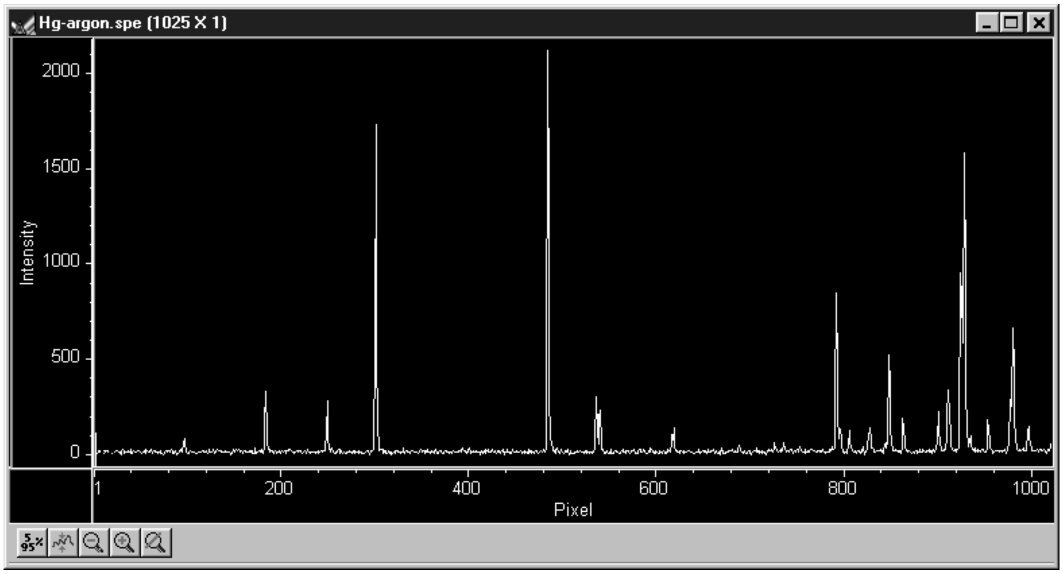


Figure 40. Typical Mercury-Argon Spectrum

4. To store the most recent data set, select **Start Storage** from the Acquisition menu or click on the **Start Store** button on the **Custom Toolbar**. Data acquisition will halt and the most recent image will be stored in a file having the name specified on the Data File tab page.

5. For a PI-MAX system, switch the **Camera State** back to **Safe** mode on the Acquisition|Experiment Setup|Main tab page.

This completes the initial spectroscopy data acquisition routine that should work with any Princeton Instruments brand Controller.

Chapter 4

Initial Imaging Data Collection

Introduction

ATTENTION Imaging is only possible if the WinSpec/32 software you are using has the Imaging Option installed.

The procedure in this chapter will enable you to begin collecting real image data promptly. Minimum requirements are assumed. If your system is more complex, e.g., requiring consideration of complex timing and synchronization issues, you will have to carefully study the other chapters of this manual as well as the manuals provided for the system hardware components before data acquisition that addresses those needs will be possible. Nevertheless, it is a good idea to begin with the simplest possible operating mode. This approach will give you operating experience and familiarity that will prove very valuable when you go to make more complex measurements. For additional information about the various menus and dialog boxes, refer to the online Help topics.

Underlying assumptions for the following procedure are that the hardware has been installed per the instructions in the hardware manual(s) and that the hardware setup as discussed in Chapter 2 has been completed. A further assumption is that a good imaging subject is available. Often, a picture or optical target mounted on a wall or lab bench will give good results. If initial data collection is to be done using a microscope, be sure to read the chapter on microscopy in your controller manual before attempting data collection.

There are two data collection modes, ***Focus*** and ***Acquire***:

- In ***Focus*** mode operation, no frames of data are stored until **Start Storage** is selected. This mode is particularly convenient for familiarization and setting up. For ease in focusing, the screen refresh rate should be as rapid as possible, achieved by operating with axes and cross-sections off, and with Zoom 1:1 selected.
- In ***Acquire*** mode, every frame of data collected is stored. This mode would ordinarily be selected during actual data collection. One limitation of Acquire mode operation is that if data acquisition continues at too fast a rate for it to be stored, data overflow will eventually occur. This could only happen in Synchronous (Full Speed) operation.

The following data collection procedures are done in the ***Focus*** mode.

WARNING

If using an intensified camera, note that data collection in the following procedure will be done in the **Shutter(CW)** mode, in which the camera can be damaged if exposed to light overload. Before powering the controller and camera, reduce the room light to reduce the risk of damage. Note that intensifiers are particularly at risk in pulsed laser operation, where overload spot damage can occur without raising the average current to where the overload detection circuits will be activated. It is far better to be careful than sorry. *Before proceeding, take the time to carefully read the manual for your intensified camera.*

Also, take particular care that your intensified camera is connected properly for shutter-mode operation. Cabling and peripheral considerations for intensified cameras are more complex than for unintensified cameras. *Again, read your camera manual.*

Temperature Control

Before continuing, the array temperature should be set to some easily achieved value in the operating range and Temperature lock should be established. The way this is done depends on the controller.

Temperature Control for a system using an ST-133 or a MicroMAX

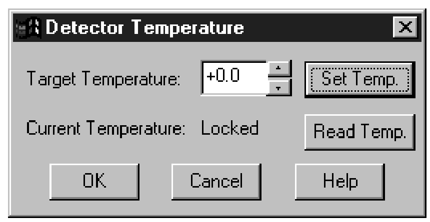


Figure 41. Temperature dialog box

1. Open the WinSpec/32 Setup menu and click on **Detector Temperature**. This will cause the Temperature dialog box to appear as shown in Figure 31.
2. Set the **Target Temperature** to the desired value (0° suggested for initial data acquisition).
3. Click on the **Set Temp.** button. When the **Current Temperature: Unlocked** message changes to **Current Temperature: Locked**, temperature lock will have been established.

Note: Both the MicroMAX and the ST-133 additionally have a **Temp Lock** LED on the panel of the Analog/Control module that visually indicates when temperature lock occurs.

Temperature Control for Other Systems

ST-121, ST-130 or ST-138 Controller: Change the dial setting on the front panel of the Controller.

PentaMax: Set the temperature on the front panel of the Temperature/Power Supply unit.

MicroView: Not user-settable. Temperature is solely under software control.

Cleans and Skips

With some controllers, specifically the PentaMAX, ST-130, ST-133 and ST-138, there is a Cleans/Skips tab page in the Hardware Setup dialog box. Cleans are used to reduce charge buildup on the CCD array while waiting to begin data acquisition. Skips are used when the Region of Interest (ROI) is smaller than the full chip; they allow binning and quick traversing of the rows that precede and follow the ROI. For the procedures that follow, load the default values for these parameters by bringing the **Cleans/Skips** tab page to the front, and then clicking on **Load Defaults** followed by **Yes**.

Exception: With a PI-MAX camera, Cleans should be set to 1 and Strips per Clean to 4.

Experiment Setup Procedure (all controllers)

1. Open the Experiment Setup dialog box (Figure 42) from the Acquisition menu.

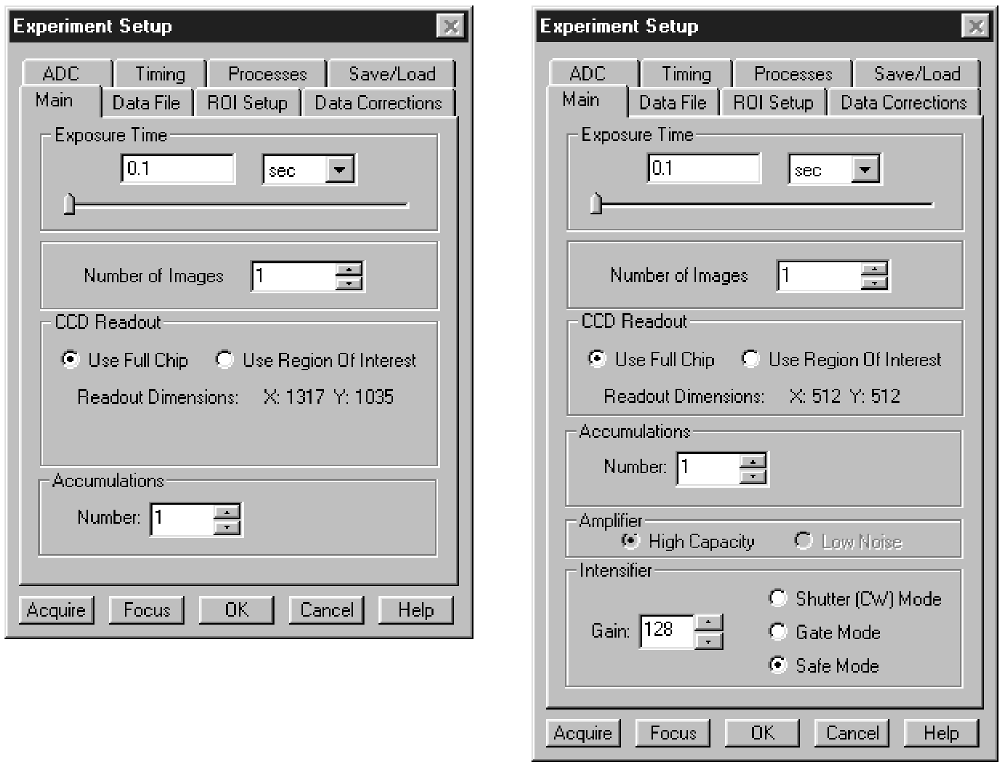


Figure 42. Experiment Setup: Main tab page; left, all but PI-MAX; right, PI-MAX

2. On the **Main** tab page, set the following parameters.

   Exposure time: 0.1 seconds. ***(For PI-MAX system using PTG, enter 0 sec)***

   Number of Spectra/Images: 1

   Use Full Chip: selected

   Accumulations: 1

   Gain (PI-MAX only): 128
   Preamplifier Node (PI-MAX with Thomson 512 only): High Capacity. *This is a reported parameter value. To set it, select FAST on the A/D tab page.*

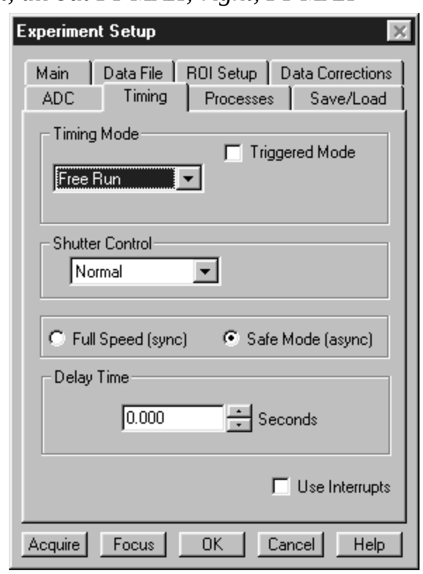


Figure 43. Experiment Setup: Timing tab page

Camera State (PI-MAX only): Safe (the photocathode is biased OFF)

WARNING

Intensified Cameras: If working with an intensified camera, the room light should be subdued so as to allow *safe* **Shutter (CW)** mode operation of the camera. *Intensified cameras are quite susceptible to damage from light overload in Shutter (CW) mode operation and particularly subject to damage from light overload in Gated mode operation with high-intensity pulsed light sources. See your camera manual for detailed information.*

Also, take particular care that your intensified camera is connected properly for Shutter (CW) mode operation. Cabling and peripheral considerations for intensified cameras are more complex than for unintensified cameras. *Again, read your camera manual.*

3. On the **Timing** tab page (Figure 43) set the following parameters.

Note: Not all of these parameters are provided for every controller model. Ignore parameters that don't apply to your system.

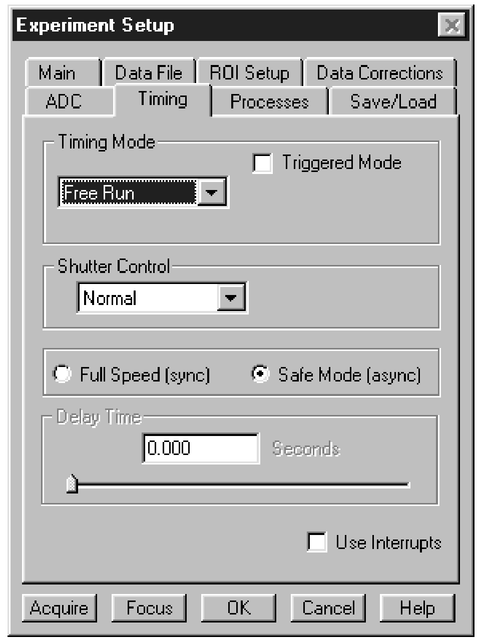


Figure 44. Timing tab page

Timing Mode: Free Run ***(For PI-MAX system: Ext.Sync for DG535; Int.Sync. for PTG)***
Triggered Mode: not checked
Continuous Cleans: not checked ***(For PI-MAX system: checked for DG535; unchecked for PTG)***
Shutter Control: Normal. ***(For PI-MAX system: Disabled Open for PTG)***
Internal Sync (PI-MAX with PTG only): selected
Pre Open: Not checked. ***(For PI-MAX system: checked for DG535 or PTG)***

Safe Mode (async): selected
External Trigger: not checked
Edge Trigger: + edge
Delay time: 0
Use Interrupts: not checked

4. On the **Data Corrections** tab page (Figure 45) all of the correction functions should be OFF.

5. On the **ADC** tab page (Figure 46), set the parameters as they apply to your particular system. Parameters that might be listed follow:

Rate: ADC converter rate. Only those rates available for your A/D controller will be displayed, making it necessary to designate the A/D type first. Select the maximum speed allowed by the converter. If the camera is a PI-MAX with a Thomson 512 CCD, select FAST. ST-130 owners must confirm that the internal hardware jumpers of their controller are properly set for the desired speed. *See the ST-130 manual for details.*

Type: For systems having more than one A/D converter, both FAST and SLOW will be available. Make this selection before selecting the rate or resolution.

Controller Gain (PentaMAX only): Set to Gain 3

Resolution: Number of bits. Choices limited by A/D type selection.

Bit Adjust (ST-138 only): Set to No Clip

ADC Offset (5MHz MicroMAX only): Use the default setting.

Analog Gain (ST-133): Medium 2x.

> **Note:** Not all of these parameters are provided for every controller model. Ignore parameters that don't apply to your system.

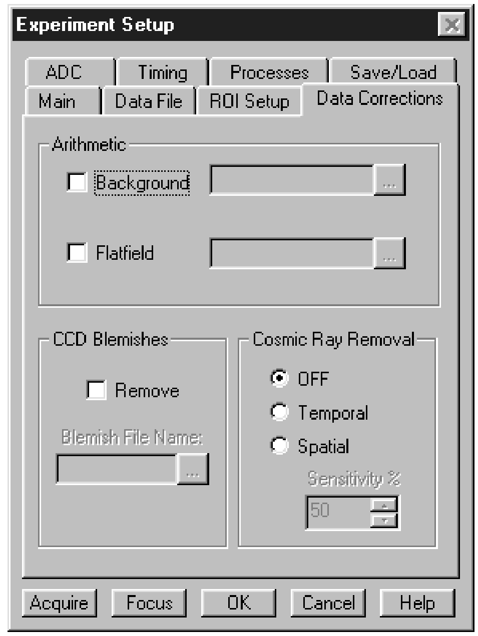


Figure 45. Data Corrections tab page

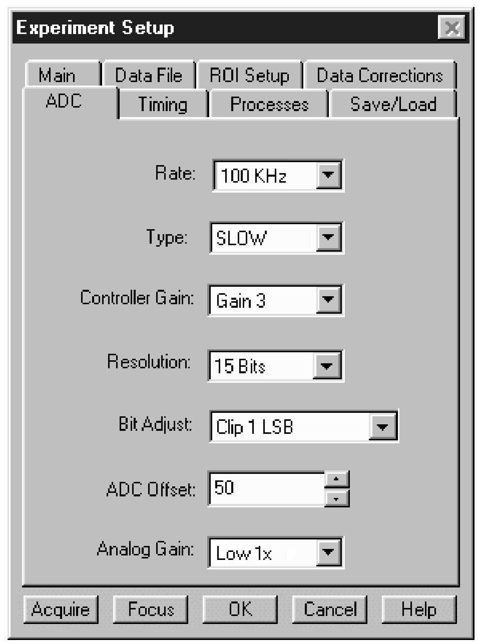


Figure 46. Generic ADC tab page

6. On the **ROI** tab page (Figure 47), select Imaging Mode. WinSpec/32 operated in Imaging Mode always uses the full chip area and ROI considerations do not apply.
7. No **Processes** tab page functions should be selected.
8. On the **Data File tab page**, make the following selections.

   Auto Increment File Name Enable: should be OFF.

   Overwrite/Append Existing Files: Select Overwrite (data file will overwrite an existing file having the same name).

   Overwrite Confirmation: Check this box so that you will be warned that the specified file name is already in use. If not checked, the old data file will be overwritten by the new one. No warning is provided.

   Data Type AutoSelect: Should be selected.

   Auto-save and prompts: Select **Don't auto-save or ask to save**. With this selection, you won't receive a prompt when a file is closed as a result of starting a data collection A prompt will still be issued if you close the file explicitly and it has not been saved since being collected.

   Use a New Window for each run: Leave unchecked.

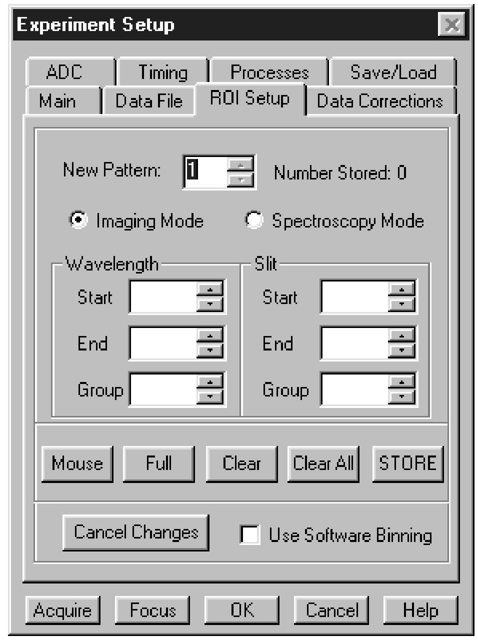


Figure 47. ROI tab page - imaging selected

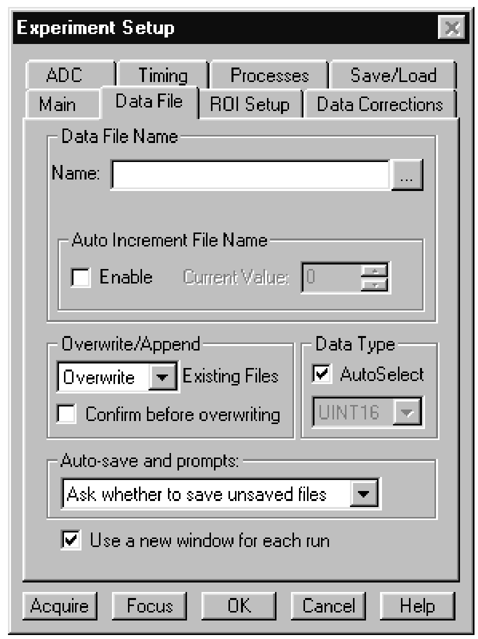


Figure 48. Data File dialog box

9. Click on the button to the right of the **Name** field. This will open a browse box. Select the directory where you want the stored file to go. In the example illustrated, the file name is TESTFILE1 and it will be stored in a directory named Data. *If the file name doesn't automatically appear in the browse box, type it in.* The file type should be WinX Data (*.spe).

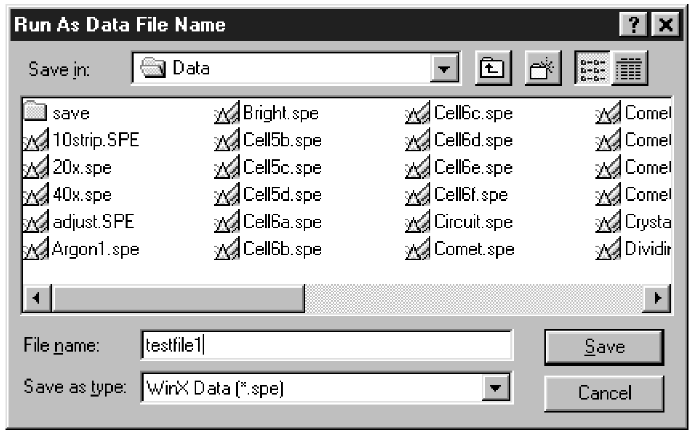


Figure 49. File Browse dialog box

10. Click on the **Save** button to save the entered information and return to the Experiment Setup dialog box.

11. Click on **OK**. This will close the **Experiment Setup dialog box**.

12. Once again, click on **Acquisition** in the Menu bar. Again, the Acquisition menu will appear as shown in Figure 39.

Figure 50. Acquisition menu

Data Collection Procedures (controller specific)

MicroMAX or ST-133

The procedure that follows for these controllers is in two parts, **Video Focusing** and **Data Collection**. In focusing, images are displayed on the video monitor (not the computer monitor) and no data is collected. This allows rapid and easy adjustment of the system optics. Once the settings have been optimized, data collection begun can begin.

Focusing

This procedure applies for a MicroMAX or ST-133 system that includes a video monitor connected to the Video port (BNC connector) on the controller. If your system doesn't include a video monitor, go to the **Data Collection - All Controllers** section, which begins on page 68.

1. Select **Video** from the Acquisition menu. This will allow live data to be displayed on your video monitor.

2. Select **Video Focus** from the Acquisition Menu. The **Interactive Camera** dialog box (Figure 51) will open.

3. Click on the **RUN** button in the Interactive Camera dialog box. The camera will begin acquiring pictures at the fastest possible rate will and the image will be displayed on the video monitor. *Note that the image will not be displayed on the computer monitor while the Interactive Camera dialog box is open.*

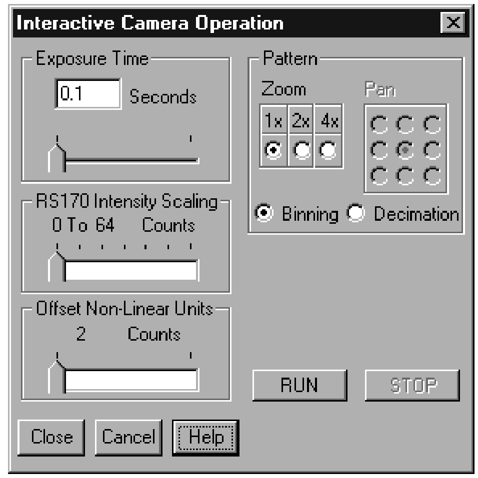


Figure 51. MicroMAX or ST-133 Interactive Camera dialog box

4. Focus the system optics and set the Interactive Camera dialog box **Exposure Time**, **RS170 Scaling** and **Offset** adjustments for the best viewed image. In addition to the Exposure Time, Intensity Scaling and Offset parameters, the Pattern parameters determine *which* CCD pixels will be displayed on the video monitor. *Note that, in Focus mode, the images will not appear at the computer but only at the video monitor.* If the number of pixels on the CCD is very much larger than the number of video pixels, you can use the Pan function to select any one of nine different subsets to display. The Zoom function gives additional control. One-to-one mapping from the selected region to the screen occurs with 2× selected. You may additionally have the option of selecting Binning, in which a wider view is achieved by combining adjacent pixels, or Decimation, in which pixels are discarded according to an algorithm.

   The exposure time will be the same as that set via the Experiment Setup **Main** tab page. *The two exposure settings track. Changing it at either location should update the other setting automatically.* The Intensity Scaling, together with the Offset, determines how the image data is mapped to the 256 gray-scale levels. Begin with the Intensity Scaling set to “1 to 4096” (slider all the way to the right). Similarly, the Offset setting should initially be set to 2 (slider all the way to left).

5. When no further improvement in the observed image can be obtained, click on **Stop** in the Interactive Camera Operation dialog box to halt focus-mode operation.

6. Click on **Close** to close the Interactive Camera Operation dialog box and return to the Experiment Setup dialog box.

Data Collection

1. Click on **Focus** to begin collecting data. An acquisition can also be started by clicking on **Focus** on the Acquisition Menu or by clicking on the **Focus** button on the **Custom Toolbar**. Images will be continuously acquired and displayed on the computer screen and on the video monitor.

2. To store the most recent image, select **Start Storage** from the Acquisition menu or click on the **Start Store** button on the **Custom Toolbar**. Data acquisition will halt and the most recent image will be stored in a file having the name specified on the **Data File** tab page.

This completes initial data acquisition with a MicroMAX or an ST-133 Controller.

PentaMAX

The procedure that follows for the PentaMAX Controller is in two parts, **Focusing** and **Data Collection**. In focusing, images are displayed on the video monitor and no data is collected. This allows rapid and easy adjustment of the system optics. Once the settings have been optimized, focus mode operation should be ended and data collection performed.

Focusing

This procedure applies for a PentaMAX system that includes a video monitor connected to the Video port (BNC) of the PentaMAX. If your system doesn't include a video monitor, go to the **Data Collection - All Controllers** section, which begins on page 68.

1. Select **Video** from the Acquisition menu. This will allow live data to be displayed on your video monitor.

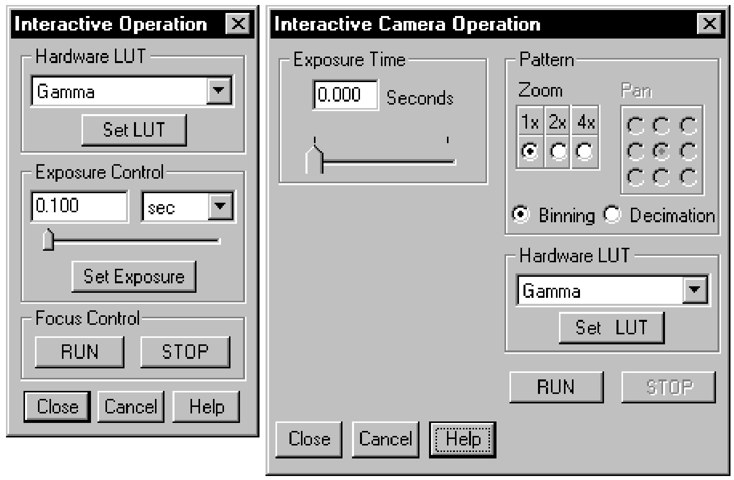


Figure 52. PentaMAX Interactive Operation dialog box

2. Select **Video Focus** from the Acquisition Menu. The Interactive Operation dialog box that will be displayed depends on the PentaMAX version. Version 5 and higher will display the righthand dialog box shown in Figure 52. Earlier versions, will display the lefthand dialog box.

3. Note the **Hardware LUT** field. This selection sets the scaling of the video display only. Unless the signal is very weak, the best LUT choice will be Gamma.

4. Click on the **RUN** button in the Interactive Operation dialog box. Data acquisition at the fastest possible rate will commence immediately and the image will be displayed on the video monitor. *Note that the image will not be displayed on the computer monitor while the Interactive Operation dialog box is open.*

5. Focus the system optics and, if necessary, adjust the **Exposure Time** in the Interactive Camera dialog box for the best viewed image. The exposure time will be the same as that set via the Experiment Setup **Main** tab page. *The two exposure settings track. Changing it at either location should update the other setting automatically.*

6. When no further improvement in the observed image can be obtained, click on **Stop** in the Interactive Operation dialog box to halt focus mode operation.

7. Click on **Close** to close the Interactive Operation dialog box and return to the Experiment Setup dialog box.

Data Collection

1. Click on **Focus** to begin collecting data. Data collection can be initiated by means of the **Focus** button in the Experiment Setup dialog box, by selecting **Focus** from the Acquisition Menu, or by clicking on the **Focus** button of the **Custom Toolbar**. Images will be continuously acquired and displayed on the computer screen.
2. To store the most recent image, click **Start Storage** on the Acquisition menu or click on the **Start Store** button on the **Custom Toolbar**. Data acquisition will halt and the most recent image will be stored in a file having the name specified on the **Data File** tab page.
3. If you want to initiate data acquisition, select **Focus** again. To store the new data to disk, again click **Start Storage** on the Acquisition menu or click on the **Start Store** button.

This completes initial data acquisition with a PentaMAX Controller.

Data Collection - All Controllers

The following data collection procedure works for all controllers. However, it doesn't exercise some of the special features, such as video monitor support, available on certain controller models.

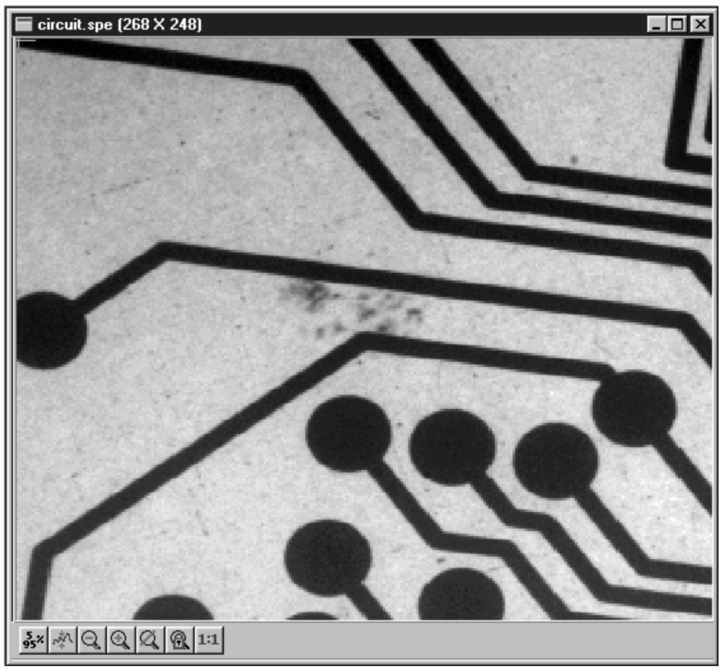


Figure 53. Typical Data Acquisition Image

1. Click on **Focus** to begin collecting data. Data collection can be initiated by means of the **Focus** button in the Experiment Setup dialog box, by clicking on **Focus** on the Acquisition Menu, or by clicking on the **Focus** button of the **Custom Toolbar**. Images will be continuously acquired and displayed.
2. Observe the displayed data and adjust the system optics for the best possible image. *It may be necessary to readjust the Exposure Time (Experiment Setup **Main** page).*
3. To store the most recent image, click **Start Storage** on the Acquisition menu or click on the **Start Store** button on the **Custom Toolbar**. Data acquisition will halt and the most recent image will be stored in a file having the name specified on the **Data File** tab page.

4. For a PI-MAX system, switch the **Camera State** back to **Safe** mode on the Acquisition|Experiment Setup|Main tab page.

This completes the initial data acquisition routine, which should work with any Princeton Instruments brand Controller.

This page intentionally left blank.

Chapter 5

Opening, Closing, and Saving Data Files

Introduction

This chapter discusses how to open, close, and save existing data files to disk. Options for saving and deleting files will be explained. Data files created with temporary file names should be saved to disk periodically. Files should be closed completely to conserve RAM for data collection.

Data files can be deleted directly from WinSpec/32, without using the File Manager or any other file utility.

Note: WinSpec/32 can read data files acquired with earlier versions of WinSpec. Versions of WinSpec prior to 1.6 cannot read WinSpec/32 data files. Neither can versions prior to 1.6 read data files that were collected with earlier versions and then opened, modified and saved using WinSpec/32. This should be considered carefully before modifying and ***saving*** old data files with WinSpec/32.

Opening Data Files

In WinSpec/32 files are opened according to Win 95 conventions, as follows.

1. Select **Open** from the File menu. The File Open dialog box will appear (Figure 54).

2. Open the directory containing the data files. Clicking on the button at the right of the Look In field opens a browser function, allowing you to quickly and easily access the correct folder. As shown in Figure 54, the data files will be listed below.

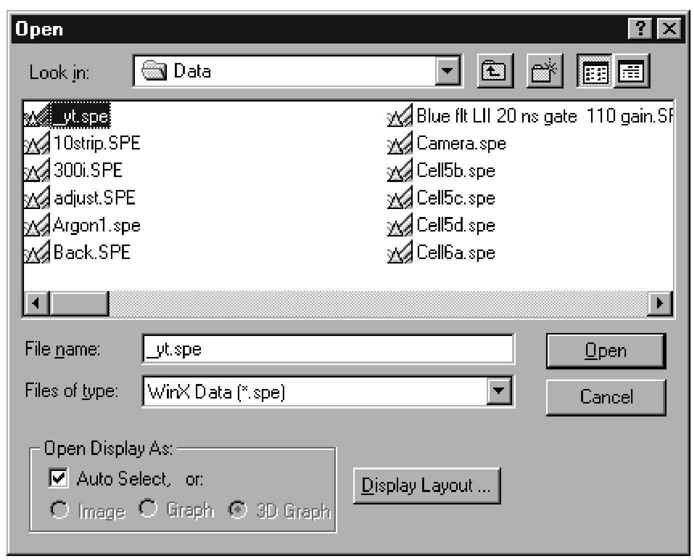


Figure 54. Open dialog box

3. If you want the software to control how the data will be displayed when the file is opened, check **Auto Select**. Leave **Auto Select** unchecked if you want to retain control over whether the data will be displayed as an **Image**, **Graph** or **3D Graph**.

Auto Select is the factory default selection.* In addition, one of the three radio buttons, **Image**, **Graph** or **3D Graph**, will be selected but grayed out if Auto Select is checked. If Auto Select is unchecked, the grayed out selection will become active and govern how the file is opened.

- When **Auto Select** is checked, the way the data is displayed depends on the number of data strips it contains.
  - ⇒ If there are eleven or more strips of data, they will be displayed as a normal image, such as that shown in Figure 98 *(page 113)*.
  - ⇒ If there are at least three data strips but less than eleven, the data will be plotted as a 3D Graph as shown in Figure 77 *(page 99)*.
  - ⇒ If there are only two strips of data, they will be displayed as graphs stacked in a two-dimensional plot, the same as for a 3D Graph of two strips. *See (page 98).*
  - ⇒ A single strip ***will always*** be plotted as a simple X vs. Y plot. Note that from two to ten strips, the intensity (Y axis) scale shifts position as required to read true for the selected strip.
- If **Image** is selected, all data points will be plotted as a function of the strip and pixel number.
- If **3D Graph** is selected, multiple data strips will be plotted as a function of intensity versus pixel number, the actual number of data strips plotted depending on the 3D Layout display parameter settings. All of the strips could come from the same frame, or, in the case of a file containing multiple frames, the same numbered strip could come from each frame.
- If **Graph** is selected, the selected data strip only will be plotted as a function of intensity versus pixel number.

4. Note the **Files of Type** field, which allows you to select files for listing according to their type. If **WinXData** (*.spe) is selected, only files of type *.spe will be listed. This is the native WinSpec/32 format. If **TIFF** or **8-bit TIFF File** (*.tif) is selected, only files of the type *.tif will be listed. If **All Files** (*.*) is selected, all files in the folder will be listed. WinSpec/32 can open either *.spe files or *.tif files (8-bit or 16-bit). Select type **8-bit TIFF File** to open an 8-bit TIFF file. Select type **TIFF File** to open a 16-bit TIFF file.

---

* The open/display default selection can be changed and saved from the Display Layout window.

5. Either double-click on the name of the file you want to open or single-click on the name and then click on the **Open** button. For example, with 3D Graph selected, double-clicking on Hid-lamp.spe would open that file, producing the display shown in Figure 55. Note that there are many different ways of controlling how the image will be displayed, as described in Chapter 8.

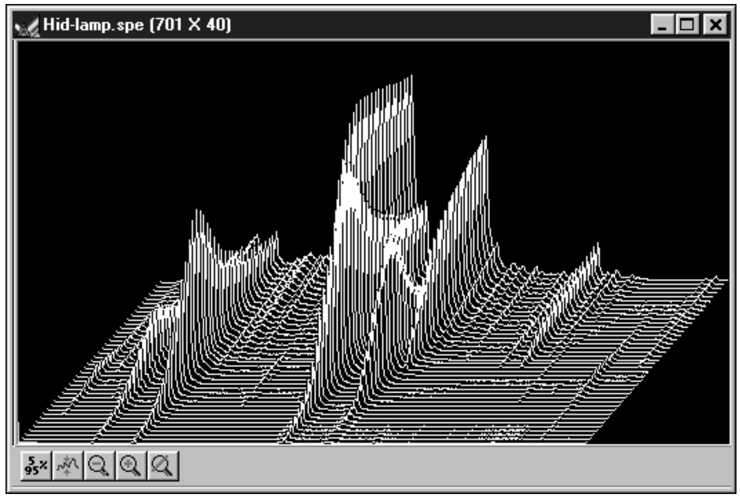


Figure 55. High Intensity Lamp Spectrum

Multiple Files: It is also possible to open multiple files at the same time by using the Win95 Shift Click and Control Click selection features. To select a *range of contiguously listed files* for opening:

- Hold the Shift key down and click on the first file in the range. The file will be selected.
- Then hold the Shift key down again and click on the last file in the range. That file *and all the files between the two designated files* will be selected.

To select multiple files which are *not* listed contiguously:

- hold down the **Ctrl** key and then click on the first file. That file will be selected.
- Then hold down the **Ctrl** key again and click on the second file. That file will also be selected.
- Proceed in similar fashion to select each file to be opened.

Once all files to be opened have been selected, click on **Open** (or double-click on a selected file) and all of the selected files will be opened.

There are a number of additional options and operations that can be performed from the Open dialog box. For example, clicking the Display Layout button will directly open the Display Layout dialog box, described in Chapter 8. In addition, options for the organization of the Open dialog box itself can be selected by means of the icons to the right of the **Look In** field, or by right-clicking the mouse anywhere in the file listing area of the box *(but not on a file name)*.

Right-clicking *on a file name* opens a Windows shortcut menu that provides a number of additional operations, including open, delete, rename, print, properties, and edit operations such as copy and cut.

Saving Data Files

Data files must be saved to disk before exiting the software. It is also recommended that you save periodically when making measurements to minimize the overall risk of data loss. If you exit and there are unsaved data files, you will be prompted to save them. The File menu provides three Save commands, as follows.

1. **Save:** Saves the active data file using the original file name and type and in the original directory (folder).
2. **Save As:** The Save As dialog box is used to save the active data file to a user-specified file name and directory. The file type can be changed.
3. **Save All:** Saves all open data files using the original file names and directories (folders).

Sometimes during data collection or processing, windows will be opened and display data with an <untitled #> title. These are temporary files, and they must be saved to disk if you want to keep them. The Save As dialog box performs this function. The Save As dialog box also allows you to open a file and save it with a different name.

Saving temporary data files

The WinSpec/32 software allows you to work with temporary files, files with names like <untitled 1>. To save these files, or to save any file to a new filename, perform the following steps.

1. Select **Save As** from the File menu. The Data File Save As dialog (Figure 56) appears.
2. Open the directory where you want the file saved. Clicking on the button at the right of the **Save In** field opens a browser function that will allow you to quickly and easily select the target directory.

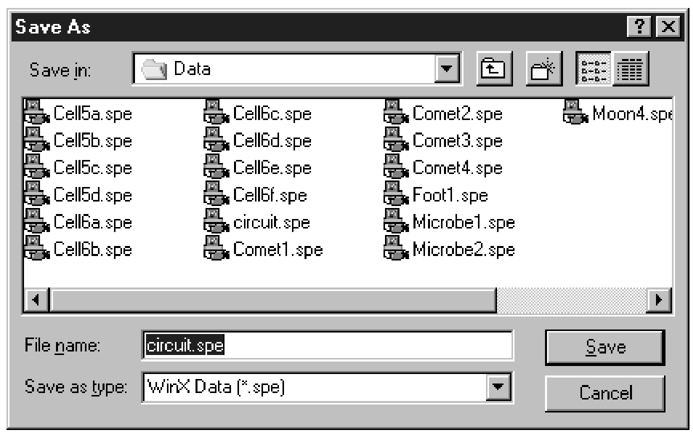


Figure 56. Data File Save As dialog box

3. Type in a name for the file. Windows 95 long file-name convention applies. It is not necessary to add the .spe extension. it will be added automatically according to the specified file type.

   Save as type: Indicates the file type. The data types currently supported are listed in Figure 57. If All Files (*.*) is selected, you will be able to save the file with any extension. The file, however, will be saved in the *.SPE file type format. *Only the data is saved. This could have some unexpected effects. For example, if you save a graph as a *.TIF file, and then open the file with an image editor, you will see the data presented as a single strip image, not as a graph.*

Figure 57. Save As Data Types

4. Click on **OK** to save the file or **Cancel** to close the Data File Save As dialog without saving the file.

Data File tab page

The **Data File** tab page provides you with additional control and flexibility in naming and saving newly collected data. Because the settings on this tab page are applied to data acquisition, not post-processing, make your entries before acquiring data. The auto-save, auto-name, and auto-increment features allow you to acquire data and save it according to the filename template you define. Also, you can take advantage of the multiple open windows functionality and specify that each new data run opens a new window on the display window.

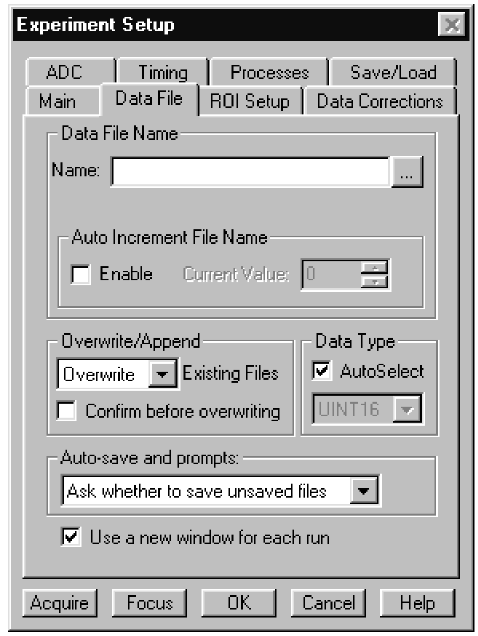


Figure 58. Data File tab page

Closing a Data File

An open data window can be closed by clicking on the box at the upper right of the window or by clicking on **Close** in the File menu. An open data window can be removed from view by clicking on the box at the upper right of the window. The file will be reduced to an icon on the task bar but the data will remain loaded in RAM. There may be situations where you would want to do this to reduce desktop clutter. Unless you intend to expand the file for display again, it is ordinarily better to actually close the file so that the RAM it is using will be freed for other use. If the file hasn't been saved, you will be prompted.

There are several ways of closing an open data window. These differ in subtle ways as follows.

- The box at the upper right of the data window will close that window only.
- The box at the upper right of the window will also remove the data window from view by reducing it to an icon on the task bar. There may be situations where you would want to do this to reduce desktop clutter. However, the data will remain loaded in RAM, reducing the memory available for data collection. Unless you intend to expand the file for display again, it is ordinarily better to actually close the file so that the RAM it is using will be freed for other use.
- **Close** in the File menu closes all windows using the data set displayed in the active data window. This may be important if New in the Window menu or in the Data Window Context menu has been used to open additional windows with the same data. Simply clicking on Close in the File menu will close all windows containing the same data, regardless of how it is displayed.

- **Close** in the Control menu, accessed by clicking on the WinSpec/32 icon at the left end of the Title bar, closes WinSpec/32, as does double-clicking on the WinSpec/32 icon. Similarly, the key combination ALT+F4 also closes WinSpec/32.
- **Close All** in the Window menu closes ***all*** open data files.
- The key combination **Ctrl+F4** closes the active window only.

Deleting Data Files

You can delete data files directly from within WinSpec/32, without having to close WinSpec/32, and without having to use the Windows 95 Explorer or another file utility. This is achieved using the File Operations menu, accessed by right-clicking on the file name in the Open dialog box, as explained below.

1. Select **Open** from the File menu. *Only files with the selected data type, *.spe or *.tif, will be listed.*
2. Position the mouse cursor on the name of the file you want to delete and click the *right* mouse button. This will open the "right-click" File operations menu, as shown in Figure 59.
3. Click on **Delete**. Then answer yes to the query asking whether you wish to send the file to the recycling bin. The file will be deleted and the File Operations menu will close.

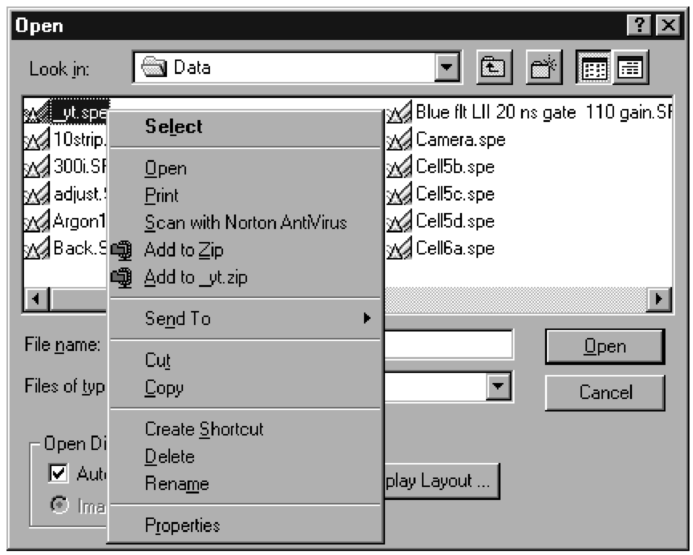


Figure 59. Right-click File Operations menu

Note: Click on the Open dialog box **Cancel** button to exit the dialog box without deleting any files.

Multiple Files: It is also possible to delete multiple files at the same time by using the Win95 Shift Click and Control Click selection features. To select a *range of contiguously listed files* for deleting:

1. Hold the Shift key down and click on the first file in the range. The file will be selected.
2. Then hold the Shift key down again and click on the last file in the range. That file *and all the files between the two designated files* will be selected.
3. To select multiple files which are *not* listed contiguously:
4. Hold down the **Ctrl** key and then click on the first file. That file will be selected.

5. Then hold down the **Ctrl** key again and click on the second file. That file will also be selected.

6. Proceed in similar fashion to select each file to be deleted.

Once all files to be deleted have been selected, *right-click* on a selected file to open the File Operations menu. Then click on **Delete** to delete all of the selected files.

This page intentionally left blank.

Chapter 6
Wavelength Calibration

Introduction

You can calibrate the WinSpec/32 software either by using the spectrograph stepper motor position (Spectrograph calibration) or by performing a wavelength calibration. Spectrograph calibration, described in Chapter 7, precisely calibrates the movement of the spectrograph gratings. Wavelength Calibration is good for one position of the grating only. Once you move the grating (by hand or by controlling the stepper motor) a different wavelength calibration must be performed for that spectrograph position.

Note: Even after the spectrograph setting is fixed, moving the sample, refocusing, or almost any adjustment of the input optics can have an effect on the wavelength calibration. For the most accurate calibration possible, Roper Scientific recommends recalibrating the system after ***any*** optical adjustment.

Changing the WinSpec/32 Calibration Method

Switching between Wavelength Calibration and Spectrograph Calibration is controlled using the Usage dialog box. This dialog box determines whether calibration is turned on or off, and which type of calibration is used. The display can be calibrated by controlling the stepper motor of the spectrograph, called Spectrograph Calibration (discussed in Chapter 7), or the display can be calibrated for a fixed spectrograph position by entering the position of known peaks from a known source such as a mercury or neon lamp. The calibration of the spectrograph for a fixed position is called Wavelength Calibration and is described in this chapter.

Changing the Calibration Method

1. Select **Usage** from the Calibration menu. The dialog in Figure 60 will be displayed.
2. Select the desired method of calibration.
   - **Auto Spectro** selects Spectrograph Calibration as described in Chapter 7. A spectrograph supported by WinSpec/32 must be installed for this selection to be available.
   - **Manual** applies the wavelength calibration to the active data. The calibration is performed using the Default Calibration Setup dialog box, accessed by selecting **Setup** on the Calibration menu.
   - **Off** selects uncalibrated operation.

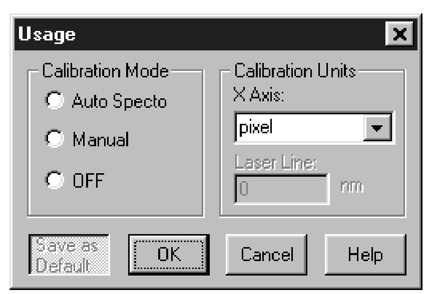


Figure 60. Calibration Usage dialog box

3. Select the desired X Axis units. *This option is only available if the data set is calibrated.* If **relative wave numbers** are selected, it will additionally be necessary to enter the wavelength of the laser line.

4. Click on **OK**.

See the discussion of the **Calibration Usage** dialog box in the online Help for details concerning the Calibration Usage dialog box selections.

Calibration Menu

The **Calibration** menu, which can be called by clicking on Calibration in the menu bar, is shown in Figure 61. The Calibration menu contains two items, Setup and Usage, which call the Calibration Setup and Calibration Usage dialog boxes. Brief descriptions follow.

Figure 61. Calibration menu

Setup: Once a single spectrum has been acquired or loaded, the menu item **Setup** opens the Calibration Setup dialog box. A calibration session consists of finding the peaks, marking the known peaks to be used for calibration, and saving the calibration data as the default or applying it to the active data set only.

Usage: Selects the Calibration mode and Units. Once the wavelength calibration has been performed, it can be applied by selecting **Manual**, or turned off by selecting **Off**. Selections can either be saved as default power-up parameters or be applied to the active data set only. For more information, see the online Help discussion of the Calibration Usage dialog box.

Wavelength Calibration Procedure

Before a wavelength calibration can be performed, it is necessary to either load a spectrum or acquire one. For good calibration results, the spectrum should have well defined peaks for which you know the wavelength. A calibration requires at least two points defined by pixel and by units. Naturally the more points used, the more accurate the calibration. The ideal calibration spectrum would have one peak at the start of the array (or region of interest), one at the end of the array or region of interest, and one midway between the end peaks. In real life, the ideal spectrum is seldom available, but the closer you can come to this ideal the better the calibration results will be. Figure 62 shows a mercury-argon spectrum that could serve as the basis for a good calibration in many situations. *Appendix B contains wavelength tables for Argon, Neon and Mercury, together with a detailed spectrum for Hg-Argon.*

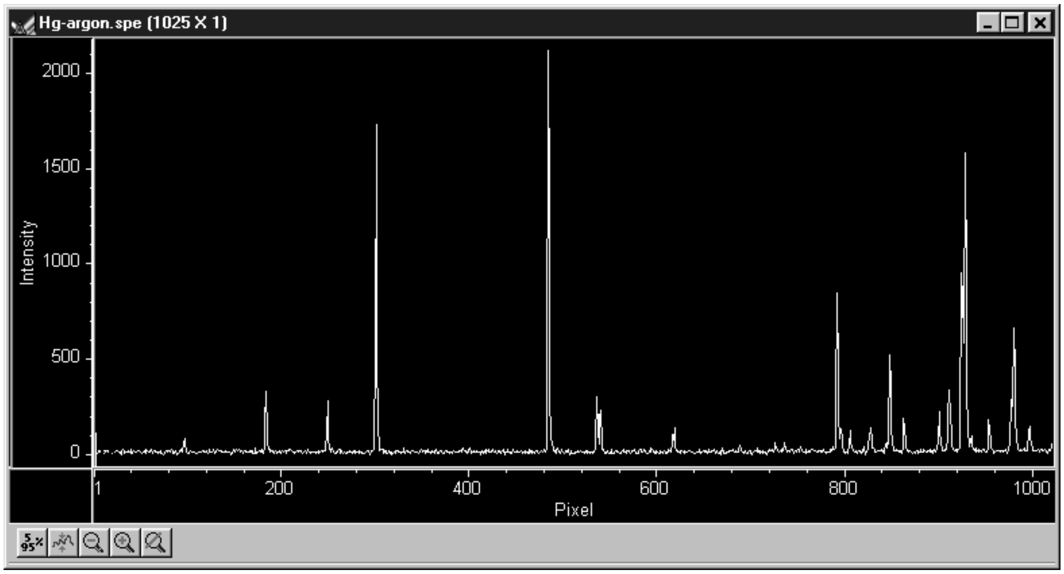


Figure 62. Hg-Argon spectrum

Once you have the calibration spectrum displayed on the screen as the active data set, proceed as follows.

1. Click on **Setup** in the Calibration menu to open the Calibration Setup dialog box. If a previous calibration had been saved, the calibration values would be listed. If no previous calibration had been saved as the default, no values would be listed. *For more information, see the online Help for this dialog box..*

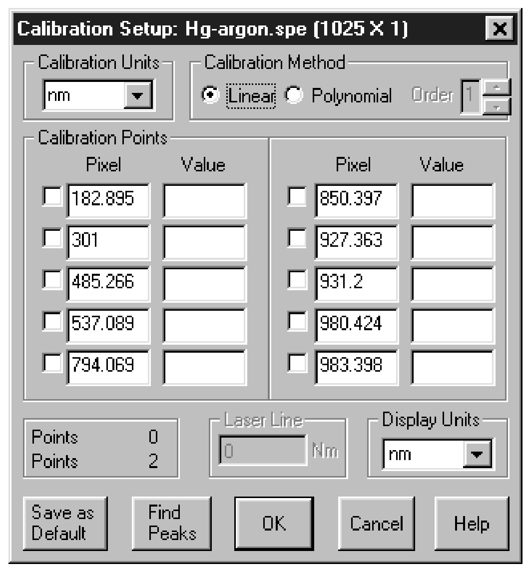


Figure 63. Calibration Setup dialog box after running Find Peaks routine on Hg-Argon spectrum

2. Click on **Find Peaks**. An automatic peak finding routine will be performed. The *maximum* number of peaks is equal to one quarter the number of displayed pixels. The pixel values for the 10 highest peaks will be shown in the Pixel boxes in the Calibration Setup dialog box as shown in Figure 63. Note that the Find Peaks routine causes a small red arrow to be displayed above each peak found in the spectrum together with a notation indicating the peak location in pixels (Figure 64).

Note: Each time the Find Peaks routine is initiated the *displayed* peak heights will decrease. Clicking on the data window Autoscale button will restore their original displayed height.

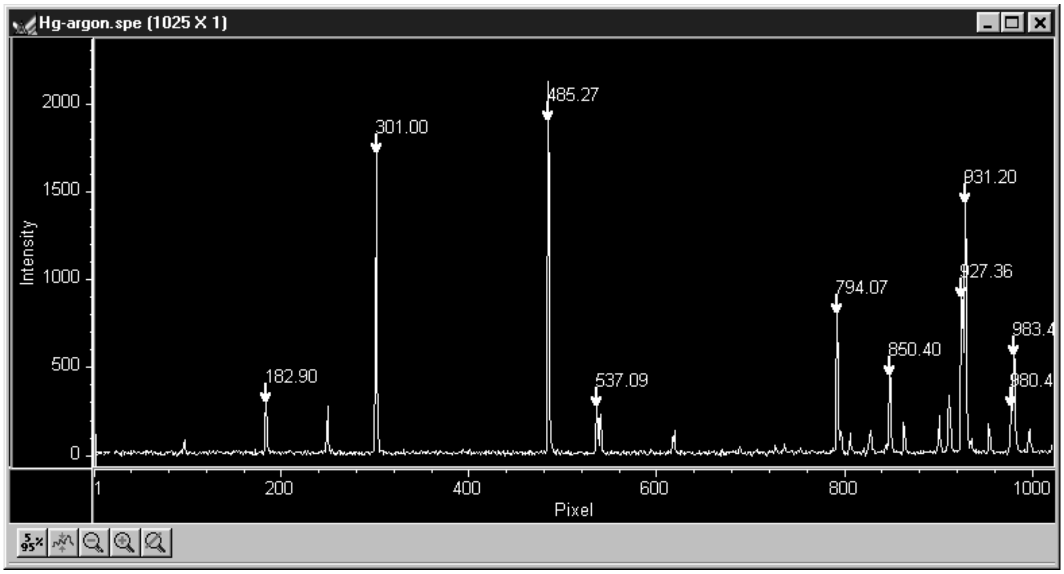


Figure 64. Spectrum after running Find Peaks routine

3. Select the calibration points. For the example being considered, the peaks at 182.90, 301.00, 485.27 and 931.20 would be good choices. *The decimal point locations are based on the calculated center of peak, and not necessarily the largest intensity position.*

4. Select the Calibration Units (if not nanometers) and select the Display Units. Both the Calibration Units and the Display Units are nm (the default) in the example.

5. Manually enter the wavelength of the selected peaks. *Appendix B contains wavelength tables and a detailed spectrum for Hg-Argon.* In our example, the wavelengths for the selected peaks would be:

Peak Location (Pixels)	**Peak Location (Wavelength in nm)**
182.90	365.02
301.00	435.83
485.27	546.07
931.20	811.53

6. Once the wavelengths have been entered for the selected peaks, check the selection box to the left of the Pixel box for each peak selected. (Figure 65). A checkmark in the box indicates that the peak is selected. *Note that wavelength values must be entered for these peaks before the selection box can be checked.*

7. Click on **OK**. This completes the wavelength calibration and the dialog box will close. At the same time, the Calibration Mode selected in the Usage dialog box will automatically change from Off to Manual.

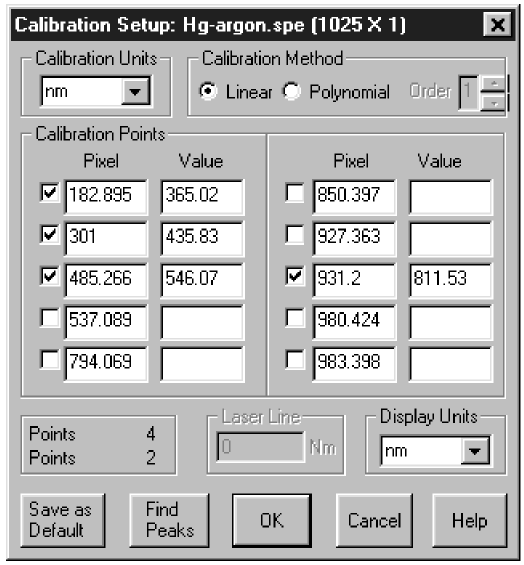


Figure 65. Setup Calibration screen after selecting peaks and entering calibration wavelengths

Note the appearance of the data display. The peak find routine display data (arrows and pixel number of each peak found) does not change. The x-axis units will however change to reflect the display units.

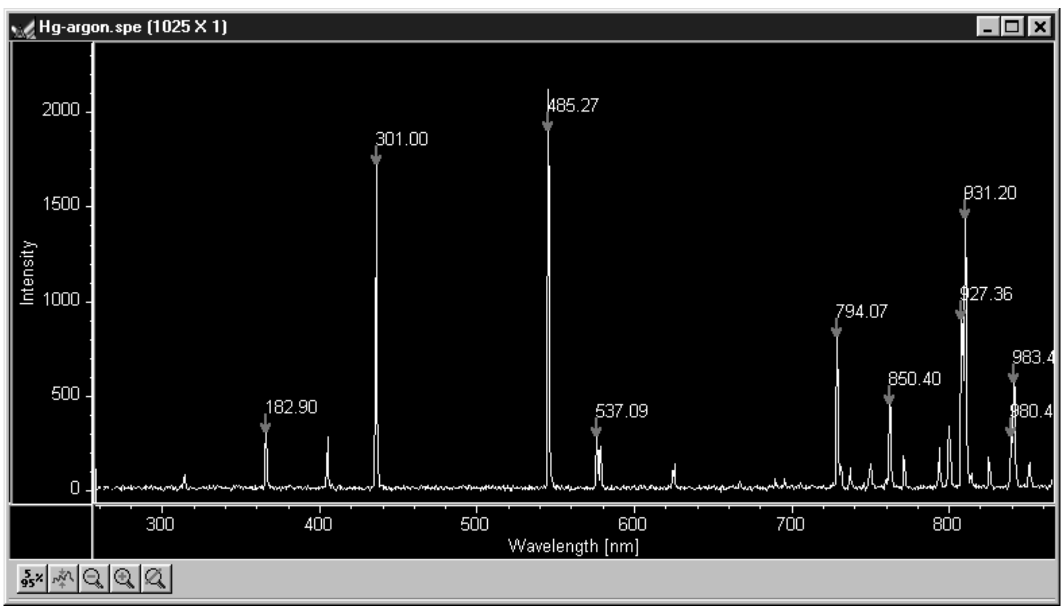


Figure 66. Spectrum after calibrating

Save as Default

The **Save as Default** button in the Calibration Setup dialog box determines whether a calibration is temporary or permanent (until changed). Once a calibration has been saved as the default, it will be automatically applied to subsequently acquired data. ***It will not be applied to data files recalled from disk.***

Note: The default state of the button, not only with respect to the button setting but also with respect to whether it is disabled (grayed out and not user-settable) depends on the situation, as follows.

No Data

If you open the Calibration Setup menu and there is no data, **Save as Default** will be pressed and disabled, that is, it will be locked in the **Save as Default** state. Should you then click on **OK**, no calibration values will written to the Windows Registry.

Not Live Data

If there is data in the active window when you open the Calibration Setup menu, but the data isn't live, such as would be the case if it were recalled from disk, **Save as Default** is under user control, with "not pressed" as the default state. Note that if the opened data file was saved in a calibrated state, that calibration will be in effect when the file is opened, the calibration values will be loaded in the calibration setup, and the data displayed.

Live Data

If the active window is displaying live data, **Save as Default** will be under user control but in the selected or "pressed" state. If **Save as Default** is selected and you click on **OK**, the calibration will be stored in the Windows Registry and will be automatically applied to all subsequent acquired data, unless a new calibration is performed. If **Save as Default** is unselected and you click on **OK**, the calibration in effect (i.e., in the Calibration Setup dialog box) will apply to the active data file only.

Calibration, Display, and User Units

The default **Calibration Units** are nanometers (nm). These units can be changed, with the change taking effect immediately. Calibration units to choose from are nm (nanometers), cm-1 (wavenumbers), rel. cm-1 (relative wavenumbers), and user units (units other than above). For relative wavenumbers only, the wavelength of the excitation laser must be entered in the Laser Wavelength box in nm. Display unit choices are the same, with the additional selection of pixels.

The **Display Units** selection can be different from the Calibration units, except in the case of **User Units**. Under Display Units, the choices are pixels, nm (nanometers), cm-1 (wavenumbers), and rel. cm-1 (relative Raman shift wavenumbers). Theses units are the ones shown on the X-axis whenever calibrated spectra are displayed. To display files without calibration, even files collected with a specific calibration, select the pixel option under Display Units.

User Units allow the operator to scale the spectra to any arbitrary unit.

Calibration Method

A calibration requires at least two points defined by pixel and by units. Naturally the more points used, the more accurate the calibration. The points must always be defined by pixel number, but nanometers can be changed to another unit if desired.

Two mathematical models can be used to fit the calibration to the data. The first, Least Square, calculates a linear approximation of the fit by minimizing the sum of the squares of the errors between the fit and the calibration points. Linear approximation is generally sufficient. The Polynomial method uses a higher order function of the form $a + bx + cx^2 + \ldots$ where the “order” of the polynomial is the highest power of x used. The general rule is:

(# Cal Peaks - 1) = Order
maximum order = 5

If four peaks are active in the Calibrate dialog, the order of the polynomial can be 2 or 3. Even if ten peaks are used, the maximum order of the Polynomial is 5 (up to x^5). As a general guide, we advise calibrating using the Linear calibration method with widely separated peaks as previous described. If the available peaks are clustered, a Polynomial fit (using the smallest order possible) may give a good fit in the region of the calibration peaks, but have increasing large deviation the further you get from them. In an extreme case, there may even be two values for the same pixel, a clearly impossible condition which will result in an error message.

With the Linear calibration method, at least two peaks are required to calibrate. For a Polynomial calibration, the number of peaks must be at least one higher than the order of the polynomial. This information is displayed at the lower left of the Calibration Setup dialog box. The lower Points value is the number of peaks required. The upper points value is the number available for calibration. A peak is available if it has been found, its known value has been entered, and the adjacent checkbox has been checked.

This page intentionally left blank.

Chapter 7
Spectrograph Calibration

Introduction

You can calibrate the WinSpec/32 software by either using the spectrograph stepper motor position (Spectrograph calibration) or by manual wavelength calibration. Spectrograph calibration is achieved using the Calibrate selection on the Spectrograph menu, and is described in detail in this chapter. Wavelength calibration, which is only good for one position of the grating, is explained in Chapter 6.

The spectrograph calibration routine requires you to enter certain default values into a series of dialogs. You are also required to have a known source, such as a mercury lamp, placed near the entrance slit of the spectrograph. Once you have completed the following calibration procedure, any movement of the spectrograph will be accounted for in the display of spectral information.

Notes:

The spectrograph ***MUST*** be focused and aligned properly before a good calibration can be achieved. Spectrograph focusing and alignment is an art onto itself and is beyond the scope of this manual. Basically it consists of filling the aperture from a broad light source and adjusting the focusing mirror for the sharpest image (narrowest possible symmetrical peak) on the CCD. Focusing can also be accomplished by moving the detector in and out. Different detectors and/or spectrographs will have different means for doing this. In addition, it may be necessary to rotate the detector so that the spectral line is perfectly vertical on the CCD.

The Offset, Adjust and Dispersion parameter values for WinSpec/32 will not be the same as they were with earlier versions of WinSpec. This is true even if the same spectrograph is used. You cannot simply enter values you may have recorded when using the earlier (16-bit) WinSpec versions. If you do, very large calibration errors will be introduced. The calibration must be performed using the following procedure.

Preparation

1. Install the spectrograph, mounting it to the detector per the instructions in the Detector manual, and turn it on. You may have to restart the WinSpec/32 software after turning on the spectrograph.
2. Mount a suitable light source (mercury lamp preferred) near the entrance slit of the spectrograph so that the light passes through the spectrograph onto the detector.

3. Review the **Define Spectrograph** selections and settings to be sure they are correct for the calibration to be performed.
4. The **Experiment Setup** parameters must be set so that a spectrum can be acquired. Using **Easy Bin**, select a single strip of several rows near the center of the CCD and an exposure time between 0.1 and 0.5 seconds.
5. A filename should have been entered for the test acquisitions using the Data File tab page (Experiment Setup dialog box). Also, **Overwrite Confirmation** should be turned off so you won't see warning messages about overwriting data files. Exit the Experiment Setup dialog box by clicking on the **OK** button.
6. Acquire some data and display the data as a graph. Next position and size the data window. We suggest locating it at the upper left and sizing it so that it doesn't extend more than half way across the screen. Then select **Keep Window Placement** on the Display Layout General tab page, followed clicking on **OK**. This operation assures that all data windows will fall in precisely the same spot and will be precisely the same size, a configuration that conveys a significant convenience advantage when calibrating.

Notes:

1. You must use the supplied cable to control the spectrograph. Do not use a standard 9-pin serial cable, even if it worked with an earlier version of WinSpec.
2. If the spectrograph does not move or you get an error message such as "Communication Error with Spectrograph", the spectrograph setup is probably incorrect. Check the power on the spectrograph, the cable connections, and the settings in the Spectrograph dialog. Also try turning off and back on the spectrograph, then closing and reopening the WinSpec/32 software.
3. If wavelength direction is reversed, you won't be able to calibrate successfully. However, a warning message will be displayed. If this happens, open the Hardware Setup dialog box and select the Display tab page. If Rotate is selected, toggle the Flip box. If Rotate is not selected, toggle the Reverse box. Click on **OK** and then begin Offset calibration again.

Calibration Parameters

1. Select **Auto Spectro** on the Usage dialog box (to open, select Usage on the Calibration menu). *If the **Use for Auto-Spectro Calibration** check box on the Define Spectrograph Main tab page was used to designate a particular spectrograph as the one to be used for calibration purposes, that spectrograph will be automatically selected.*
2. If the **Save as Default** button on the Usage dialog box isn't already selected, select it now.
3. Select **Calibrate** on the Spectrograph menu. This will open the Spectrograph Calibration dialog box (Figure 67).

4. Be sure the correct **Spectrograph to Calibrate** is selected. If another spectrograph is indicated, click on the down arrow at the right of the selection box to display all of the installed spectrographs and make the correct selection. *If only one spectrograph has been installed, the selection box won't appear but the spectrograph model will be reported.*

5. Be sure the correct **Grating to Calibrate** is selected. Calibration is grating specific. If the indicated grating is incorrect, click on the arrow at the right of the selection box to display the available gratings and make the correct selection.

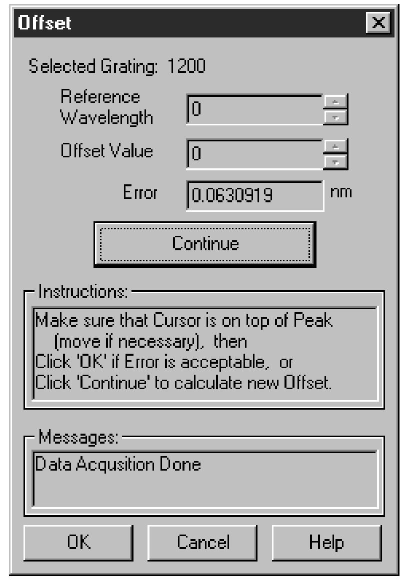


Figure 67. Spectrograph Calibration dialog box

6. Be sure the indicated value for the **Detector Pixel Width** in microns is correct. The default value will depend on the type of CCD chip installed. Note that some design factors, such as a tapered fiber optic ahead of the chip, will change *the pixel size seen by the spectrograph* and so will have to be taken into account in determining the value to be entered.

7. Be sure the indicated **Magnification** value is correct for your spectrograph. This parameter is determined by the geometry of the spectrograph. Contact your spectrograph manufacturer if you have any questions about the magnification parameter value.

8. Select the Grating Movement Mode, **Slew** or **Scan**. Operation with Slew selected will be significantly faster than with Scan selected.

Offset

CAUTION

> You must begin calibration with the **Offset** procedure and end with the **Dispersion** procedure. Performing the steps in this order is absolutely necessary for correct calibration.

Theoretically, if you were to move your spectrograph to the zero order peak or any other known peak, the peak would fall exactly on the center of the array. In the real world, the mechanical tolerances of the mounting will probably result in the peak being a few pixels off. The Offset procedure that follows allows you to correct for this small offset error.

1. Select **Info** on the View menu. The Info dialog box should be visible. This will help indicate the status of spectrograph movement and data collection.

2. In the Spectrograph Calibration dialog box, click on the **Offset** button. This will open the Offset dialog box (Figure 68).

3. The dialog box that appears has a Reference Wavelength entry box. This is the wavelength where the spectrograph is set for the offset measurement. All Acton spectrographs use the zero order, that is, a setting of “0.”

4. Click on the **Start Offset Procedure** button. The spectrograph should now move to the reference wavelength and data acquisition will commence. Then a peak-find will be performed and the resulting data will be displayed.

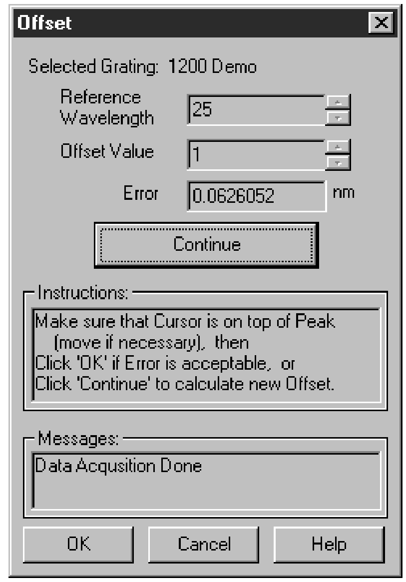


Figure 68. Offset dialog box

5. Figure 70 illustrates a typical Offset data acquisition. The reference peak should appear near the center of the display and the cursor should be near or on the highest point of the peak. If the peak is saturated, cancel, lower the exposure time, and repeat the operation. The display X-axis should be calibrated (any units other than pixels). *If the X-axis is calibrated in pixels, select the desired units as the calibration units on the Usage dialog box (opened by selecting Usage from the Calibration menu).*

Peak Locator

Before going on, you have to make a judgment regarding the location of the cursor on the peak. There may be situations where you will need to readjust the cursor position to get it precisely on the correct location. Although this should be a relatively uncommon event, it could happen, and it is important to take a moment to understand how the peak locator works, how it may appear to be in error when it in fact it is not, and how it could come to be in error and require manual intervention to correct the cursor position.

The peak locator works by taking the second derivative of the spectrum to find the peaks. Each peak found is then divided in two so that the area to the left of the divider equals the area to the right of the divider. The cursor is located at precisely the point where the divider intersects the peak. Note that, depending on the shape of the peak, the cursor may or may not end up precisely on the highest point. Figure 69 shows three possible peaks, and illustrates the action of the peak finder in each case.

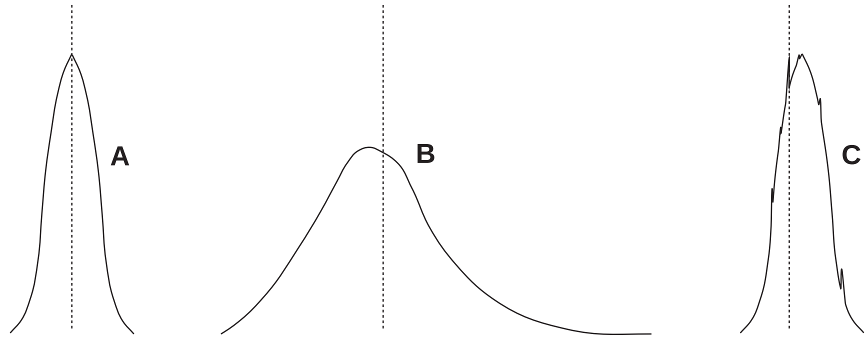


Figure 69. Peak locator examples

Peak **A** is perfectly symmetrical. As you would expect, dividing it into two equal areas and locating the cursor at the intersection of the divider with the peak will put the cursor precisely at the highest point. Peak **B**, on the other hand, is not symmetrical but rather extends further to the right than to the left. As a result, the final cursor position is a little to the right of the highest point. *This is the correct peak location. Any attempt to "improve" it by manually moving the cursor to precisely the highest point will degrade the offset computation. Note that moving the cursor immediately changes the reported Error. Do not assume that this means the cursor wasn't optimally located. Rather it indicates a possible optical problem and the spectrograph may need to be realigned.* Peak **C** is like peak A but is accompanied by a number of noise spikes. The peak finder is quite sensitive and might well select one of these spikes as the real peak and incorrectly place the cursor on the noise spike as shown in **C**. If this happens, the correct action would be to manually adjust the cursor position to the right so that it is on the true peak before going on.

Doublets are also a problem. At any stage of the calibration procedure the peak finder might find the wrong peak of a doublet. For example, if using the 579.066 nm mercury line in doing the Dispersion Calibration, you need to take care to check that the peak finder hasn't selected the 576.96 nm line instead. If it does, it is a simple matter to move the manually move the cursor to the correct peak. *Note that the zoom function can also be controlled using the data window icons.*

If it is difficult to see the precise cursor position, simply press the keyboard **Insert** key to expand the display about the cursor position. The key may have to be pressed several times to achieve the desired resolution. *(Use the Delete key to return to the original display.)* If you do decide to move the cursor, note that each time a cursor-positioning arrow key is pressed, the cursor will move one data point. Assuming no horizontal binning is in effect, one data point will correspond to one pixel on the array.

As a final comment, even if you should move the cursor when it wasn't necessary, repeating the Calibration Offset cycle a few times will still achieve an optimum offset adjustment.

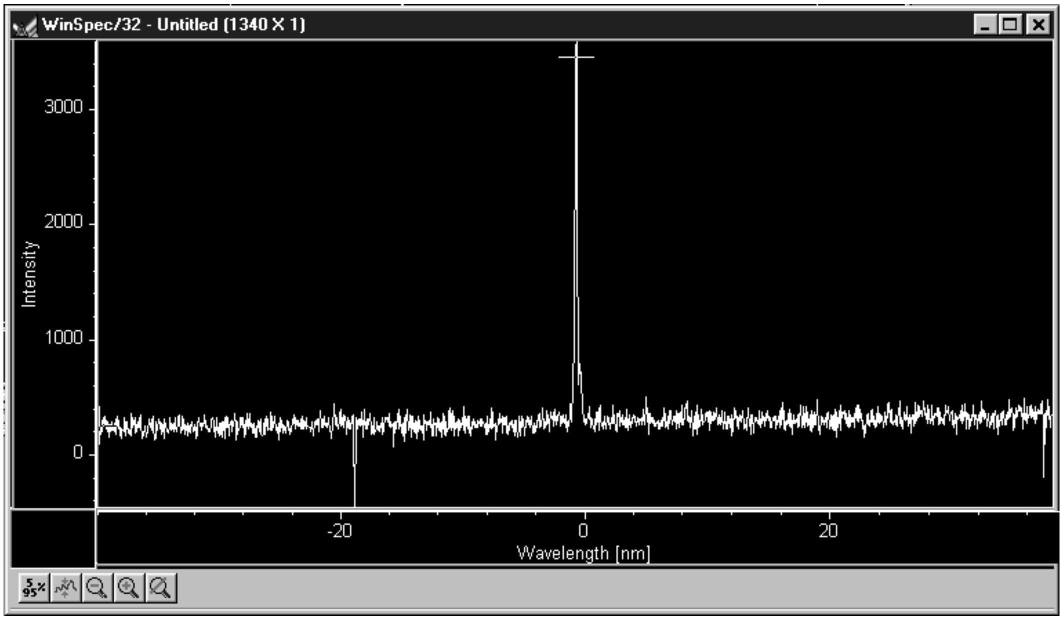


Figure 70. Offset Spectrum for zero-order measurement

6. Note the reported **Error** value in the Offset dialog box. The value is reported in nm. Transposed to pixels it should be less than one pixel. *The number of nm represented by one pixel will depend, of course, on the dispersion of the grating.*
7. Press **Continue** to initiate another offset computation cycle. The reported error should decrease. Repeat the cycle two or three times – until no further reduction in the error can be achieved. The final error value achieved may wander a bit with each cycle repetition, reflecting the noise content of the spectrum.
8. Click on **OK** to close the Offset dialog box and return to the Spectrograph Calibrate dialog box.

Adjust

Once you have adjusted the Offset for a reference wavelength (or for the zero order peak) other wavelengths may still be improperly calibrated. To see why this is so, think of the calibration in terms of the linear general equation:

$$y = mx + b$$

Although this is a simplified model, it suffices to show the basic relationships. The “b” term can be thought of as the offset, which is adjusted to place the reference at precisely the center of the array. The location of points away from the offset reference will be determined by the “m” or slope term (as well as “b”) and the Adjust procedure allows “m” to be set so that adjusting the spectrograph to other wavelengths will result in this wavelength falling on the center of the array.

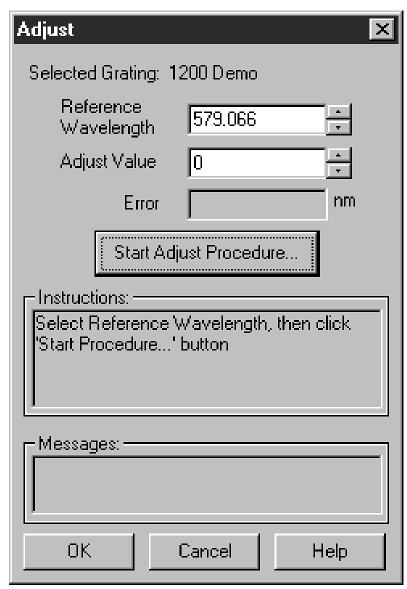


Figure 71. Adjust dialog box

1. Click on the **Adjust** button to open the Adjust dialog box.
2. Enter as the Reference Wavelength a known line in the observed spectrum, such as 579.066 for Mercury. Next click the **Start Adjust Procedure** button.
3. The spectrograph will move to the reference wavelength and collect a spectrum. It will also perform a peak-find operation and display the acquired data. The reference peak should appear somewhere near the center of the display and the cursor should be on the peak at or near the highest point.
4. Figure 72 illustrates a typical Adjust data acquisition. The reference peak should appear near the center of the display and the cursor should be near or on the highest point of the peak.
5. As was the case for the Offset adjustment, before going on, you have to make a judgment regarding the location of the cursor on the peak. Take particular care that the proper peak has been found. If, for example, the peak finder places the cursor on the 576 peak, manually move the cursor to the 579 peak. For additional information, refer to the earlier discussion of how the peak finder works in the Calibration Offset procedure.

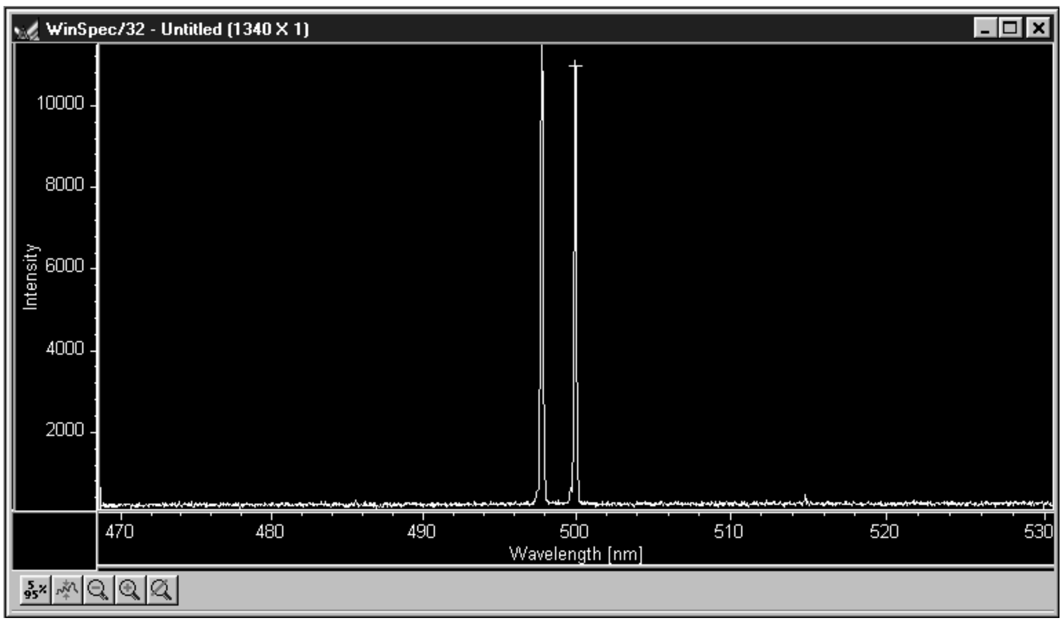


Figure 72. Calibration Adjust spectrum

6. Note the reported **Error** value in the Adjust dialog box. The value is reported in nm. Transposed to pixels it should be less than one pixel. *The number of nm represented by one pixel will depend, of course, on the dispersion of the grating. The nm/pixel can be approximated by picking the difference in the location of the two peaks while in pixel mode, and dividing the difference reported in calibration units in the calibration mode.*

   Note: The absolute value of the peak is reported in the Info box. If it is not already open, open it by selecting Info on the View menu.

7. Press **Continue** to initiate another Adjust computation cycle. The reported error should decrease. Repeat the cycle two or three times – until no further reduction in

the error can be achieved. The final error value achieved may wander a bit with each cycle repetition, reflecting the noise content of the spectrum.

8. Click **OK** to close the Adjust dialog box and return you to the Spectrograph Calibrate dialog box.

Dispersion

Now that Offset and Adjust are complete, the spectrograph can move a target peak very close to the center of the display. The final step is to calibrate the wavelength scaling so that peaks on the far left or the far right in the window are also accurately calibrated. This is called the Dispersion calculation, and again it is automated in WinSpec/32.

To adjust the Dispersion calculation you will make two measurements in the lower spectral range (253.652 for Mercury); one measurement with the peak at the left edge of the display and one with the peak at the right edge. Then you will make two measurements in the upper spectral range (579.066 for Mercury). After these steps, WinSpec/32 then tries to find the combination of Focal Length, Inclusion Angle, and Detector Angle that minimizes the error.

Note: Some CCDs have very little response at 253.652. If this is the case for your detector, it will be necessary to use a peak having a longer wavelength as the low value. For mercury, the 435.833 line should prove suitable.

1. Click on the **Dispersion** button to open the Dispersion dialog box. If you have never calculated the Dispersion before, click on the **Default** button. This provides standard values for Focal Length, Inclusion Angle, and Detector Angle based on the manufacturer's data for the active spectrograph. If you have already run the Dispersion calculation before and it provided satisfactory values, they will be displayed and should be used as your starting values.

2. Enter the Lower and Higher Reference Wavelengths. For the mercury spectrum, use 253.652 (low) and 579.066 (high). *Again, if your CCD doesn't have sufficient response to calibrate at 253.652, it will be necessary to use a different peak.* It isn't necessary to enter a Target Wavelength. It will be calculated during the procedure.

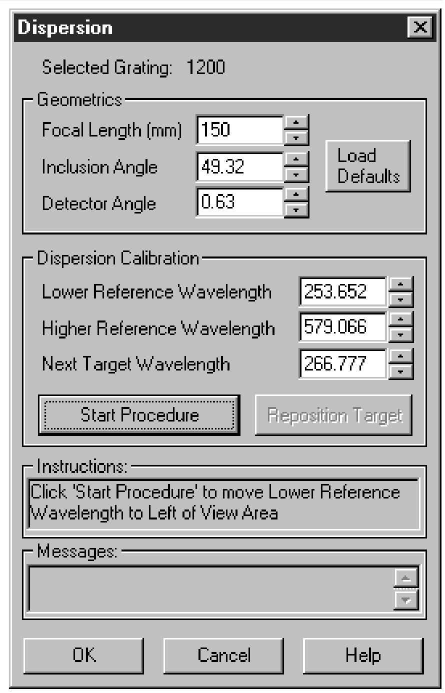


Figure 73. Dispersion dialog box

Note: In the following steps, four data sets will be taken, each initiated by you. The **Start Procedure** button initiates the first, and the same button, named **Continue** once the first data set has been taken, is used to initiate each of the other three. After each data set is taken, you have the option of adjusting the cursor position on the peak. However, as previously explained, this will not be required or advisable in most instances. *See the Peak Finder discussion in the Calibration Offset procedure.* The order in which the data sets are taken is as follows.

- Low peak (253.652) at the left of the display.
- Low peak (253.652) at the right of the display.
- High peak (579.066) at the left of the display.
- High peak (579.066) at the right of the display.

3. Click on the **Start Procedure** button.

   - WinSpec/32 will acquire the first data set and display it. It will also calculate the Target Wavelength so that the Lower Reference Wavelength peak appears near the left edge of the display. *The Target Wavelength is the wavelength the spectrograph must move to in order for the reference wavelength to be properly located near the edge of the display*.
   - If the peak is outside the display you should enter a Target Wavelength which might be better and click the **Reposition** button. If the peak is too close to the center of the display you should enter a slightly higher Target Wavelength and click on the **Reposition** button. Once the peak appears near the left edge, check, and if necessary adjust, the cursor position on the peak using the same criteria as for the Offset and Adjust operations. Then click on **Continue to Step 2** to initiate the second data acquisition.
   - The spectrograph will acquire the second spectrum. If the peak is close to the right edge of the display as expected, click on **Continue to Step 3** to initiate the third data set acquisition. If the peak is not in the right position, use the **Reposition** button to move the spectrograph as required to position the low peak near the right edge of the display. Then click on **Continue to Step 3** to initiate acquisition of the third data set.
   - The spectrograph will acquire the third spectrum, this time positioning the cursor on the high peak at 579.066. If the peak is close to the left edge of the display as expected, click on **Continue to Step 4** to initiate the fourth data set acquisition. If the peak is not in the correct position, use the **Reposition** button to move the spectrograph as required to position the high peak near the left edge of the display. Then click on **Continue to Step 4** to initiate acquisition of the fourth data set.
   - After completion of the fourth data set, once again check to be sure the cursor is on the correct peak and manually move it if it is not.

After all four reference points are taken, WinSpec/32 begins an iterative process to find the best values. This process is initiated by clicking on the **Calculate Results** button You will see the parameters change as WinSpec/32 performs the calculations. The program stops when the best parameters are displayed in the Dispersion dialog box. If satisfied with the calibration, simply click on **OK** to make the save the final dispersion parameters as part of the calibration data for the grating. Click on **Cancel** to revert back to previously saved parameters. Note that you can also change the parameters manually and click on **OK** to save them.

Having completed the calibration for one grating, select the next grating and repeat the procedure. Continue until all available gratings have been calibrated.

Chapter 8
Displaying the Data

Introduction

WinSpec/32 can display data as an image, as a two dimensional graph, or as a 3D Graph (multiple strips from the same graph or the same strip from multiple frames). You can choose to allow the software control how the data will be displayed or make the selection yourself. To have WinSpec/32 control the data-display mode, simply select the **Auto-Select** check box provided on the File Open dialog box and also on the Display Layout dialog box. The Auto Select algorithm makes the selection depending on the number of data strips as follows.

⇒ If there are eleven or more strips of data, they will be displayed as a normal image, such as that shown in Figure 74.

Figure 74. Image display of 256 data strips

⇒ If there are at least three data strips but less than eleven, the data will be plotted as a 3D Graph as shown in Figure 75.

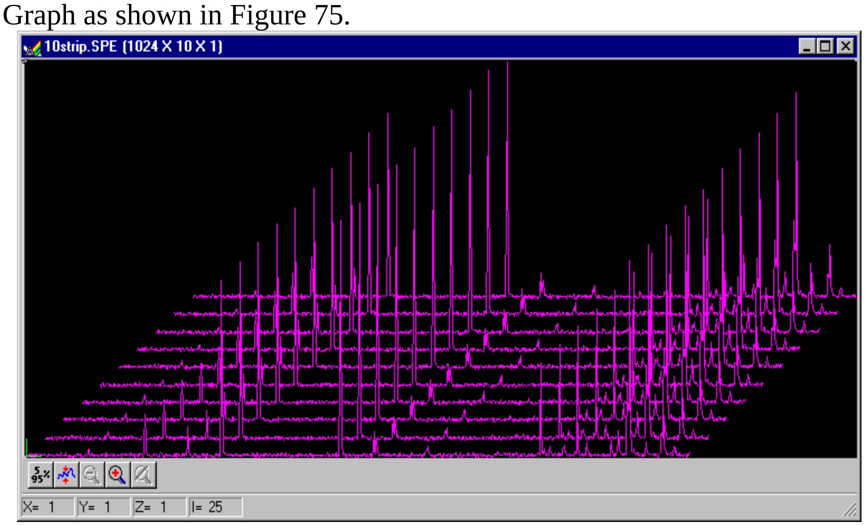


Figure 75. 3D Image display of 10 data strips

⇒ If there are only two strips of data, they will be displayed as graphs stacked in a two-dimensional plot, the same as for a 3D Graph of two strips.

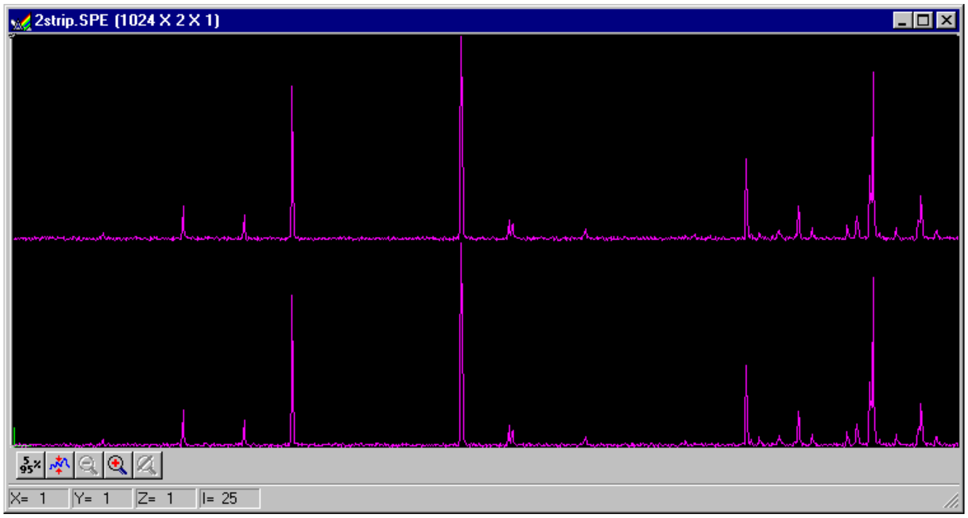


Figure 76. 3D graph with two data strips

A single strip ***will always*** be plotted as a simple graph. Note that from two to ten strips, the intensity (Y axis) scale shifts position as required to read true for the selected strip.

The file Open dialog box and Display Layout dialog box both contain the three display-mode select radio buttons, **Image**, **Graph** and **3D Graph**. If you want to control the data-display mode yourself, simply leave Auto Select unchecked and the display mode will correspond to whichever of the three radio buttons is selected.

Screen Refresh Rate

The Screen Refresh Rate is an important but oft overlooked display performance parameter. At times, such as when focusing, by making the screen refresh rate as rapid as possible, the focusing operation may be much easier to perform than it would be with a slow refresh rate. To obtain the fastest possible refresh rate, simply operate with the axes and cross-sections both switched off (View menu) and with the Zoom factor set to 1:1. *Note that the Zoom 1:1 button on the Data Window toolbar is only present when viewing an image.* To check the refresh rate, click on the Status bar (bottom of screen) **Collection Status** pane, which is immediately to the left of the Timer pane (right end of Status bar). The refresh rate will be displayed in the Collection Status pane. Do not confuse the screen refresh rate with the data collection rate.

Data Displayed as a 3D Graph

Data files can be opened as 3D graphs from the Open dialog box. Figure 77 shows a 3D graph with five data strips. Figure 76 (on the previous page) shows a 3D graph with two data strips. Both examples illustrate the behavior of the **Auto-Select** algorithm as discussed on page 97. The following paragraphs contain procedures for opening and displaying data in graphical format.

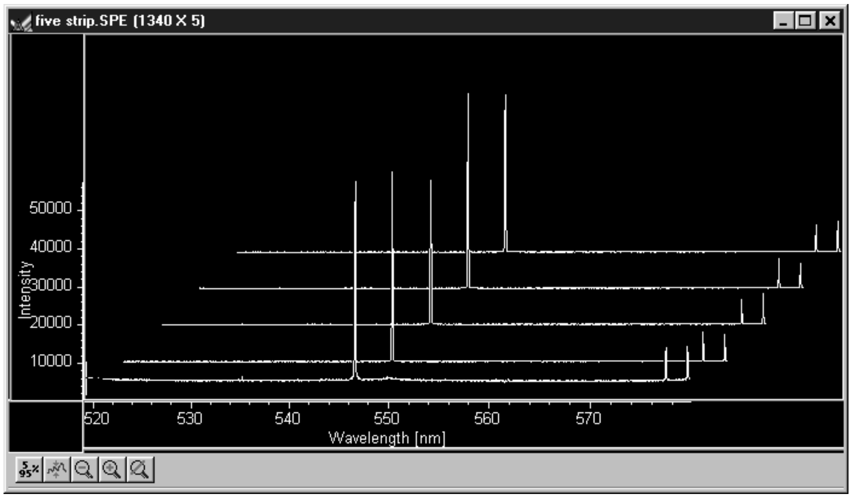


Figure 77. 3D graph with five data strips

Displaying Hid-lamp.spe

The data file used in this exercise is Hid-lamp.spe, one of the data files supplied with your WinSpec/32 software.

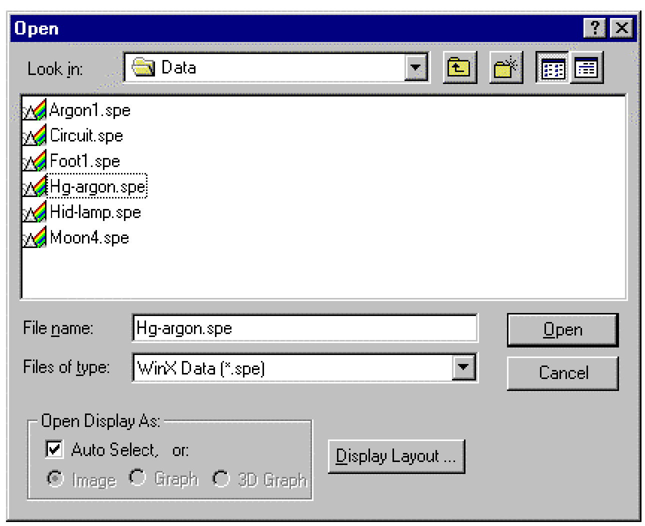


Figure 78. Open dialog box

1. From the File menu select **Open**. The Open dialog box (Figure 78) will appear, allowing you to select the image to be opened. The Look-In box provides a browser function so that the directory where the images are located can be easily accessed. By default the data directory is a subdirectory of the WinSpec program directory. Files of the specified type (the WinSpec/32 data type is *.spe) in the current directory and any subdirectories are listed in the box below the directory name.

2. The Image, Graph and 3D Graph radio buttons at the bottom of the box allow you to select whether the file will be opened and displayed as an image, two dimensional graph or as a 3D graph. Select **3D Graph**. (Auto Select should not be checked.)

3. From the data directory select the image file called Hid-lamp.spe. Click on the **OK** button. A window of the appropriate dimensions should appear immediately. The graph display may take a few seconds, depending on the speed of the computer. The initial appearance of the display may vary depending on the initial Display Layout parameter settings.

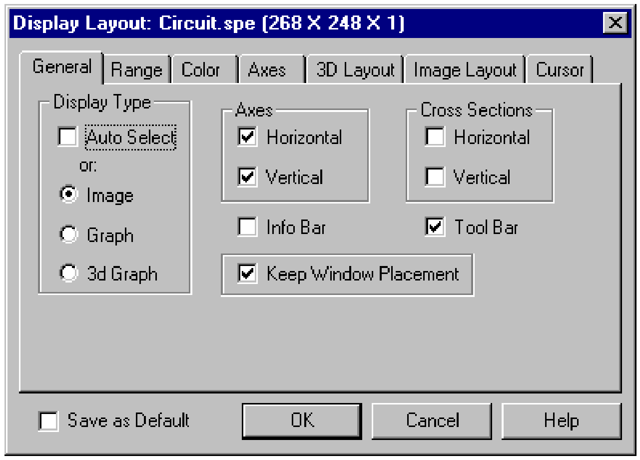


Figure 79. Display Layout dialog box

4. Select Layout on the Display menu. The Display Layout dialog box will open as shown in Figure 79.

5. Check and, if necessary set, the following parameter selections on each tab page.

   General tab page
   Display As: 3d Graph
   Auto Select: unchecked
   Axes: both boxes checked
   Cross Sections: both boxes checked
   Keep Window Placement: unchecked

   Range tab page
   Initial Autoscale: checked
   Set to Full Range: checked
   Frame: 1

   Color tab page: no changes

   Axes tab page
   Horizontal axis: checked
   Horizontal label: checked
   Horizontal label string: Pixel
   Vertical axis: checked
   Vertical label: checked
   Vertical label string: Intensity

   3D Layout
   3D Mode: Multi-strip; same frame selected
   3D Properties: Remove Hidden Line checked; other two boxes unchecked.
   Z Axis Endpoint: %X set to 20; %Y set to 40
   3D Marker curves: Marker Curves unchecked; Curve set to 5

6. Click on **OK**. The Display Layout dialog box will close and the data display, exclusive of the intensity profiles, should appear as shown in Figure 80. Each strip is displayed as a plot of intensity vs. pixel number. The first strip is at the front and the last strip is at the back. Initially the cursor will be at the lower left. Use the up arrow key to move to a higher numbered strip and the right arrow key to move to a higher

numbered pixel on the strip. Then click the Intensity Autoscale key to scale the intensity profiles. *Note that clicking the mouse button at different points on the display will change the pixel selection but not the strip.*

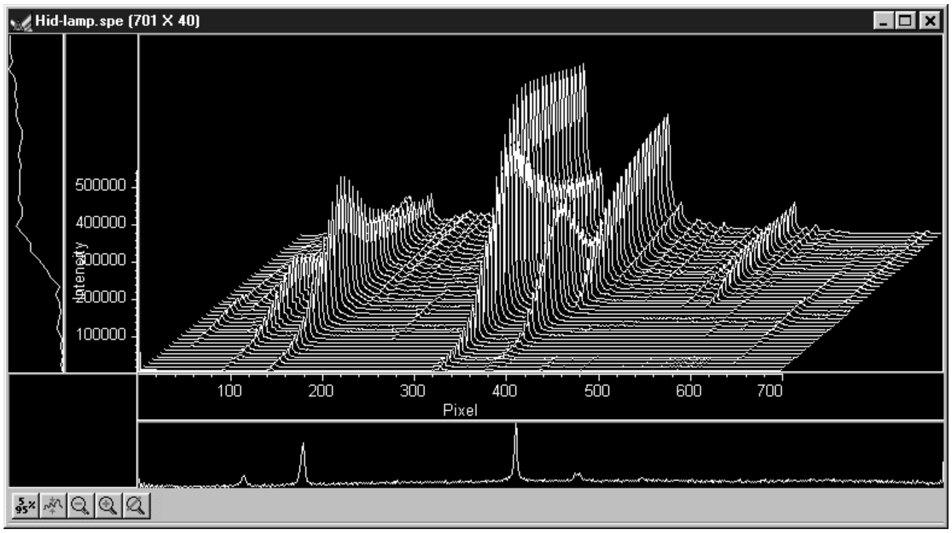
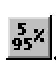
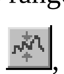


Figure 80. Hid-lamp.spe 3-D Graph

7. Press the **Insert** key repeatedly. Each time it is pressed the display expands about the cursor position. Then press the **Delete** key repeatedly to contract the display, restoring the appearance of the data display.
8. Note the cross sectional displays in Figure 80. The vertical cross-section profiles the intensity at the same point on each successive strip. The horizontal cross-section profiles the intensity at each point on the same strip. If the large cursor is selected, cursor projections will intersect the cross section to show indicate the cursor position. These projections may not be visually aligned with the cursor position on the main plot. This effect will be particularly noticeable with a long Z axis. Because of perspective effects, the higher numbered strips will be further away and visually smaller. The axes automatically adjust so that they read true for the strip on which the cursor is located. However, because the cross-section profiles expand to use all of the available space, they will not be in alignment visually with the cursor. The profile shapes will be correct, and the point on the profiles intersected by the large cross-hair extensions will accurately indicate the cursor position. Also, the information box will accurately report the pixel number and intensity at the cursor position.

5%-95% display range

1. Click on . The data display will shift so that it only fills the 5% to 95% region of the window range. Had the data initially extended all the way to the window boundary, the data display would have been slightly compressed to fit within the 5%-95% range.
2. Click on , restoring the image to its initial appearance.

3. Before advancing to the next topic, open the **View** menu. Then select the Small cursor and deselect Cross-Sections.

Selecting a region of interest

1. Using the mouse, drag a rectangular region on the image as shown in Figure 81.

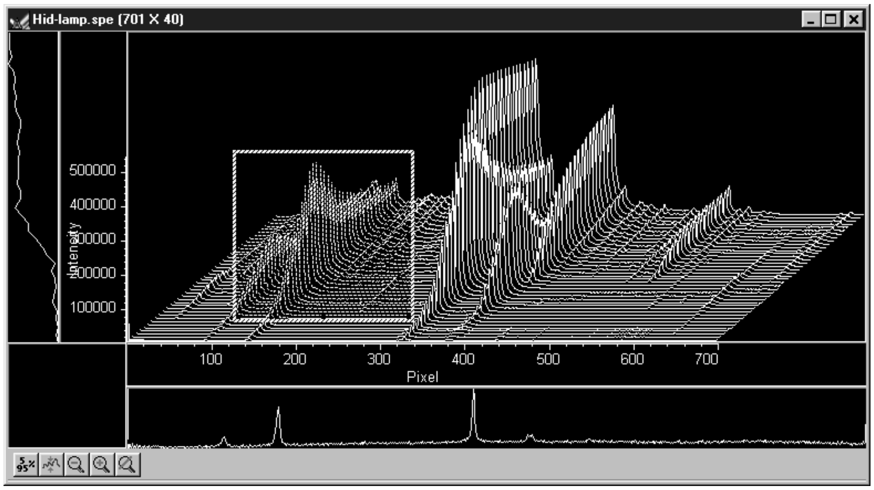


Figure 81. Hid-lamp.spe 3D graph with region selected for viewing

2. Click on  (Zoom In). The view will change so that only the selected region is displayed as shown in Figure 82.

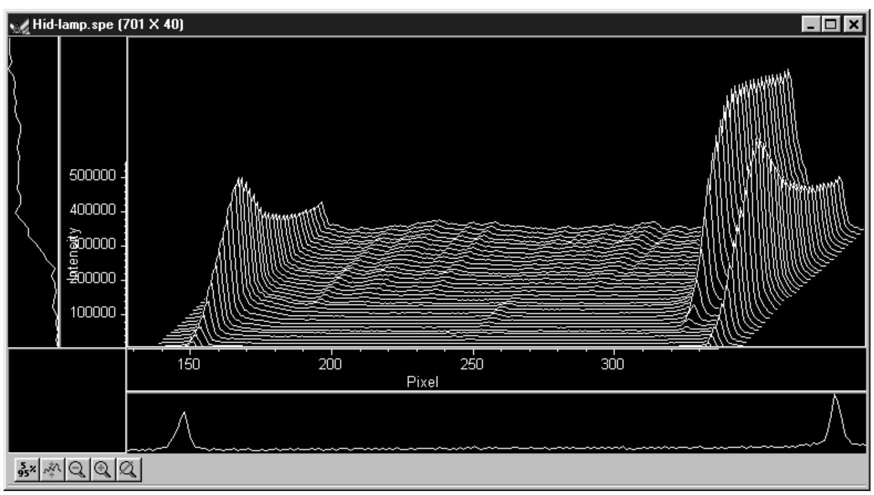


Figure 82. Hide-lamp.spe 3D graph expanded to show defined region

3. Click on  (Undo All Zoom-In). The original view will be restored.

Information box

On the View menu, select Info. The information box should appear as shown in Figure 83. The first line reports the intensity and pixel number at the cursor position. The second line reports the frame number, strip number, and the pixel number. The intensity in A/D counts is reported at the X and Y position corresponding to the cursor position. If a region is defined by dragging the mouse cursor, the region coordinates, length and height will also be reported. *You may have to lengthen the Information box for all this information to appear.*

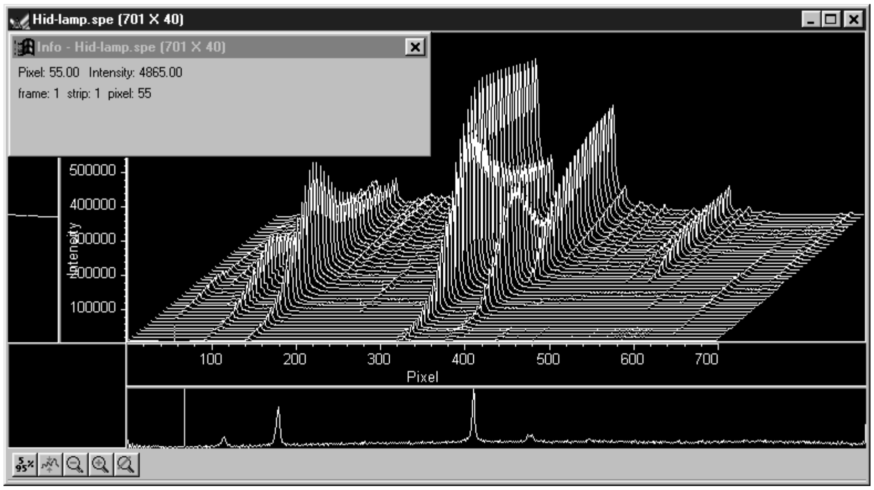


Figure 83. Graphical display with Information box

Note: When you open the information box, it becomes the active window. To perform operations in the data display window, such as changing the selected strip, you must again make the data display window active by clicking the mouse cursor anywhere in the data box. The data-window title bar will become highlighted, indicating that it is the active window, and the cursor positioning functions will become operative again. The data displayed in the information box will continue to be updated automatically.

Displaying a single strip

1. Open the **Display Layout** dialog box by selecting Layout on the Display menu.
2. On the **General** tab page, with Auto Select unselected, click on the Display Type **Graph** radio button and then on **OK**. The single data curve for the strip on which the cursor is positioned will be displayed.

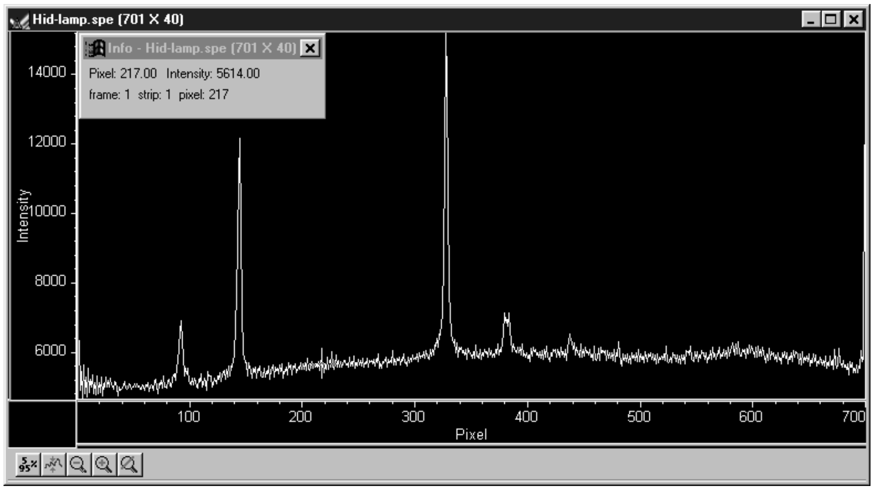


Figure 84. Single strip displayed graphically

3. Try operating the cursor positioning keys to demonstrate their effect. The left/right arrow key move the cursor along the strip, and the up/down keys move it from strip to strip. The **Home** and **End** keys move the cursor to the strip ends, and **Shift + Home** and **Shift + End** move it the first strip and last strip, respectively. The **Insert** and **Delete** keys expand or contract the data about the cursor position.

Restore the 3D display by selecting **3D Graph** on the Display Layout|General tab page.

Cursor

The cursor's appearance and behavior are a bit different with graphical plots than with image plots, as detailed in the following table.

Table 1. Cursor appearance and behavior for images and graphs

Selection	Image Plot	Graph	3D Graph
None	No Cursor	No Cursor	No Cursor
Small	Small cross; both mouse and arrow keys can place cursor at any pixel on image. **Home** and **End** keys move cursor to end points on strip. **Shift + Home** moves cursor to first strip. **Shift + End** moves it to the last strip.	Small cross; left/right arrow keys select pixel on strip; up/down arrow keys select strip to be displayed. **Home** key moves to first pixel, **End** key to last pixel.	Small cross; left/right arrow keys change selected pixel on strip; **Home** key moves to first pixel, **End** key to last pixel. Up/down arrow keys move cursor from strip to strip. **Shift + Home** moves to first strip, **Shift + End** to last.

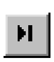
Selection	Image Plot	Graph	3D Graph
			Strips may all be from same frame or each may be from a different frame.
Large	Large cross; rays extend to edges of data set; with projections through the cross-section profiles if displayed. both mouse and arrow keys can place cursor at any pixel on image. **Home** and **End** keys move cursor to end points on strip. **Shift + Home** moves cursor to first strip. **Shift + End** moves it to the last strip.	Same as Small Cursor and Graph combination.	Same as Small Cursor and 3D Graph except that cursor ray projections through the cross-section profiles are provided. These will not necessarily be visually aligned with the cursor.

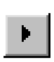
Strip Selection

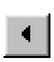
As described above, when displaying data as a graph, the up/down arrow keys can be used to select a higher or lower numbered strip. This is true if displaying multiple strips or a single strip. For additional utility where a large change is required, **Shift + Home** can be used to move the selection to the first strip and **Shift + End** to move it to the last one.

Four of the Custom Toolbar buttons similarly allow the selected strip to be changed when data is displayed as a graph.

 Selects the first strip.

 Selects the last strip.

 Selects the next strip.

 Selects the previous strip.

These buttons have no effect on the strip selection when viewing data as an image. Instead they select the first, last, next and previous frame respectively if the data set contains multiple frames.

Note: When displaying the data as a graph, to view data from multiple frames, it is necessary to select **Same Strip - Multi Frame** on the 3D Layout tab page of the Display Layout dialog box.

It might further be noted that these buttons do not appear on the default Custom Toolbar. Instead they must be added using the Customize Toolbar dialog box, accessed by selecting **Custom Toolbar** on the **Setup** menu.

Cursor Curve and Marker Curves

In analyzing a data display, it is often desirable to highlight the cursor curve and to have every *n*th curve displayed in a different color as a convenient marker. WinSpec/32 provides these functions as demonstrated in the following procedure.

1. On the 3D Layout tab page, select **Highlight Cursor Curve** and **Marker Curves On**. Then press **OK**. The cursor curve and marker curves should be clearly delineated. Note that on a color monitor they would be in contrasting colors and much easier to see than in a black and white print as shown in Figure 85.

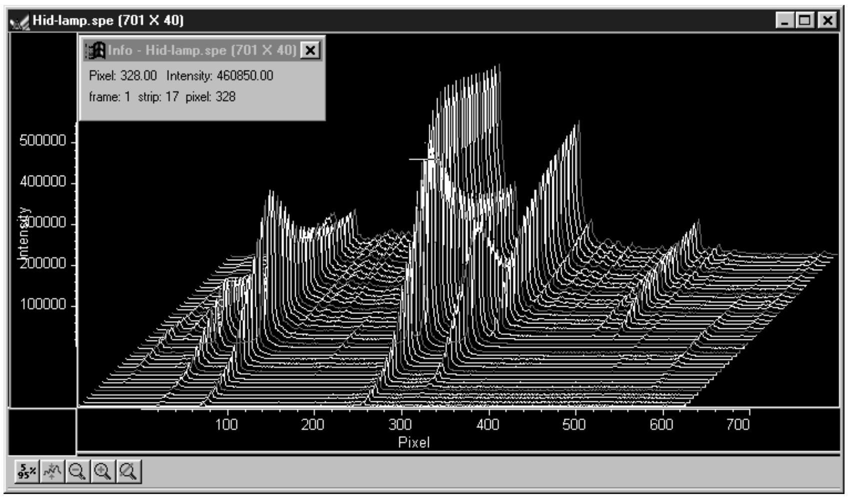


Figure 85. 3D display with cursor curve and marker curves

   Note that displaying the data with Highlight Cursor Curve displayed affects the time required to step the cursor from curve to curve. If Highlight Cursor Curve is OFF, the cursor can step without updating the entire display. If Highlight Cursor Curve is ON, the entire display updates with each step, a considerably slower operation.

2. If the Cursor Curve and Marker Curves don't appear, the problem may be with the assigned colors, which should be different from the normal graph color and different from the background color. On the Display Layout Color tab page, it the **Active 3D Graphs** button that allows the cursor-curve color to be set. The **Marker Graphs** button is used to set the marker-curves color.

Hidden surfaces

You may wish to shift the view to show the hidden or underside of the display, as illustrated in the following procedure.

1. Open the Display Layout dialog box and make the following changes.

   Range: Change Y so that the range is "from 40 to 1" (not "from 1 to 40").

   3D Layout: Select **Show Hidden Surface** and deselect **Highlight Cursor Curve** and **Marker Curves On**. **Remove Hidden Lines** should be selected. Change the Z Axis Endpoint to X% 25 and Y% 0.

The Z Axis Endpoint can be set by entering values up to 80% X (either polarity) and 80% Y (positive only) or graphically by using the mouse. If you click on **Adjust Z Graphically** and then on **OK**, the Z Axis Adjust window will appear. Position the cursor in the window, depress the left mouse button, and drag the cursor around the WinSpec/32 desktop until you see the desired axis orientation. Then release the mouse button.

Because the data is displayed the moment you depress the mouse button and then updated as you drag the cursor, you can see the effects of dragging the axis while moving it. When working with a high-density data set, every *n*th line will be suppressed during the adjustment so the process remains fast. When the data is displayed as desired, releasing the mouse button will cause the entire data set to be displayed with the new orientation.

TIP: Since you can move the cursor outside the data window, reducing the data window size before adjusting the Z axis will give you greater range of motion while dragging the axis.

2. Click on **OK**. The data should be redisplayed as shown in Figure 86, with the hidden surface (darker lines) clearly visible.

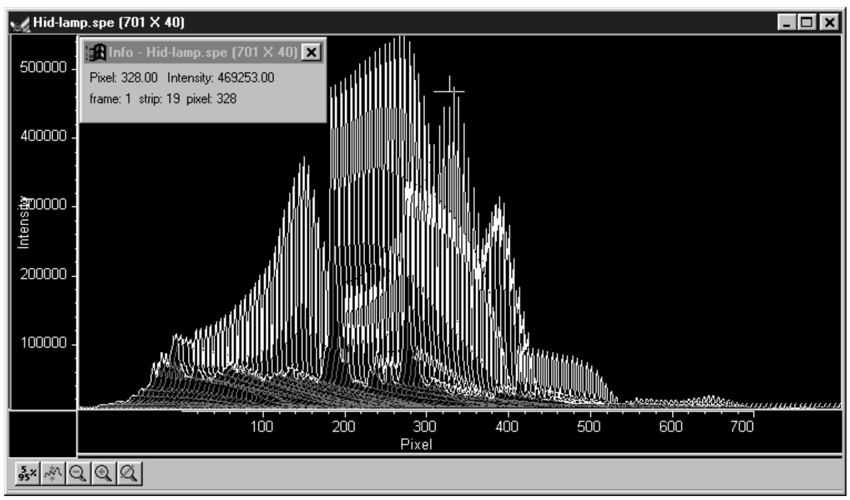


Figure 86. 3D plot with hidden surfaces

3. If the hidden surfaces aren't clearly delineated, it may be necessary to change the color assigned to them, which should be different from the normal graph and background colors. The Normal Hidden Surface button on the Display Layout Color tab page allows the hidden-surface color to be selected. *Note that the Marker Hidden Surface button allows the color of the marker curves in hidden surface regions to be set.*

Data Window Context menu

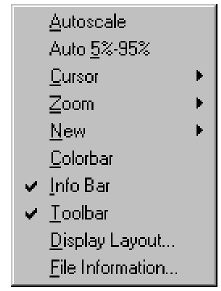


Figure 87. Data Window Context menu

For your convenience, the essential data window functions have been gathered into a single menu, illustrated in Figure 87. This menu, which is available whether the data is displayed as an image, graph, or 3D graph, can be accessed by right-clicking anywhere in the data display area. Brief descriptions of the provided functions follow.

Note: Right-clicking inside an ROI will open the ROI context menu.

Labeling Graphs and Images

For graphs and images, the normal context menu (right-click) is as shown in Figure 88.

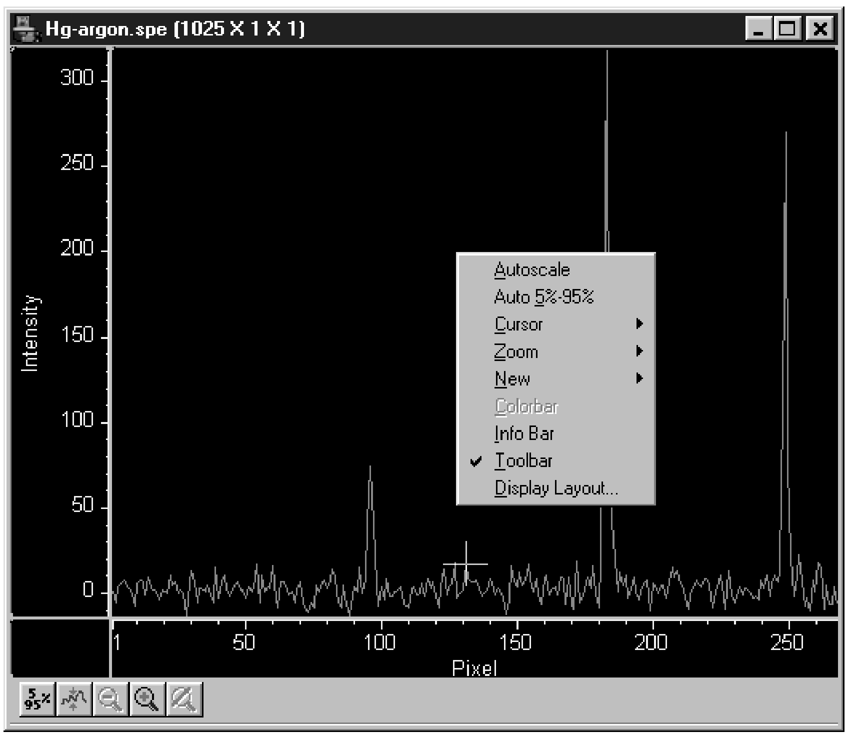


Figure 88. Normal Context menu

This menu was changed for ROIs. If there is an ROI, and if the mouse is right-clicked in the ROI, the context menu changes to that shown in Figure 89.

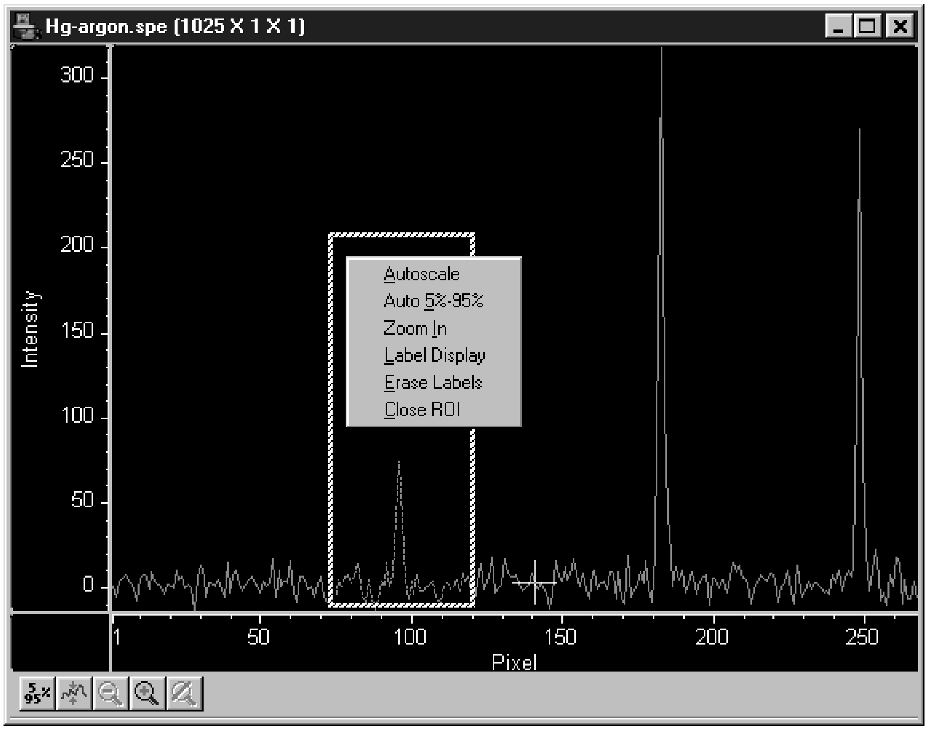


Figure 89. ROI Context menu

If the mouse is right-clicked outside the ROI, the normal menu (Figure 88) appears. The ROI context menu (Figure 89) contains the usual actions pertaining to the ROI (autoscaling on the region inside the ROI, and zooming in to the ROI region) plus three new actions:

Label Display: which allows user labels to be placed on the display,

Erase Labels: which removes ALL user labels from the display, and

Close ROI: which erases the ROI with no other action (it doesn't move the cursor!).

The **Label Display** action brings up a dialog box and opens an Edit box **-** ***Inside the ROI!*** as shown in Figure 90.

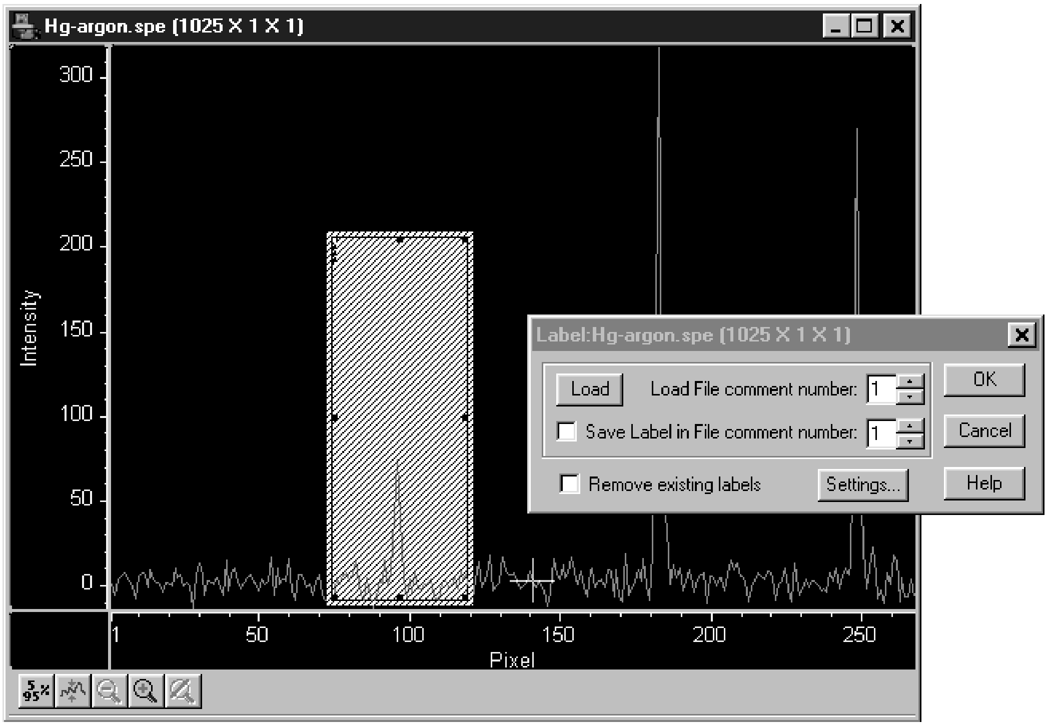


Figure 90. Label Display action

The dialog box allows loading a previously saved label (from one on the SPE file's 5 comment fields); alternatively you can type the label into the edit box. The label can be saved into a file's comment field (when **OK** is clicked). The source comment field and the destination comment field can be different.

Clicking **Remove existing labels** will erase all previous labels from the display before adding the current label.

The **Settings** button brings up a dialog box with options for the label itself (Figure 91). The Display Label Settings dialog box allows you to change the color of the label text, to choose between an opaque (white) background and a transparent background, and choose whether the labels are to run vertically or horizontally. The opaque background works well with images, where the label can get lost inside the image.

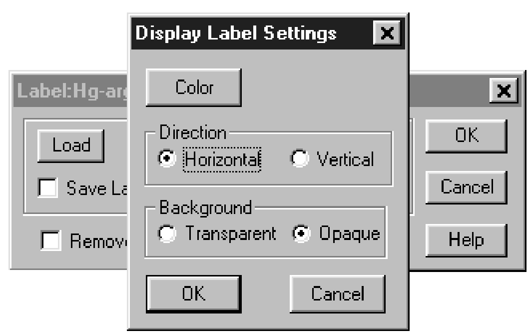


Figure 91. Label options subdialog box

The simplest way to label a display would be to place the ROI where the label should appear (the origin starts at the top left corner of the ROI box), right-click inside the ROI box, type the label text, and click **OK**. Figure 92 shows a label as entered in the label text entry box. Figure 93 shows the same label as it will appear with the data after clicking on **OK**.

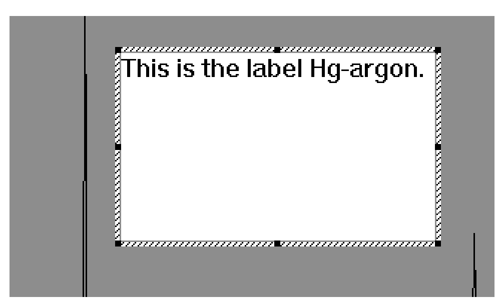


Figure 92. Label text entry box

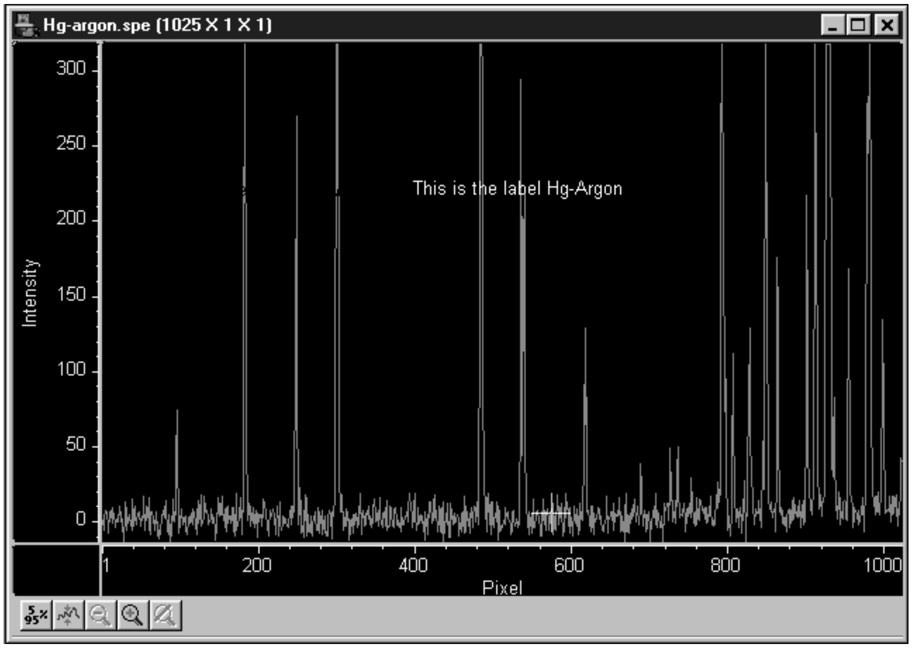


Figure 93. Data with finished label

Generally it is advisable to save the label in a comment field; otherwise, once the label is printed and the display is closed, the label will be lost. In fact, once the label is on the display, it cannot be edited. However, if it has been saved, it can be edited, as follows.

1. Erase labels.
2. Call up the display label menu.
3. Load the label.
4. Edit the label in the edit box.
5. Check the **Save Label** box to save the changes.
6. Click **OK** to print the corrected label.

Labels are printed with the same font as is used for the axes. To change fonts, use the Display Layout, Axes dialog, and select Fonts… (this works even if axes are not displayed).

To reposition the label, move or resize the ROI (and Edit) box before you click on **OK**. Moving the box, however, requires that you position the mouse very near the edge of the box, because further in, the Edit box will capture the mouse. Resizing is done in the usual way with the ROI box handles. If the ROI box is accidentally erased, just redraw a new one in the desired location, and the Edit box will reappear.

The Edit box wraps lines at the end of the box, and the Label function will display the label as it appears in the box (Figure 94)

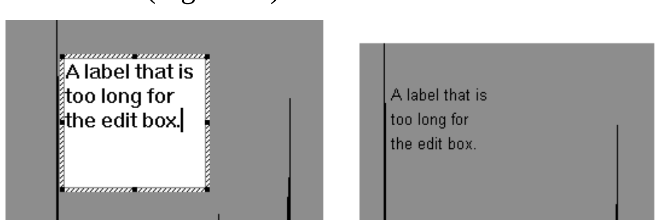


Figure 94. Edit box with line-wrapped label and finished label with same line wraps

To correct the line-wrapping, simply resize the ROI as shown in Figure 95.

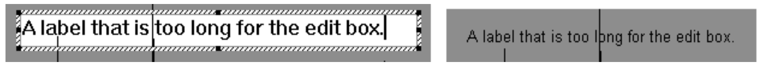


Figure 95. ROI resized to correct line-wrapping

The font can be changed after the label is printed on the display:

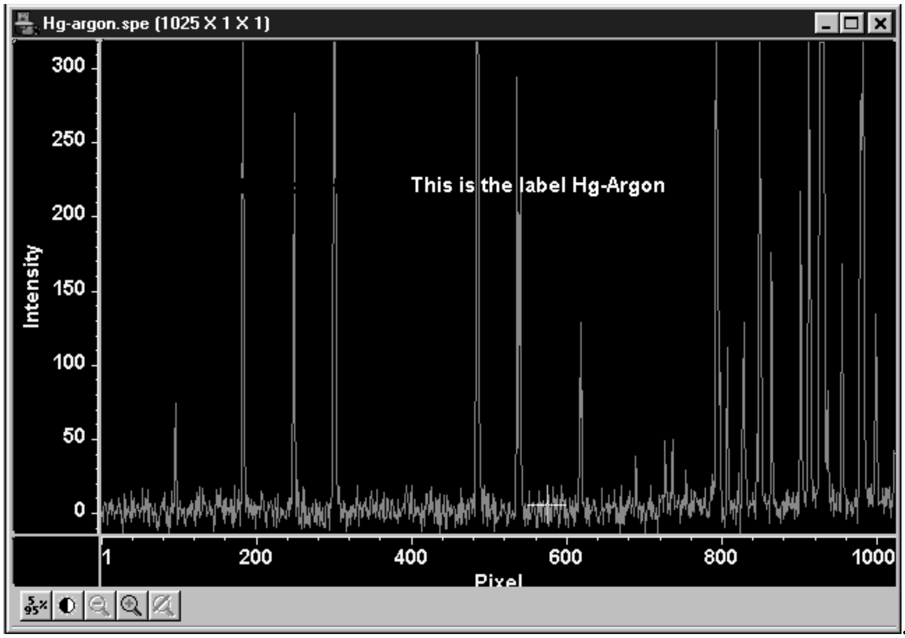


Figure 96. Display after changing font selection

To change the background or color, the label must be erased and reprinted; it can only be altered inside the edit box.

Data Displayed as an Image

WinSpec/32 can display data as an image, as a two dimensional graph, or as a 3 D Graph (multiple strips from the same graph or the same strip from multiple frames). You can choose to allow the software control how the data will be displayed or make the selection yourself. To have WinSpec/32 control the data-display mode, simply check the **Auto-Select** box provided in the **File Open** dialog box and also in the **Display Layout** dialog box. The Auto Select algorithm makes the selection depending on the number of data strips as described on page 97.

Displaying circuit.spe

The image used in this exercise is circuit.spe, one of the images supplied with your WinSpec/32 software. Once you become comfortable working with this image, you should have little difficulty in working with images from actual measurement data.

1. From the File menu, select **Open**. The **Open** dialog box (Figure 97) will appear, allowing you to select the image to be opened. The **Look-In** field provides a browser function so you can easily find the directory where the images. By default, the data directory will be a subdirectory of the directory where WinSpec/32 was installed. Subdirectory names and the filenames of all files of the specified type (the WinSpec/32 data type is *.spe) in the current directory are listed in the box below the directory name. *The WinSpec/32 data type is WinXData (*.spe).*

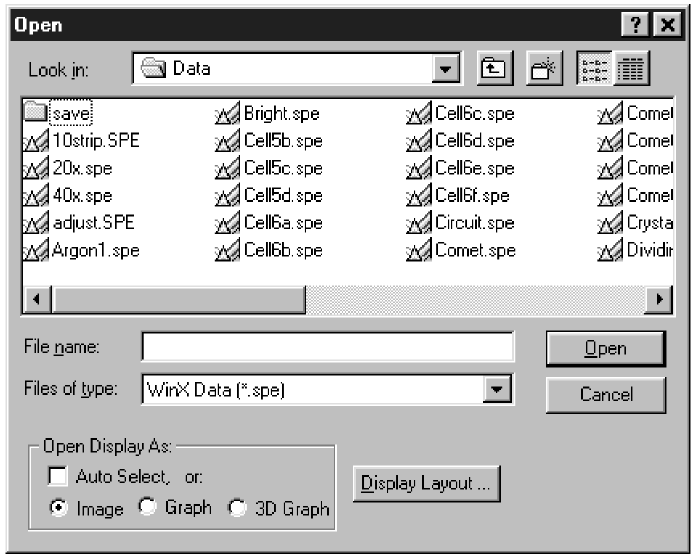


Figure 97. Open dialog box

Note: The directory can be changed by changing the selection in the Look-In box. The next time the Open dialog box is opened, the new folder name will appear in the box and its contents will be shown.

2. If the **Auto-Select** check box is checked, deselect it. Then select **Image**.

3. From the data directory select the image file called CIRCUIT.SPE. Click on the **OK** button. A window of the appropriate dimensions should appear immediately. The image display (Figure 98) may take a few seconds, depending on the speed of the computer.

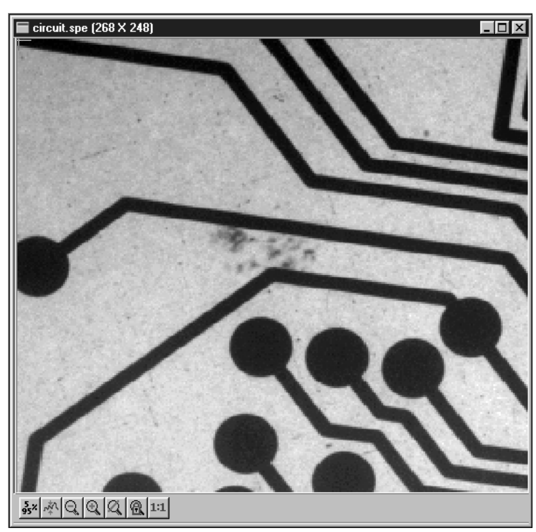
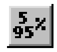


Figure 98. Circuit.spe image

Changing the brightness range

1. Click on  (5%-95%) (located beneath the displayed image as shown in Figure 98). You will observe a moderate brightening of the image as it autoscales on the central 90% of the image histogram. The brightest (pixels with high dark charge) and the darkest pixels (pixels with low response) are ignored.

2. Click on the  (Autoscale) button, restoring the image to its initial appearance.

Brightness/Contrast control

Select Palette on the Display menu. This will open the Brightness/Contrast dialog box (Figure 99). Note that the window includes a plot of display brightness (Y axis) versus data value (X axis). As settings are changed, the displayed curve change to reflect the change in the transfer function. *(See the online Help for a detailed discussion of the palette and transfer function options.)*

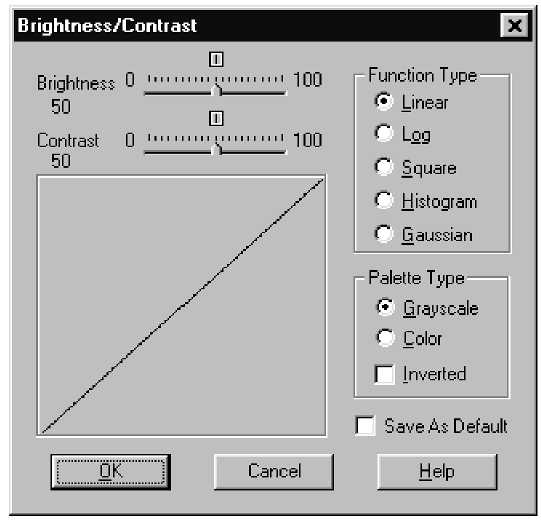


Figure 99. Brightness/Contrast dialog box

1. Change the brightness and contrast settings to obtain the most pleasing image display. Note that clicking on the small square above the Brightness scale and above the Contrast scale will restore the default brightness and contrast values (50).

2. Try different Function and Palette Type selections to see the effect on the displayed image. Note that the displayed curve will also change, reflecting the change in the brightness transfer function. Until you gain more operating experience, we suggest you leave the Function Type set to Linear, the Palette to Grayscale, and the Brightness and Contrast both to 50.

3. Click on **OK** to close the box. Any setting changes will be applied.

Selecting a Region of Interest

1. Using the mouse, position the cursor at one corner of the region to be defined, depress the left mouse button, drag the cursor to the diagonally opposite corner, and release the mouse button. Refer to Figure 100.
2. Click on the  (Zoom In) button. The view will change so that only the selected region is displayed as shown in Figure 101.

   Note: The Display Layout Cursor tab page allows you to change how the ROI region is displayed.

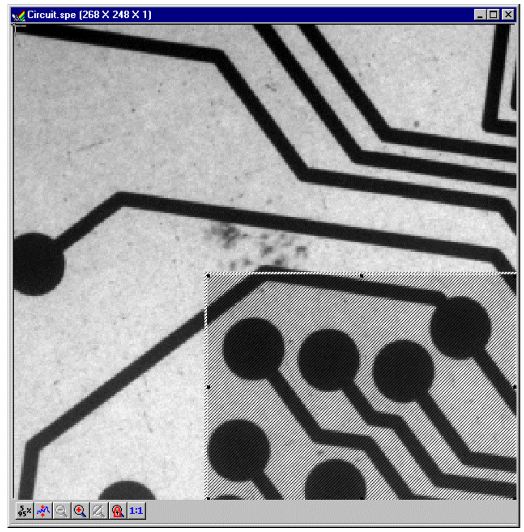


Figure 100. Circuit.spe with region selected for viewing

3. Click on the  (Undo Zoom-In) Button. The original view will be restored.

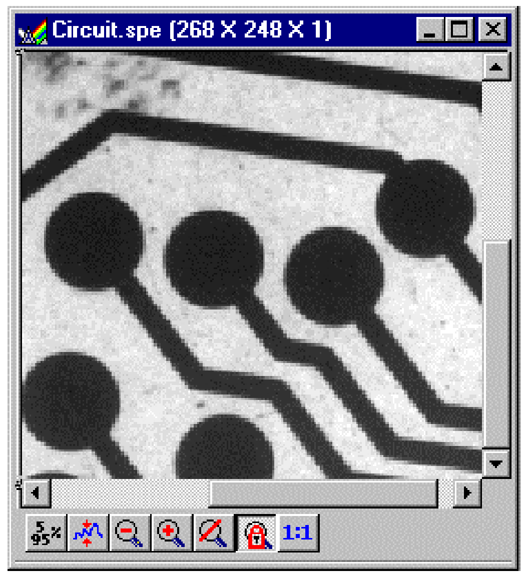


Figure 101. Circuit.spe expanded to show defined region

Opening the Display Layout dialog box

With the image still open, select Layout from the Display menu. The Display Layout dialog box will open (Figure 102). *Note that you can also access the Display Layout dialog box by clicking on the Display Layout button of the Open dialog box.*

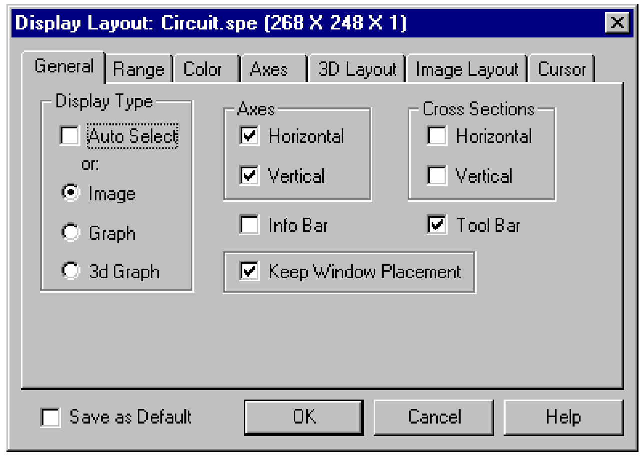


Figure 102. Display Layout dialog box

Viewing axes and cross sections

1. Still in the Display Layout dialog box, select Axes Horizontal, Axes Vertical, Cross Sections Horizontal and Cross Sections Vertical. *Refer to the online Help for additional information on Axes and Cross Sections.*

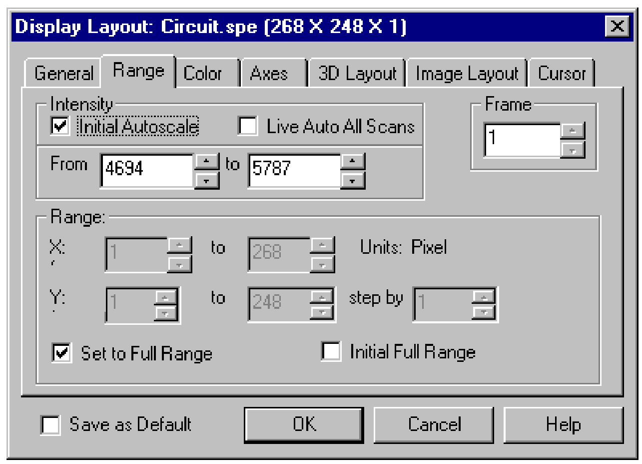


Figure 103. Range tab page

2. Click on the **Range** tab to move the Range tab page (Figure 103) to the front. **Initial Autoscale** and **Set to Full Range** should be selected. The Frame number should be "1."

3. Click on the **OK** button. The Display Layout dialog box will close.

4. Click on the  (Autoscale) button at the bottom of the image window. Then select the large cursor by clicking on Cursor on the View menu and then on Large as shown in Figure 104.

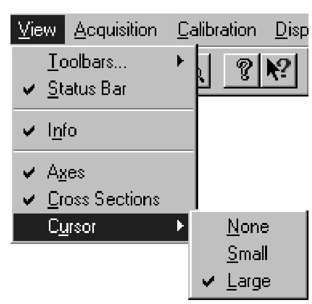


Figure 104. Selecting the large cursor

5. The display should now appear as shown in Figure 105. The axes will be labeled in image pixels and strips with respect to the CCD chip used to acquire the image. The vertical image intensity profile at the cursor position will be displayed to the left and the horizontal image intensity profile at the bottom. The minimum and maximum values for each profile are indicated. Note that you can use the mouse and drag the axes and profile boundaries to change the size of the profile display regions. To change the cursor location simply click the mouse at the new

spot. The cross-sectional graphs will change to reflect the profiles at the new location.

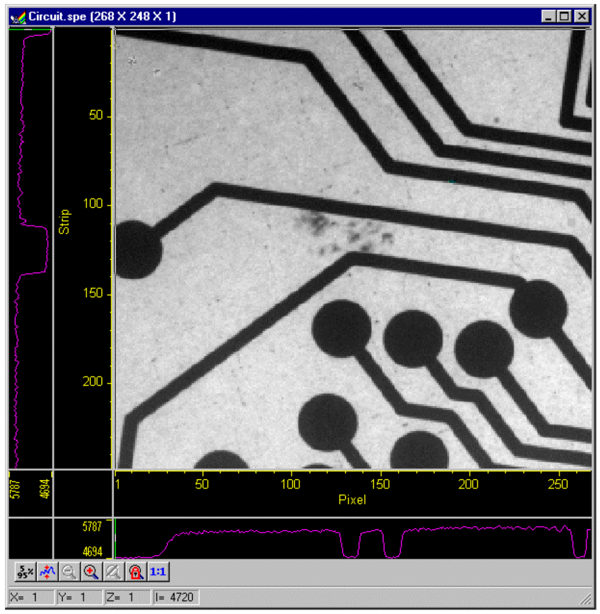


Figure 105. Circuit.spe with axes and cross-sections

Information box

On the View menu, select Info. The information box should appear as shown in Figure 106. The intensity in A/D counts is reported at the pixel and strip position corresponding to the cursor position. Also reported are the Frame number, Aspect ratio, and X and Y Zoom in effect. If a region is defined by dragging the mouse cursor, the region coordinates and diagonal length will also be reported.

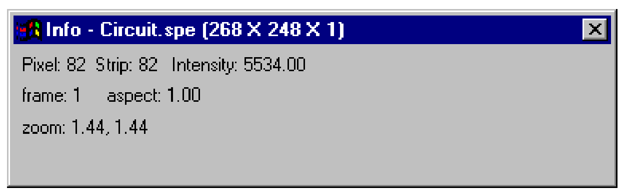
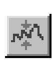
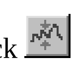


Figure 106. Information box

Autoranging the intensity in a ROI

1. Drag the mouse cursor to define a rectangular region of interest on the displayed image.

2. Click on  (Autoscale). The display will autorange to the intensity range in the defined region. The effect will be an increase in contrast in the observed image. Throughout the image, pixels darker or lighter than those in the defined region will be displayed as black or white.

3. Click the mouse anywhere in the displayed image and click  again to restore the original image view.

Relabeling the axes

1. Open the Display Layout dialog box and open the Axes tab page (Figure 107). Note that Horizontal Axis, Vertical Axis, and the Label box for each are all checked (If unchecked, the corresponding axis or label would not be displayed.)
2. Change the axis label for both axes. Then click on **OK**. The displayed axes will no longer be named **Pixel** and **Strip**, but rather the new labels.
3. Try selecting different fonts to see the effect. Only True-type or Type 1 (Postscript) fonts will work correctly. Open the Fonts dialog box, change the various font choices, and click on **OK** twice. To return to the original font choices, select 10 pt Arial Regular.
4. Reopen the Axes tab page and change the axis labels back to their original designations (**Pixel** for horizontal; **Strip** for vertical).

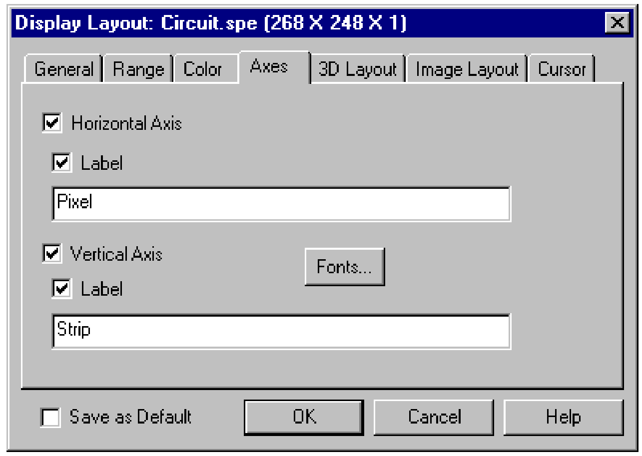


Figure 107. Axes tab page

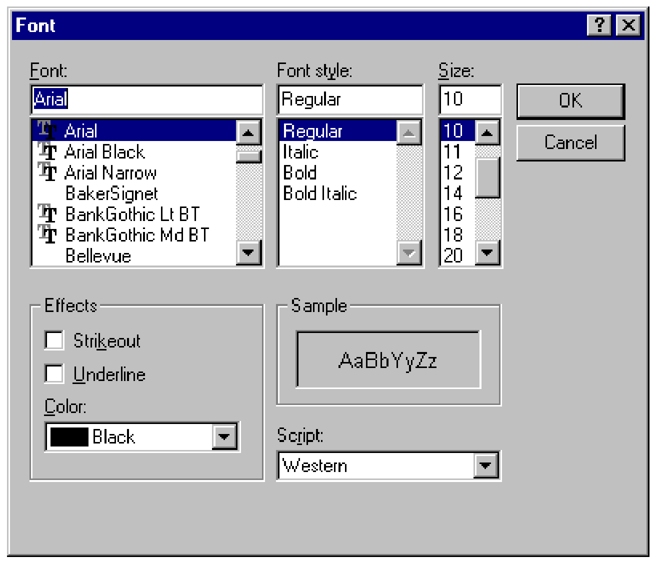


Figure 108. Fonts dialog box

Changing the Color of the Axes and Labels

1. Open the **Color** tab page. Note that there is a button for each item to which a color can be assigned and that the current color for each item is indicated in a color swatch to the right of the button. The default for the Axis is yellow.
2. Click on **Axis**. The color palette will open as shown in Figure 109.

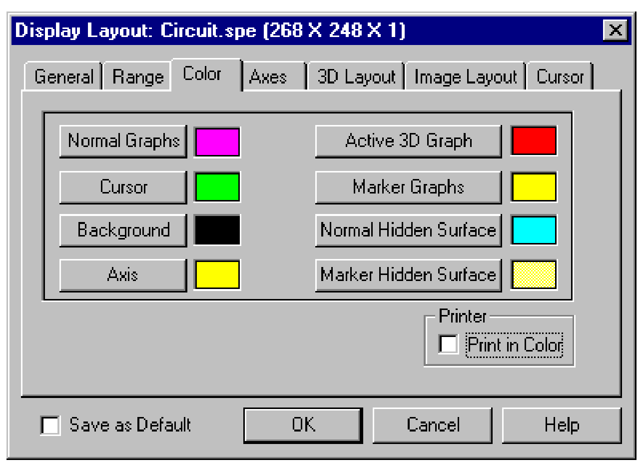


Figure 109. Color tab page

3. Select a different color by clicking on the swatch of the desired color. Then click on **OK** to close the **Color** dialog box and on **OK** again to close the **Display Layout** dialog box. The axes and colors will now appear with the new color.
4. Repeating the process, open the **Color** dialog box again and restore the default color. Again, click on **OK** to close the **Color** dialog box and on **OK** again to close the **Display Layout** dialog box. The axes and labels will now be displayed in the original color.

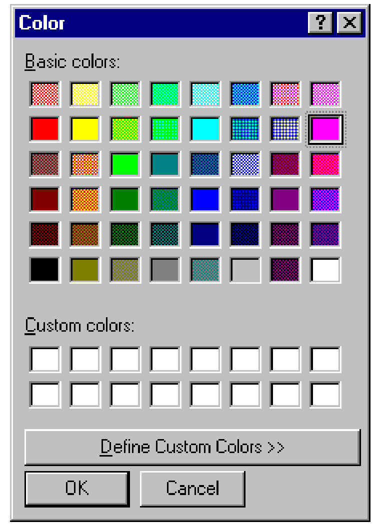


Figure 110. Display layout color palette

Specifying a new ROI and Intensity range

1. Open the **Range** tab page. Note that you can change the displayed intensity range as well as the X-Y range.
2. Try entering more restricted ranges and note how the displayed image changes. Changing the X-Y range by entering new values is functionally equivalent to changing the displayed area by dragging the cursor as previously described. Selecting a narrower intensity range results in pixels brighter and darker than the range limits being displayed as white and black respectively. The effect is to increase the contrast of the image. Each time a change is made, click on **OK** to close the Display Layout dialog box and observe the effect of the change.
3. On completing your display experiments, restore the defaults (Autoscale Intensity and Full Range checked). Last, close the data file.

Displaying a Z-Slice

1. Open a data file with multiple frames.
2. Position the cursor in the data window.
3. Click on Z-slice button. It will cut a section across multiple frames.

This page intentionally left blank.

Part 2
Advanced Topics

This page intentionally left blank.

Chapter 9

Binning & ROI Definition

Overview

General

A Region of Interest (ROI) may be the entire CCD array or it may be a rectangular subregion of the array. For data acquisition, the definition of such a region is done either from the Easy Bin dialog box (Figure 118) accessed from the Acquisition menu or from the ROI Setup tab page (Figure 119), accessible after selecting Experiment Setup from the Acquisition menu. Easy Bin is a simple way of a defining a single full chip width ROI. ROI Setup allows you to create multiple ROIs with greater flexibility in ROI location and width.

Each ROI is defined in the X and Y direction by a start pixel, an end pixel and a group/height (binning) factor. After one or more regions have been defined and stored, data acquisition will use these regions to determine which information will be read out and displayed and which information will be discarded.

When ROIs are used to acquire data, the ROI parameter information (for the first 10 ROIs) is stored in the data file when that data is saved to disk. You can review this information for the active data display by using the File Information functionality (accessible from the File menu or from the Display Context menu).

Notes:

1. For Flatfield Correction, Background Subtraction, etc., the images must be ***exactly*** the same size.
2. References to X and Y axes assume that the shift register is parallel to the X-axis and that the data is shifted to the shift register in the Y direction. See Figure 111 below.

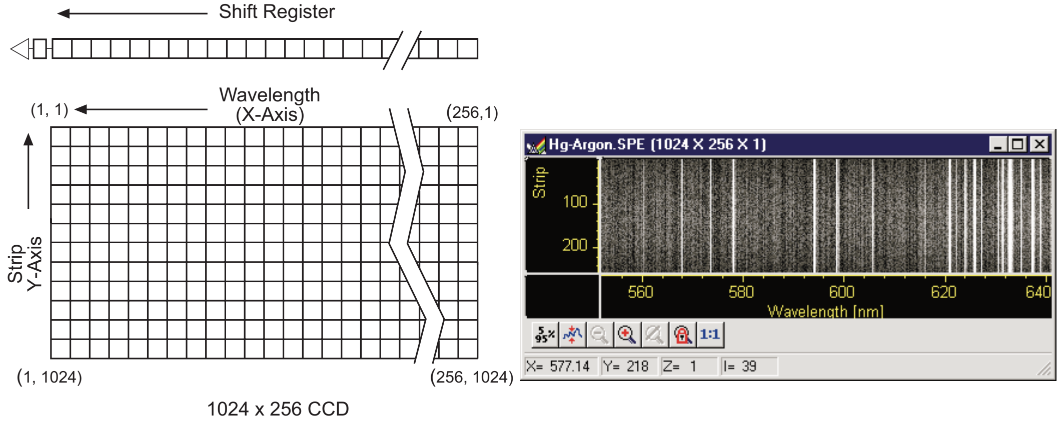


Figure 111. Assumed CCD Array Orientation

Spectroscopy Mode

In Spectroscopy Mode (the default if the Imaging option has not been installed), all pixels in a column are automatically binned. The effect is to produce a single strip of data which is then displayed as a spectrum. If **Use Full Chip** is selected, data acquisition will result in as many data strips as there are pixel strips on the chip, allowing a full frame image to be acquired. If **Use Region of Interest** is selected, data acquisition will result in as many data strips (spectra) as there are defined ROIs.

Imaging Mode

In **Imaging Mode** (available only if the option has been installed) you have the ability to acquire full-frame or ROI-specific images.

If the Imaging option has not been installed, images can only be acquired through the **Use Full Chip** function (on the Experiment Setup|Main tab page). When this is selected, data acquisition will result in as many data strips as there are pixel strips on the chip, allowing a full frame image to be acquired.

Binning (Group and Height parameters)

Overview

Binning is the process of adding the data from adjacent pixels together to form a single pixel (sometimes called a super-pixel). The combination of pixels can be along the X-axis, the Y-axis, or along both axes. The combination can occur while data is being shifted into the shift register (hardware binning) or after the data has been sent to the host computer (software binning).

Hardware binning, performed *before* the signal is read out by the preamplifier, may be used to improve the signal to noise (S/N) ratio. For signal levels that are readout-noise limited this method improves S/N ratio linearly with the number of pixels grouped together. For signals large enough so that the detector is photon shot noise limited, and for all fiber-coupled ICCD detectors, the S/N ratio improvement is roughly proportional to the square-root of the number of pixels binned.

Hardware binning also reduces readout time and the burden on computer memory, but at the expense of resolution. Since shift register pixels typically hold only twice as much charge as image pixels, hardware binning of large sections may result in saturation and “blooming,” spilling charge into adjacent pixels.

Notes:

1. If you have a PCI card, and your controller is other than a MicroMAX or PentaMAX, you must ensure that the number of pixels to be read out is always an even number. A warning will appear if this is not the case. If you are doing binning, the number of pixels digitized (after hardware binning is complete) must be an even number.
2. If blooming is an issue, you can use software binning instead of hardware binning. Software binning is activated by checking **Use Software Binning** on the ROI Setup tab page. While Software binning will prevent saturation of the CCD chip shift register pixels, it is not as fast as hardware binning.

Spectroscopy Mode

X-axis binning can be used in spectroscopy mode to improve the signal-to-noise ratio. However, in many instances a longer exposure time, higher light level, or use of an intensified system may prove to be better ways of improving the signal-to-noise ratio in that they don't degrade the resolution.

As stated earlier, Y-axis binning is the key factor that distinguishes spectroscopy readout from imaging readout. In spectroscopy, ***all*** pixels in each column of an ROI (the entire chip or a specified subregion) are ***automatically binned***. The effect is to generate a single strip of data which is then displayed as one spectrum.

In WinSpec, the ROI definition and binning parameters for spectroscopy are grouped under the headings of **Wavelength** and **Slit**. The Wavelength (X-axis) parameters determine the start point and length of a data strip and the amount of X-axis binning. By default, the Group value is 1 (no binning) but can be increased to indicate the number of pixels being binned to increase the sensitivity (at the expense of resolution). The Slit (Y-axis) parameters determine the vertical location and height of the Y-axis columns. When multiple ROIs are defined, all of the ROIs will have the same Wavelength values, multiple data strips will be generated, and multiple spectra will be displayed. The Slit values, however, may vary from ROI to ROI as long as the Slits do not overlap.

Imaging Mode

Imaging mode allows you to define rectangular groups of pixels (of any size) that will be binned together to create an image rather than a spectrum. Separate Group parameter values can be entered in the X and Y directions for every defined parameter to give you the greatest possible flexibility in controlling the readout. Although modest binning may be employed to increase the sensitivity, there is a tradeoff in that it adversely affects the image resolution. As a result, binning when imaging is normally limited to a few pixels vertically and horizontally.

Defining ROIs

TIP: You can acquire a full-chip data set without losing your ROI definitions. To do so, simply click on the **Use Full Chip** radio button on the Experiment Setup|Main tab page. As long as **Use Full Chip** is selected, the ROI setup parameters are ignored and data collection will result in full frame data sets. To switch back to a defined ROI pattern, click on the **Use Region of Interest** radio button on the Experiment Setup Main tab page.

Examples of Spectroscopy and Imaging ROIs

Figures 112-116 show possible ROI patterns. Note that the patterns in Figure 116 demonstrate varying size ROIs, a feature of Imaging Mode.

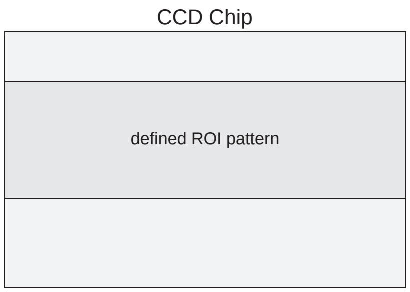


Figure 112. Single Full-width ROI

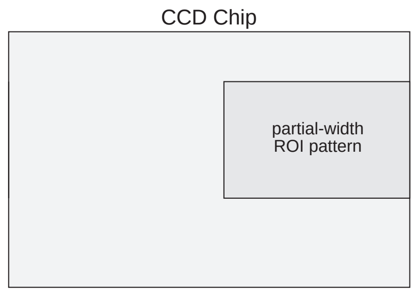


Figure 113. Single Partial-width ROI

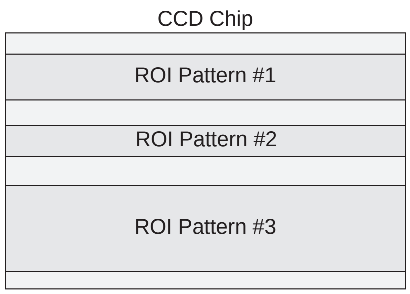


Figure 114. Multiple Full-width ROIs

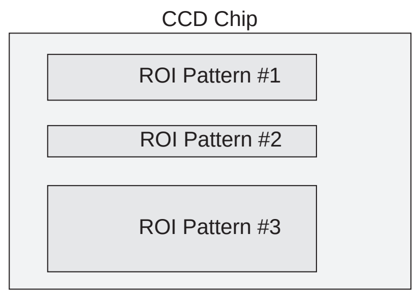


Figure 115. Spectroscopy Mode Multiple Partial-width ROIs

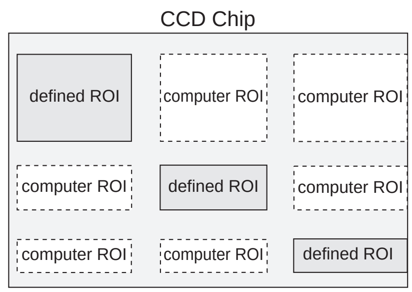


Figure 116. Imaging Mode Multiple ROIs with different widths

Constraints on Defining Multiple Regions of Interest (ROIs)

General: You may create more than 10 ROIs but when data is acquired using these ROIs, the parameter information for only the first 10 ROIs will be stored when you save the data.

Spectroscopy Mode:

1. ROIs cannot overlap. This places restrictions on the Slit (Y) values that can be specified. For example, if Pattern 1 has a Slit Start value of 1 and a Slit Height 100, the Start value for the next ROI must be greater than 100. *If a Full pattern is selected and stored, it overlaps all others, causing all data collections to be full-chip*. Figure 114 illustrates multiple full-width ROIs.

2. Once the first pattern is defined, all subsequent patterns are automatically assigned the same X-axis starting,ending, and grouping values. The first pattern need not be full width — any values in the chip range can be entered, but once stored, those values will apply as well to subsequently defined patterns. The figures below illustrate possible ROI patterns. Note the additional functionality available in Imaging Mode (Figure 116).

Imaging Mode:
In this mode, ROIs can have varying sizes and degrees of overlap. However, when you define multiple ROIs like those in Figure 116, the computer automatically generates six “side-effect” ROIs in the regions where *extensions* of the strips and columns of the defined ROIs intersect. Both the defined and computer generated ROIs will be stored and the data for both will be displayed (see Figure 117). The side-effect ROIs are necessary to accommodate hardware limitations.

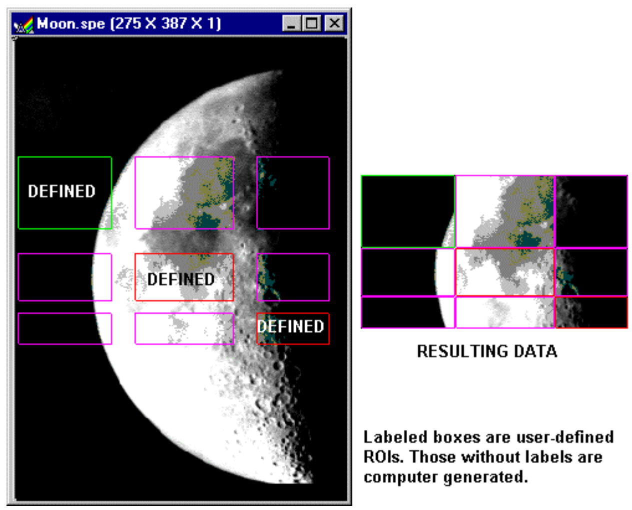


Figure 117. Multiple Imaging ROIs and Resulting Data

Methods of Defining and Storing ROIs

A region of interest (full-width or partial width) can be defined by:

1. Opening the Easy Bin dialog box and entering the values for a single, full chip wide spectroscopy mode ROI.

2. Entering values for the Wavelength (X) and Slit (Y) parameters from the keyboard.

3. Dragging the mouse cursor on a displayed image to define a rectangular region and then clicking the **Mouse** button. Before using this method, you must acquire a Full-Chip image. Otherwise, you will get a "Size of Image in Active Window is Incompatible with Current Chip Size" message when you try to define an ROI.

Note: In Spectroscopy mode, ROIs created via the mouse are limited to full chip width like the ones depicted in Figure 114. This is not the case in Imaging mode.

4. Defining the region with the mouse and then changing parameter values via the keyboard before storing the pattern. This allows you to change a full-width ROI created by mouse selection to a partial-width ROI like the one in Figure 116.

After an ROI is defined, its pattern can be stored, edited, or deleted. All defined areas will indicated on the displayed image after they have been stored. If a pattern is being edited, its outline will be green and all other patterns will have red outlines. In Imaging mode, purple outlines will be drawn if two or more patterns are defined that do not have identical Wavelength Start and End points (these outlines represent additional data that will be included in the image acquired using the ROI Setup). The display of defined regions of interest is automatically updated when patterns are added or cleared. Stored patterns are save to disk when you exit the WinSpec/32 and are automatically loaded the next time you start the program.

Notes:
1. Right-clicking inside an ROI opens the ROI Context menu, which, in addition to providing auto-scale and zoom functions, enables the labeling of image and graphical data.
2. The Experiment Setup|Save/Load tab page allows *all* experiment set parameters, including ROI, to be saved in a user-designated file for later recall. See the discussion of the Save/Load tab page in the online Help.

Defining an ROI via Easy Bin

Easy Bin allows you to define of a single, full chip wide ROI.

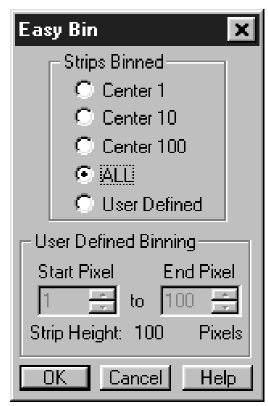


Figure 118. Easy Bin dialog box

1. Select **Easy Bin** from the Acquisition menu.
2. On the **Easy Bin** dialog box (Figure 118), click on the appropriate radio button:

   Center 1: Establishes an ROI one pixel high.

   Center 10: Establishes an ROI 10 pixel high.

   Center 100: Establishes an ROI 100 pixel high.

   All: Selects the full chip height.

   User Defined: Allows you to set the Slit (Y-axis) Start and End pixels. If you have a full chip image displayed, you can use the mouse cursor to create the bounding box for the ROI. Since all Easy Bin ROIs are full chip width, only the box's height parameters will be used.
3. If you have selected **User Defined**, enter the start and end pixels. This allows you to create an ROI that is not centered vertically on the chip.
4. Click on **OK** when you have finished.

To define multiple ROIs, ROIs that are not full chip width, and/or ROIs that are not centered vertically on the chip, use the ROI Setup functions accessible from the Experiment Setup dialog box.

Defining ROIs by Keyboard entry

1. Open the **Experiment Setup** dialog and click on the ROI Setup tab to open the **ROI Setup** tab page (Figure 119).

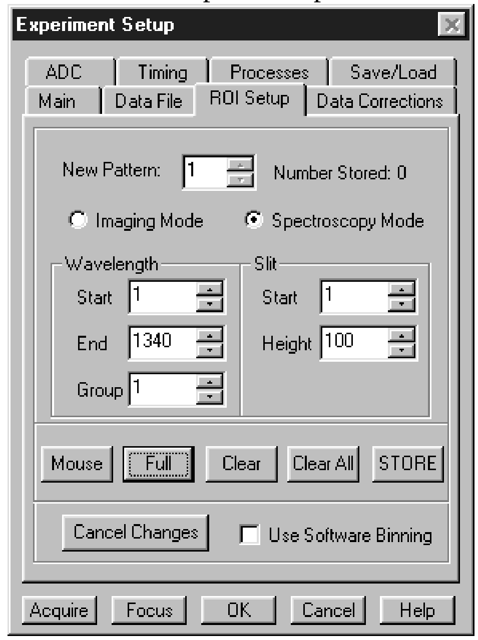


Figure 119. ROI Setup tab page (Spectroscopy Mode)

2. Select the appropriate mode (**Imaging** or **Spectroscopy**). *If you don't have the Imaging option, the Imaging Mode and Spectroscopy Mode radio buttons will not be present.*

   TIP: Acquire a full-chip image before adding or editing ROI patterns. The existing patterns will be superimposed on the image.

3. Note the **Number Stored** value. This will tell you if how many ROIs have already been stored. Depending on what you want to do, you may want click on **Clear** or **Clear All** to remove stored ROI patterns.

4. To add a new pattern, click on the spin buttons (next to the **Number Stored** text) until the text to the far left is **New Pattern**. This will not be necessary if there are no patterns stored.

   a. Enter the Wavelength (X-axis) **Start**, **End**, and **Group** values. The **Group** value controls the X-axis binning: 1 indicates no binning; higher values indicate the number of pixels being binned to increase the sensitivity at the expense of resolution.

   - **Spectroscopy Mode:** When multiple ROIs are defined, the Wavelength values for the first pattern are applied to the subsequent patterns created.
   - **Imaging Mode:** Multiple ROIs can have different Wavelength values.

   TIP: If you're not sure of the chip size, open the **Main** tab page and note the X and Y values there.

   b. Enter the Slit (Y-axis) **Start**, **Height**, and **Group** (if in **Imaging Mode**) values.

   - **Spectroscopy Mode: Height** controls the Y-axis binning: 1 indicates no binning; higher values indicate the number of pixels being binned to generate the strip of data. Do not overlap Slit values.
   - **Imaging Mode: Height** is the height of the image and **Group** determines the Y-axis binning. Image ROIs can overlap.

   c. Click on **Store** to store the newly created ROI. The **Number Stored** will be updated. Repeat this process until you have finished adding ROIs.

5. To edit an existing pattern, click on the spin buttons until the pattern number is displayed in the **Edit Pattern** field.

6. Then make your changes.

TIP: If you are changing the Wavelength (X-axis) values in **Spectroscopy Mode**, select the first pattern and enter your changes there.

7. Click on **Store** to store the changed ROI pattern.

Note: To scan the full CCD chip at any time, simply select the **Use Full Chip** radio button (on the **Main** tab page) and begin acquisition.

Defining ROIs by Mouse input

Often you can easily identify a region of interest by visually inspecting the full-chip image. When this can be done, it is very easy to define the ROI graphically as follows.

1. First, click on the **Use Full Chip** radio button (Experimental Setup Main tab page) so that a full-chip image will be acquired. Then click on **Run**. Alternatively, if you already have an image, open this image and display it on screen.
2. Next click on the **Use Region of Interest** radio button (Main tab page). Then click on the ROI Setup tab to display the ROI Setup tab page. If there are already regions stored, you will now see them displayed as rectangles on the displayed image.
3. Click on the spin button to the right of the **New/Edit Pattern** field until the field label says **New Pattern** (instead of **Edit Pattern**).
4. Use the mouse to drag an ROI box over the desired region in the image display.
5. Click on **Mouse** (ROI tab page) to enter the ROI information. Once this information is displayed on the tab page, you edit it.
6. Click on **Store** to save the new pattern.

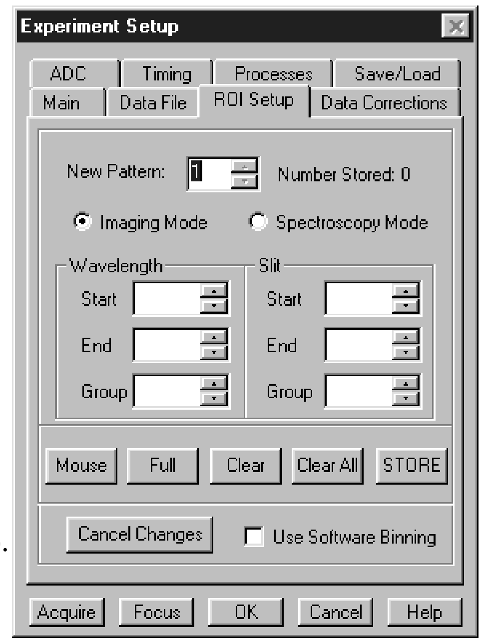


Figure 120. ROI Setup tab page (Imaging Mode)

Chapter 10
Correction Techniques

Introduction

Advanced data collection includes background subtraction, flatfield correction, CCD blemishes removal and Cosmic Ray removal. The skillful use of these techniques can significantly enhance measurement capabilities. *Note that not all of these techniques will be available in early releases of the software.*

Background Subtraction

Princeton Instruments systems are adjusted so that data have a small offset. This offset assures that small signals won't be missed. This offset can be subtracted after the signal is acquired to prevent it from having any influence on the data.

Background subtraction allows you to automatically subtract any constant background in your signal. This includes both constant offsets caused by the amplifier system in the controller as well as time-dependent (but constant for a fixed integration time) buildup of dark charge. Some users collect background spectra with the shutter open, including ambient light in their background data. The background subtract equation is:

(Raw image data – Background) = Corrected image data.

When background and flatfield operations are both performed, background subtraction is always performed first. The equation is the following:

(Raw image data – Background)/Flatfield = Corrected image data.

Below are instructions for collecting and using background data files.

Acquiring background files

This operation is similar to normal data acquisition.

1. Use exactly the same temperature setting as will be used in data collection. Wait at least 30 minutes after the detector has reached operating temperature to ensure stability.

2. Set the same binning parameters, ROI and Exposure.

3. Select **Acquire Background** from the Acquisition menu. This will immediately acquire a background file using the Experiment Setup parameters, only the shutter will remain closed for most applications.

To acquire a background with the shutter open, or if the Acquire Background feature is too restrictive in some other way, a background file can be collected as a normal data file. Once the file is collected and stored, enter the filename in the Background Subtract filename box on the Experiment Setup Data Corrections tab page (see Figure 121).

Setting automatic background subtraction

These steps instruct the software to automatically subtract a previously stored background file from each new data acquisition.

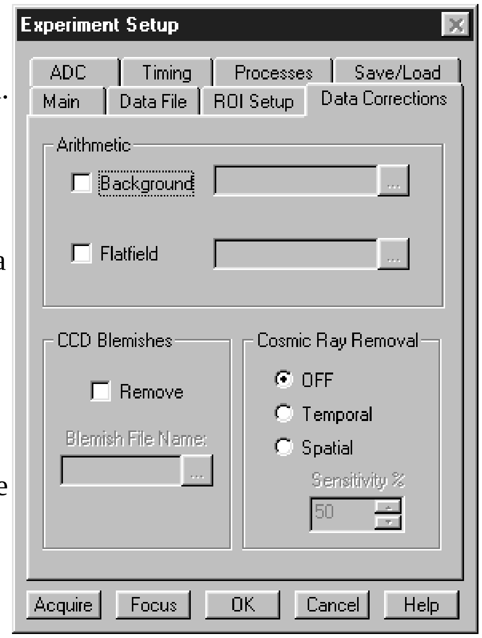


Figure 121. Data Corrections tab page

1. Select Experiment Setup from the Acquisition menu. This will open the Experiment Setup dialog box.
2. Click on the Data Corrections tab. The Data Corrections tab page will be selected (Figure 121).
3. Click on the Background checkbox to turn on background subtraction. Type in the name of a background file if it is in the current directory. Alternatively, click on the button at the end of the entry window to open the file browser to select the background file if it is in a different directory.
4. Once the Background filename has been entered, click on the **OK** button. This saves the background filename for all future data acquisitions, or until the Background is turned off.

The filename entered in the Background box will be subtracted from each new file before it is displayed or stored. If both Flatfield and Background are selected, the background will be subtracted first, before the flatfield correction.

Background Subtraction with Intensified Detectors

To properly perform background subtraction with an intensified detector, a new background must be acquired whenever the intensifier gain setting is changed. This is necessary because changing the intensifier gain also affects the dark charge of the intensifier (EBI).

Flatfield Correction

Flatfield correction allows you to divide out small nonuniformities in gain from pixel to pixel. The instructions below set the flatfield correction to be performed before data are saved to RAM or disk.

Acquiring a flatfield file

This operation is similar to normal data acquisition.

1. Use exactly the same temperature setting as will be used in data collection. Wait at least 30 minutes after the detector has reached operating temperature to ensure stability.
2. Set the same binning parameters and ROI. If you plan to use a background file with data collection, on the Experiment Setup dialog select Background and enter the name of the background file. This background file will be subtracted from the flatfield file before it is saved to disk.
3. Illuminate the detector uniformly. The accuracy of this uniformity will be translated into an accurate flatfield correction.
4. Select **Acquire Flatfield** from the Acquisition menu (Figure 50). This will immediately acquire a flatfield file using the Experiment Setup parameters. Unlike background subtraction, the shutter will open and close normally.
5. If background subtraction was selected, the background file will be subtracted from the flatfield file before it is saved to disk.

If the Acquire Flatfield feature is found to be too limiting in some way, a flatfield file can be collected as a normal data file. Once the file is collected, enter the filename in the Flatfield Correction filename box on the Experiment Setup Data Corrections tab page see (Figure 121).

Automatic flatfield correction

These steps instruct the software to automatically divide each new data file, pixel-by-pixel, by the specified flatfield file.

1. Select Experiment Setup from the Acquisition menu. This will open the Experiment Setup dialog box.
2. Click on the Data Corrections tab to select the Data Corrections tab page (Figure 121).
3. Click on the Flatfield check box to turn on Flatfield correction. Type in the name of a flatfield correction file in the current directory. Alternatively, click on the button at the end of the field to open the file browser to select the flatfield correction file if it is in a different directory.
4. Once the Flatfield filename has been specified, click on the **OK** button. This saves the flatfield filename for all future data acquisitions, or until the Flatfield correction is turned off.

Each pixel in a new file will be divided by the corresponding pixel in the Flatfield file. If both Flatfield and Background are selected, the background will be subtracted first, before the flatfield correction.

CCD Blemishes

Columns specified as bad in the blemish file will be replaced by interpolated data (based on the column before and the column after the bad column) as data is collected. After you click on the Remove checkbox, you can select the appropriate blemish file. Clicking on the button at the right of the **Blemish File Name** field opens a browse dialog box so you can locate and select a file. If you don't have a blemish file but have determined that there are one or more bad columns, you can create one to be used.

Note: *CCD Blemishes removal may not be implemented in early releases of the software.*

Creating a Blemish File

1. Open an ASCII text editor.
2. On the first line, key in the number of columns on the CCD. For example, you would key in 1024 if the CCD format was 1024 x256.
3. Press [Enter].
4. For each CCD column, enter either a 0 (no blemish) or a 1 (blemish) and press [Enter]. If there was only one blemish and it was in column 10, you would have 9 lines of 0s, a 1 in the tenth row, and 0s in the remaining 1014 lines.

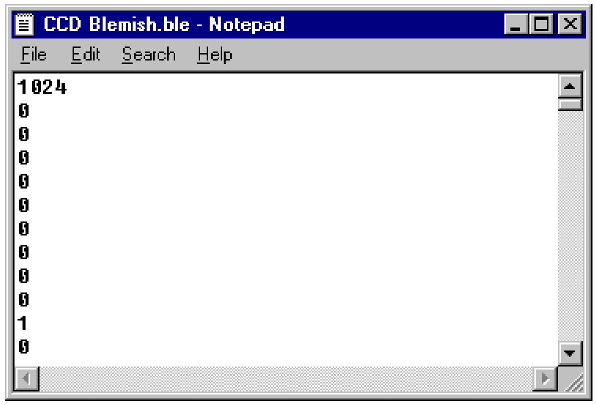


Figure 122. Blemish File

5. When you have finished entering the 0s and 1s, save the file with a .BLE extension. Files with this extension are recognized by WinSpec as blemish files.

TIP: If you have a long array, use a spreadsheet that can save data to .TXT files. The numbered rows will help you keep track of where you are. When you have finished with the data entry, save the data to a text file (.TXT extension) and then change the file extension to .BLE.

Cosmic Ray Removal

Causes highly localized spikes, such as would be caused by cosmic rays interacting with the silicon of the CCD, to be removed from the data after it is acquired but before it is stored. Two different techniques (in addition to OFF) can be selected. The Temporal technique compares a series of spectra and requires no user parameters. The Spatial technique compares the data with the set threshold level. If Spatial is selected, the Sensitivity setting determines how large a data spike must be to be identified as a cosmic ray effect (essentially the Sensitivity is a gain setting on the thresholding algorithm. A value of 0 will find 0 cosmics, while a setting of 100 will be most sensitive.). A setting of 50 will give good results in most situations. Cosmic ray data is replaced by interpolated before-and-after data.

Chapter 11

Spectra Math

Introduction

A variety of mathematical operations can be performed on WinSpec data files. This functionality, called Spectra Math, is selectable from the Process Menu. The four tab pages on the Math dialog box (Figure 123) allow you to select the source file(s), operation, and the destination file for the results of the selected mathematical operation (displayed at the top of the dialog box). Additionally, you can use the mouse to specify an ROI to be processed (available on tab pages A and B).

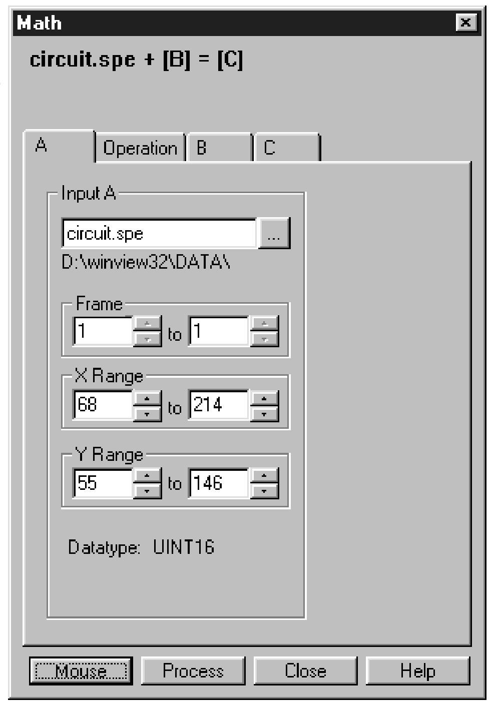


Figure 123. Math dialog box

Source Data and Destination Selection

As many as three data files can be involved in math operations and there is a corresponding tab page for each of them, **A**, **B**, and **C**. **A** and **B** are Input Files. **C** is always the Output File. Every operation requires at least one Input File and an Output File. Thus, every operation will require using tab pages **A** and **C**. In those cases where a second Input File (or a constant) is required, tab page **B** will also be used (see the online Help for detailed descriptions of the individual Math file pages).

With but a few exceptions, the parameters on the three file tab pages are the same. Brief descriptions follow.

Frame: If an input file contains multiple frames, you can specify the ones to be processed. The default is to process all frames. You additionally have the option of choosing not to write all of the frames processed to the Output File.

X and Y Range: You can specify the input file pixels to be processed. The default is to process all pixels. You additionally have the option of restricting the X and Y pixel range data written to the Output File. An alternative way to specify a region is to use the mouse to define the region on the active data display of the input file and then click on **Mouse**.

Input (Output) Filename: All three tab pages have a field for entering the filename. In each case there is a button at the end of the box which, when pressed, opens a browser to make selecting and specifying filenames and locations as simple as possible. In the case of the **B** tab page, there is additionally a field for entering a constant. Radio buttons are provided that activate one or the other of the two fields. Either a constant value or a filename can be entered, but not both.

Data Type: For the **A** and **B** tab pages, the data type is reported only and cannot be changed. In the case of the **C** (output) tab page, you can specify the data type. Data types include:

Byte: 8 bits; only the eight least significant data bits (levels 0 to 255) will be saved.

UnInt: Unsigned integer; 16 bits (0 to 65535)

Int: Signed integer; 16 bits (-32768 to 32767)

Long: Signed integer; 32 bits (-2,147,483,648 to 2,147,483,647)

Float: Floating point; 32 bits (-1.75494351e^{-38} to 3.402823466 e^{38})

Display Result: This checkbox appears on the **C** page only. If checked, the output image will be displayed as soon as the processing is complete.

Operations

On the **Operation** tab page, the math operations are listed as either Linear or Non-Linear. The operand(s) for math operations can be a single file, a file and a constant, or two files. In addition to allowing you to perform these operations on entire files, WinSpec also allows you to specify the frames (if multi-frame) and a region of interest (ROI).

- When working with a single file, the specified operation is performed on each pixel value of **A** and the result is written to the corresponding pixel of the Output File, **C**. The operations available are grouped under the Non-Linear heading:

Log10	Absolute Value
Natural Log	Bitwise Complement
Square Root	Binary NOT
Squared	

- When working with a single file and a constant, the operation will be performed on each pixel value of **A**, using the constant specified on the **B** tab page, and the result is written to the corresponding pixel of the Output File, **C**. The operations available are grouped under the Linear heading:

Addition	Min
Subtraction	Max
Multiplication	Bitwise AND
Division	Bitwise OR
Bitwise Exclusive OR	

- When working with two files, corresponding pixels from the two files, **A** and **B**, are operated on and the result is written to the corresponding pixel of the Output File, **C**. The operations that can be performed are the same as for a Single file and Constant described above.

Operation Descriptions

Linear Operations

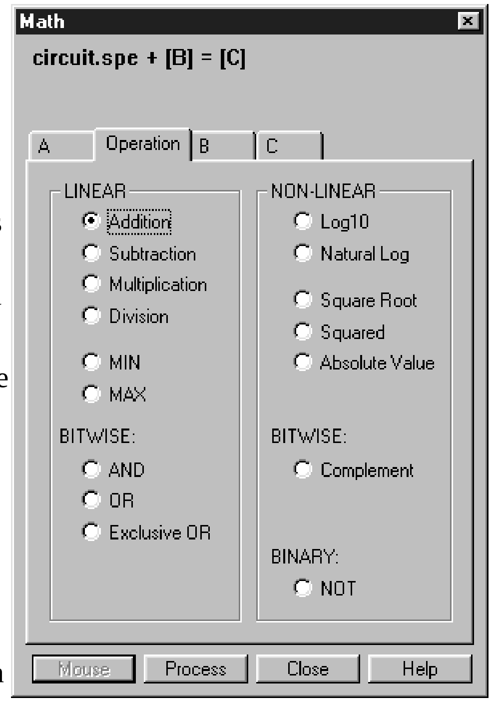


Figure 124. Operation tab page

Addition: The **A** file is added, pixel by pixel, to the **B** file and the results written to the **C** file. It is also possible to add a constant entered on the **B** tab page to each point on the **A** file, with the results written to the **C** file.

Subtraction: The **B** file is subtracted, pixel by pixel, from the **A** file and the results are written to the new file. It is also possible to subtract a constant entered on the **B** tab page from each point on the **A** file, with the results written to the **C** file.

Multiplication: The **A** file is multiplied, pixel by pixel, by the **B** file and the results written to the **C** file. It is also possible to multiply each pixel of the **A** file by a constant entered on the **B** tab page, with the results written to the **C** file.

Division: The **A** file is divided, pixel by pixel, by the **B** file and the results written to the **C** file. It is also possible to divide each pixel of the **A** file by a constant entered on the **B** tab page, with the results written to the **C** file.

MIN: The **A** file is compared, pixel by pixel, with the **B** file and the smaller of the two values written to the **C** file. It is also possible to compare each pixel of the **A** file with a constant entered on the **B** tab page, with the smaller of the two values written to the **C** file.

MAX: The **A** file is compared, pixel by pixel, with the **B** file and the larger of the two values written to the **C** file. It is also possible to compare each pixel of the **A** file with a constant entered on the **B** tab page, with the larger of the two values written to the **C** file.

Non-Linear Operations

Log10: The Log10 of the **A** file is computed pixel by pixel and the results written to the **C** file.

Natural Log: The natural log of the **A** file is computed pixel by pixel and the results written to the **C** file.

Square Root: The square root of each point in the **A** file is computed and the result written to the corresponding point of the **C** file.

Squared: Each point in the **A** file is squared and the result written to the corresponding point of the **C** file.

Absolute: The absolute value of each point in the **A** file is computed and the result written to the corresponding point of the **C** file.

Bitwise Operations

AND: A bitwise AND operation is performed on the binary representation of each pixel of the **A** file and each pixel of the **B** file, with the result written to the **C** file. A twelve-bit example follows.

	Bits	Decimal Value
Pixel value in **A**	0 1 0 1 0 1 0 10 1 0 1	1365
Corresponding pixel value in **B**	0 0 0 0 0 0 1 1 1 1 1 1	63
Result written to **C**	0 0 0 0 0 0 0 1 0 1 0 1	21

OR: A bitwise OR operation is performed on the binary representation of each pixel of the **A** file and each pixel of the **B** file, with the result written to the **C** file. An eight-bit example follows.

	Bits	Decimal Value
Pixel value in **A**	0 1 0 1 0 1 0 10 1 0 1	1365
Corresponding pixel value in **B**	0 0 0 0 0 0 1 1 1 1 1 1	63
Result written to **C**	0 1 0 1 0 1 1 1 1 1 1 1	1407

Exclusive OR: A bitwise Exclusive OR operation is performed on the binary representation of each pixel of the **A** file and each pixel of the **B** file, with the result written to the **C** file. An eight-bit example follows.

	Bits	Decimal Value
Pixel value in **A**	0 1 0 1 0 1 0 10 1 0 1	1365
Corresponding pixel value in **B**	0 0 0 0 0 0 1 1 1 1 1 1	63
Result written to **C**	0 1 0 1 0 1 1 0 1 0 1 0	1386

Complement: For each pixel value n in the **A** file, the corresponding value in the output file **C** is set to -1-n. Otherwise stated, each 0 becomes a 1 and each 1 a 0.

Binary Operations

NOT: For each pixel in the **A** file, all non-zero values yield a zero, and all zero values (only) yield a one. The resulting values are written to the corresponding point of the **C** file.

Procedure

1. Select the operation to be performed on the Operation tab page.
2. Enter the first input filename on the **A** tab page.
3. If the operation involves two files or one file and a constant, enter the second file name on the **B** tab page or enter the value of the constant on the **B** tab page.
4. If you want to process only part of the input images, change the Frame, X Range, and Y Range values on the **A** tab page, and also on the **B** tab page if two files are involved. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. Enter the name of the output file on the **C** tab page. If you want to restrict the output data range, change the Frame, X Range, and Y Range values as appropriate.
6. Select the output file datatype.
7. If you want the output file to be displayed as soon as the processing is complete, check the Display Result box.
8. Click on **OK** to begin processing, or **Cancel** to cancel the operation.

This page intentionally left blank.

Chapter 12
Y:T Analysis

Introduction

Y:T Analysis allows you to easily monitor and study the way ***spectral*** data changes as a function of time. This is particularly useful in characterizing time-dependent processes. Y:T Analysis provides for defining ***areas*** on the data, where each area is a region bounded by a starting and ending wavelength and containing a certain number of pixels whose wavelength values lie within the region. The value of an area is the sum of the intensities of the pixels in the area.

If a process study produces spectral lines that change with time, it may be useful to define a separate area for each line of interest, where each line is precisely spanned by its area. The value of each area can be the sum of the total intensities defined with respect to the baseline, or the values can be *baseline-corrected*, in which case the value of each area is the sum of the intensities with respect to an imaginary line joining the first and last pixels of the area. *This latter method is more accurate with a sloping baseline.*

After areas have been defined, they can then be mathematically operated on as specified in user-entered ***equations***. These equations allow you to can add, subtract, multiply, divide or otherwise manipulate up to eight areas. You can also include constants or ***even other equations***. The Y:T analysis modes provided give you control over when the equation calculations will be performed, how many will be performed, and on which acquired data they will be performed.

Each time equation calculations are performed, one Y:T analysis value is produced for each equation. For example, in a one-hour experiment with one Y:T equation and a Y:T sample time of one minute, at the end of the hour a Y:T analysis curve sixty points in length would have been taken and stored. If two equations had been defined for the same experiment, at the end of the hour there would be two Y:T curves, each sixty points in length. *An additional Y:T curve for the time will always be provided as well.*

Y:T curves are stored and can be displayed, printed or processed the same as any other data.

Y:T Analysis Procedure

1. Establish the **Experiment Setup** parameters for acquiring the data on which the Y:T analysis is to be performed.
2. Select **Y:T Analysis** on the **Acquisition** menu. This will open the **Y:T Area and Equation Setup** dialog box (Figure 125).

3. Define the Areas and Equations for the Y:T analysis. *A detailed discussion of the Y:T Area and Equation Setup dialog box and the process of setting Areas and Equations is available in the online Help.*
4. Click **OK** in the Y:T Area and Equation Setup dialog box to close the dialog box.
5. Select **Experiment Setup** on the **Acquisition** menu.
6. Select the **Processes** tab page (Figure 126).
7. Click the **On-Line Y:T** check box to activate the **Y:T Setup** button. *Checking the box turns on Y:T analysis. It will take place during any data acquisition run initiated with this box checked.*

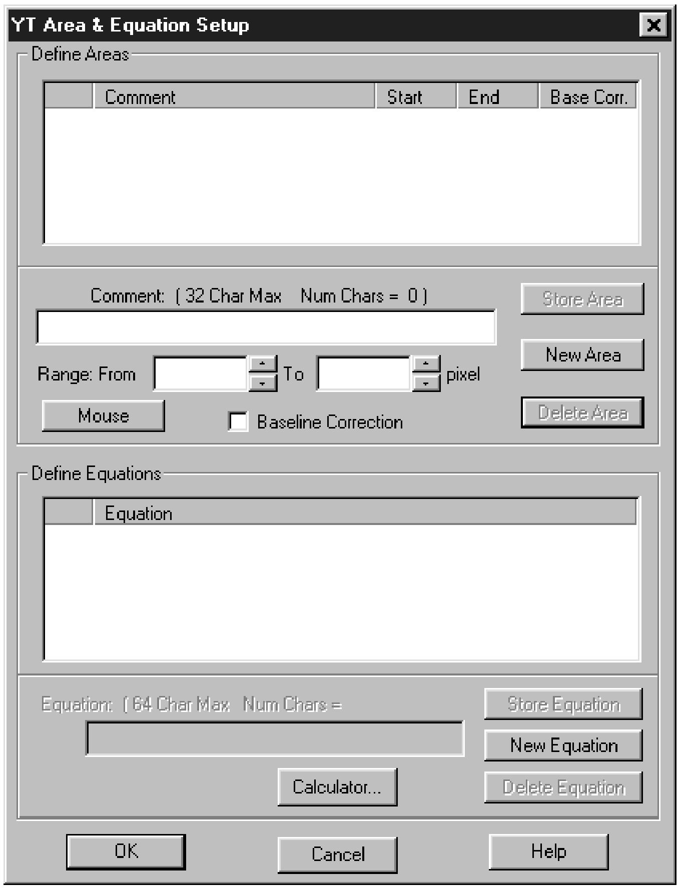


Figure 125. Y:T Area and Equation Setup dialog box

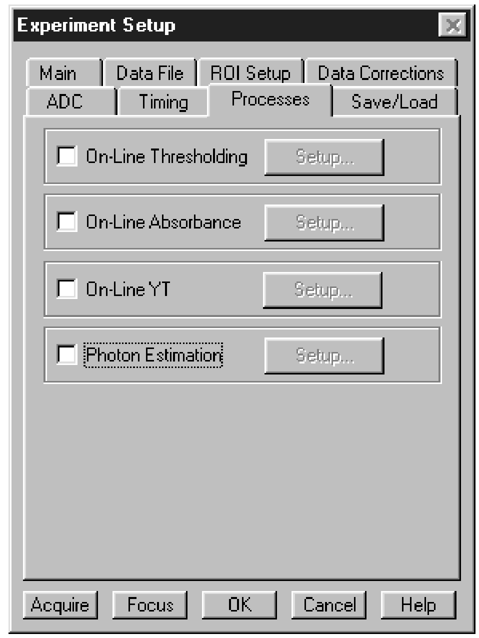


Figure 126. Processes tab page

8. Click on **Y:T Setup** to open the **Y:T Setup** dialog box (Figure 127).
9. Set the **Y:T Acquisition** mode, **Focus**, **Snapshot** or **Average** and set the **Y:T Analysis** parameters. *A detailed discussion of the Y:T Acquisition modes and parameters is available in the online Help.*
10. Click on **OK** to close the box.
11. Initiate data acquisition. As the data is acquired, Y:T points will be computed and stored as described in the online Help for the Y:T Setup dialog box. If multiple equations were defined, they would be computed in order and there would be a separate Y:T curve for each. Selecting **3D Graph** on the **Display Layout Main** page would allow all five to be viewed simultaneously. If the selection is **Graph**, only one would be visible.
    The keyboard cursor up/down arrow keys can be used to select the Y:T curve to be viewed and the Info box shows which strip is being displayed.

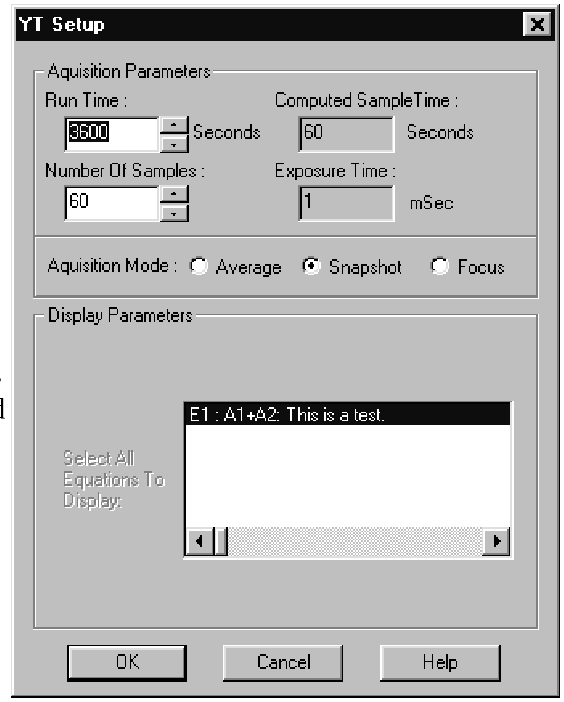


Figure 127. Y:T Setup dialog box

This page intentionally left blank.

Chapter 13
Gluing Spectra

Introduction

There are two ways to glue together multiple exposures into a single contiguous spectra. The first is to take existing spectra that have already been calibrated and have the WinSpec/32 software connect the spectra at the appropriate points. The second method requires spectrometer control. With correctly calibrated spectrometer control, the WinSpec/32 software can collect spectra and move the spectrometer, automating the process of collecting a spectrum whose wavelength range can extend the full spectral range of the detector.

Gluing Existing Spectra

You can glue any series of existing data files, providing that they all have been properly calibrated in nm. The files should overlap some in order to provide complete spectral data, but this is not required by the software. Any collection of calibrated single spectrum files can be used to create a glued file. The only requirements are that:

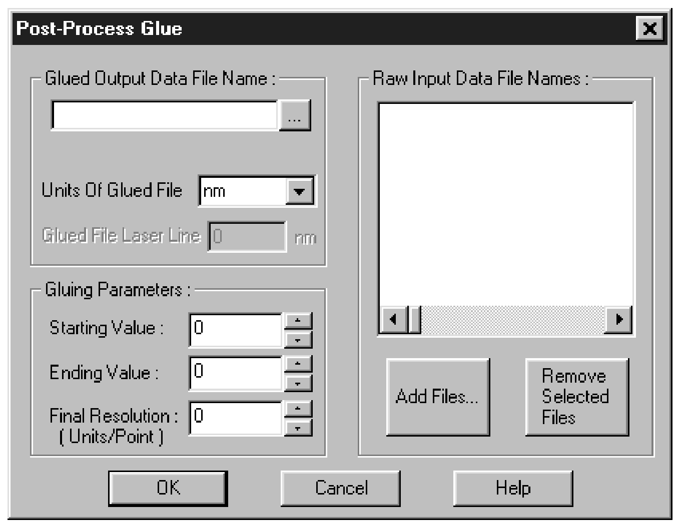


Figure 128. Post-Process Glue dialog box

- The files have been wavelength calibrated (either manually or using "AutoSpectro").
- The files have the same number of ***frames*** and ***strips*** (it is ***not*** necessary that they have the same number of pixels).

1. Take the series of data files you would like to glue and use the file manager to rename them as a series such as EXP001.SPE, EXP002.SPE, etc. You do not have to arrange these files in any particular order. These data files will not be altered in any way by the following procedure.
2. From the Process menu select **Glue**. This will open the Post-Process Glue dialog box (Figure 128). *For more information, see the online Help for this dialog box.*
3. Use the browser to select the files. The **Add Files** button opens a browser to facilitate file selection.

4. Enter the starting and ending wavelength values for the resulting file. If your wavelength range includes values that are not covered by any of the files in your series, the resulting spectrum will have some zero values. Any area where valid data was available will be used to create the glued data.
5. Enter the final resolution you would like the final data file to have. This value is in units per data point in the output file, so the lower the number the higher the resolution and the more data points the glued file will contain. For a 2400 groove per mm grating and a 0.3 m spectrometer a good final resolution would be about 0.1 nm per pixel. For a 1200 groove per mm grating this value would be 0.15 to 0.2 nm per pixel. The total number of data points in the resulting file cannot exceed 65,535.
6. Enter the Glued Output Data File Name in the field provided. The glued data will be contained in a single file.
7. If you change your mind about including one or more files in the resulting file, highlight those files in the Raw Input Data File Names listing and click on **Remove Selected Files**.
8. When you have finished selecting files, click on **SET** to execute the glue operation.

Step and Glue

If you have spectrometer control through the WinSpec software, the easiest way to create a glued spectrum is to let the software control both the data collection and the movement of the spectrometer. The software will take an exposure and, while the shutter is closed, will move the spectrometer to the next position. Unlike a monochromator with a single point detector, the wavelength calibration will not depend on the speed and timing of the stepper motor, only on its final position.

In this case you must set the amount of overlap you would like the spectra to have. The overlapping data will be averaged for a smooth transition from one exposure to the next. In addition to the glued data file, the numbered series of individual exposures remain in the computer for later processing.

1. Make sure that you have a spectrometer already installed and properly calibrated. This stepping and gluing procedure depends on having correct spectrometer calibration.
2. Click on **Calibration** on the menu bar and then on **Usage** to open the Usage dialog box.
3. Select **Auto-Spectro** in the Usage dialog box. Then select the **Calibration units** (nm, cm^{-1} or rel. cm^{-1}). Be sure the **Save as Default** button is clicked ON. Then click on **OK** to close the Usage dialog box.
4. From the Acquisition menu, select **Step and Glue**. The Step and Glue dialog box (Figure 129) will appear. *For more information, see the online Help for this dialog box.*

   Note: Again, you must have **Auto Spectro** and either **nm**, **cm^{-1}** or **rel. cm^{-1}** selected as the **Calibration Units** on the Usage dialog box (Calibration menu) in order for the Step and Glue dialog box to open. Failure to satisfy this prerequisite will generate an error message.

5. The glued data will be collected as a series of incremental files. These files will then be used to create a single glued data file. Enter the name of the File Name Template, such as EXP, in the File Names Template box. There is provision for setting the starting File Increment Value. As each incremental file is taken, the File Increment Value will increment by one. If the Reset After Each Run box is checked, the File Increment Value will reset to one and the subsequent set of incremental files will overwrite the first. If the Reset After Each Run box is unchecked, the File Increment Values assigned to the next and subsequent runs will start with the next digit after the last one used. No files will be overwritten.

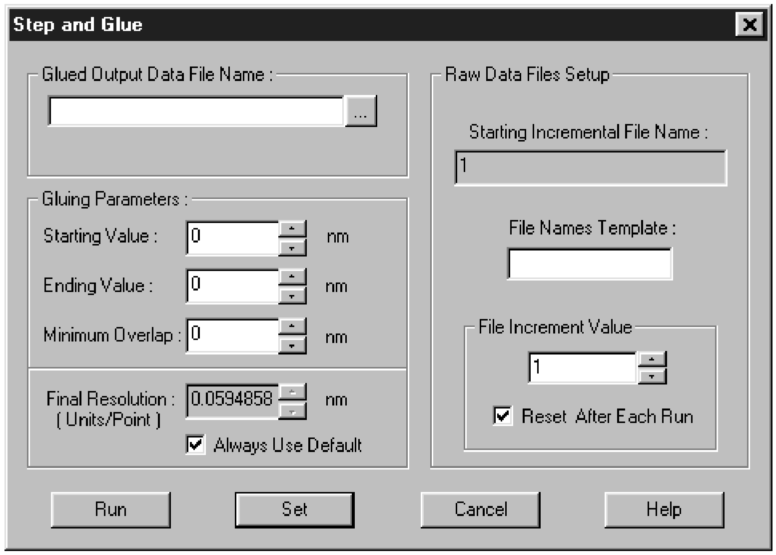


Figure 129. Step and Glue Setup dialog box

6. Enter the **Starting Value**, the **Ending Value**, and the **Minimum Overlap** in the units selected. A good overlap would be about ten times the coverage of a single pixel. To determine the coverage of a single pixel; click on **Always Use Default**; the minimum resolution will be displayed in the Final Resolution edit box (the resolution changes as the wavelength changes, decreasing at higher wavelengths).

7. Enter a **Final Resolution** for the resulting file. Unless you require a certain resolution, it is easiest to let the computer calculate the final resolution, based on the spectrometer calibration and other known quantities. In the resulting file, each point does not represent a physical pixel. The total number of data points in the resulting file cannot exceed 65,536.

8. Click on **SET** to store the Step and Glue parameters. If the experiment is ready to run, click on the **RUN** to begin collecting data. The software will collect one exposure at each spectrometer position. It will automatically move the spectrometer to the next position (with the correct amount of overlap) and collect the next exposure. The software will collect as many exposures as needed.

During data collection, individual spectra may or may not be displayed, depending on the time between spectra.

Theory

The Glue operation is done in two stages. First the data in an input file is converted into an intermediate file with the calibration of the output file, and then the converted file is glued onto the output file.

The algorithm for the file conversion is based on the fact that the pixels have small but finite dimensions; this means that each pixel has some wavelength coverage and is not just a wavelength point. When WinSpec reports the wavelength of a pixel, it is actually the wavelength at the center of the pixel. Since WinSpec uses a polynomial wavelength calibration, the wavelength at the center of a pixel "x" is:

$$\text{Wavelength (center)} = A_0 + A_1x + \ldots + A_nx^n;$$

and the wavelengths at the edges are given by:

$$\text{Wavelength (edges)} = A_0 + A_1(x \pm ½) + \ldots + A_n(x \pm ½)^n,$$

where the "+" is for one edge and the "-" for the other.

The intermediate and output file data points also have a finite wavelength coverage, given by the Final Resolution item on the Step and Glue or Post Process Glue dialog. For example, with a Starting Value of 400 nm, Ending Value of 700 nm, and Final Resolution of 1 nm, the Output File will have 301 data points, each with a coverage of 1 nm (The file itself will actually cover the range from 399.5 nm to 700.5 nm). The data point at 500 nm will have a wavelength coverage from 499.5 nm to 500.5 nm. The wavelength calibration of the Output File will be linear, and the wavelength at point "x" given by:

$$\text{Wavelength (center of point x)} = \text{Starting Value} + \text{Final Resolution} * (x - 1).$$

For each point in the Intermediate File, the conversion routine sums in values from all pixels whose wavelength range overlaps the wavelength range of the data point. If the pixel lies entirely within the range of the data point, then 100 % of its value is added; if a pixel partially lies in the data point's range, then the percentage of its value that is added is equal to the percentage of the pixel's wavelength range lying in the data point range. In the above example, if an input file pixel had a value of 1234 and a wavelength range of 498.9 nm to 499.6 nm, then the amount summed into the 500 nm point (499.5-500.5) would be

$$\{(499.6 - 499.5) / (499.6 - 498.8)\} * 1234 = 154.25,$$

where (499.6 - 499.5) is the amount of pixel in data point range, (499.6 - 498.8) is the coverage of the pixel, and 1234 the pixel's value.

This algorithm, unlike a simple interpolation or curve fitting followed by interpolation, maintains both the general spectral shape and the intensity content of the original files (Interpolation could totally remove a peak if it were between two adjacent output data point wavelengths). The algorithm is general, and doesn't depend on the input files having the same wavelength resolution or the same number of pixels.

In the second stage of the operation, the intermediate file is glued into the output file. The gluing is done in increasing wavelength point by point, based on the wavelength value of the point. Initially the output file contains all zeroes. Files are glued into the output using several rules, as follows.

- For cases with no overlap between data in the intermediate file and the output file, the intermediate file is just copied to the output file, point by point (pixels in the input file that are outside the wavelength range of the output file are discarded).
- For cases where the intermediate data overlaps the output data, the data from the two files are gradually blended over the overlap region. The most common overlap case for step and glue will be where the intermediate file starts after the output file has data, but before the output data has ended:

```
Output  file ….... x x x x x x x x 0 0 0 0 0 0 0 0 0 0 0 0 0 ...
                         | | | | |
Intermediate file        y y y y y y y y y y y y y y y y y y ...
```

  There are five points in the above overlap region, and the result of the blending would be (left to right):

overlap point number	**blending result**
1	(5/6)x + (1/6) y
2	(4/6)x + (2/6) y
3	(3/6)x + (3/6) y
4	(2/6)x + (4/6) y
5	(1/6)x + (5/6) y

  (If there is only 1 point in the overlap region then it would have (1/2)x + (1/2) y.)

- Another case occurs when the intermediate file starts before the output and ends after the output file has data. In this case also the data is blended across the overlap region.
- Since the glue is a general algorithm, there will be cases such as the following:

```
Output file        ..... x x x x x x x x ... x x x x x x x x x x x x ...
                         | | | | | |     | | | | | | |
Intermediate file        y y y y y y ... y y y y y y y
```

  or

```
Output file        …000000 x x x ... x x x x 0000000…
                           | | |     | | | |
Intermediate file        y y y y ... y y y y y y y y
```

  In these cases, the composition of the result will be 50% Intermediate and 50% Output.

One of the effects of the above rules is that multiple copies of the same file can be glued and the result will be the same as if only one copy had been used. The blending allows a smooth transition for files with broad spectra.

Calibration and ROI Offsets

In an ideal world, when a CCD camera was attached to a spectrograph, the center of the CCD array would coincide with the center of the spectrograph exit plane. In the real world, they can be separated by several pixels, so that when the spectrograph goes to 0 nm, the peak can show up 5 pixels to the right of the array center, for example. It is the function of the Calibration Offset is to compensate for this. It is a wavelength which, when sent to the Acton, will cause the zero order to land in the center of the array. This offset is then added to every wavelength sent to the Acton. This offset does not depend on the scan pattern of the ROI used.

A second kind of Offset is used when "x" ROI's are programmed into the CCD. The program is designed to keep the requested wavelength in the center of the ROI pattern (in the center of a full x-axis display). If a full x-axis is scanned or if the ROI is symmetrical (just ignore the first and last 10 pixels, e.g.), then this ROI Offset is zero. In the case of a very asymmetrical ROI where the first 512 pixels of a 1024 pixel array are skipped, the center of the array is "pixel" (1+1024)/2 = 512.5 and the center of the ROI is (513+1024)/2 = 768.5. If the requested wavelength went to the center of the array rather than the center of the ROI, it would be just outside the scanned pixels. The ROI Offset is used to compensate for this. In this example, the ROI Offset is 768.5-512.5 = 256 pixels. This offset is converted to the equivalent wavelength (at the requested wavelength) and subtracted (in this case) from the requested wavelength before being sent to the Acton.

Suppose you have calibrated your 1200 g/mm grating on the 275 and the calibration offset is 2.2057 nm (as reported on the Spectrograph | Calibrate | Offset menu). Using the above ROI, when you ask for 0.00 nm, the 256 pixel ROI is converted to -20.199 nm, and the value sent to the 275 is: 0+2.2057-20.199 = -17.98 nm.

The ROI Offset pixel to wavelength calculation uses the results of the dispersion calibration. So, if a spectrograph is being calibrated using an asymmetrical ROI, the calibration should be iterated at least once. Because the ROI Offset is calculated separately from the Calibration Offset, once a spectrograph has been calibrated using one ROI, the ROI pattern can be changed without affecting the calibration.

Chapter 14
Post-Acquisition Mask Processes

Introduction

Several post-acquisition mask processes, including Edge enhancement, Sharpening, Smoothing, a Custom Filter and Morphological Erode and Dilation operations, are provided in the WinSpec/32 software. These processes all use the same Input and Output tab pages but have unique Parameters tab pages. Since the Input and Output functionality is identical for all of these process, the Input and Output tab pages are described below. The Parameters tab pages are described in the appropriate sections.

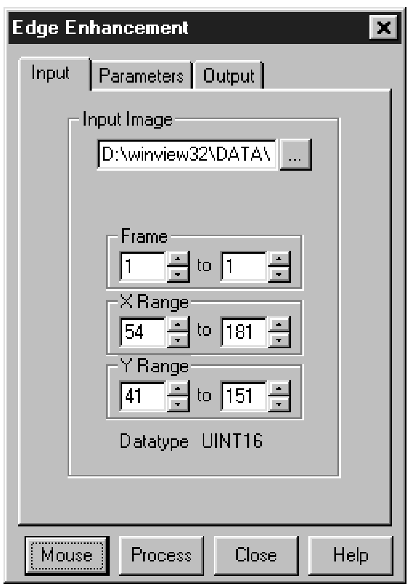


Figure 130. Input tab page

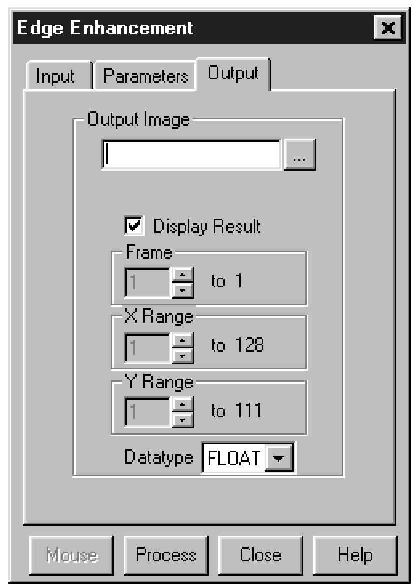


Figure 131. Output tab page

Input tab page

The Input tab page (Figure 130) selects the data to be operated on. You can specify the data file, the frames within the file, and the X and Y range on the CCD. The input datatype is reported. Note that the Mouse button at the bottom of the window allows you to use the mouse to specify the region to be processed. Simply drag a box in the data region of the active window and then click on **Mouse**. The **Frame** and **Range** parameters will assume the values of the defined region. *The **Mouse** button is only active when the **Input** tab page is selected.*

Output tab page

The Output tab page (Figure 131) allows you to name the output file. It additionally allows you to select whether the modified data is to be displayed and to select the data type. The frame and X-Y range are reported information only.

Edge Enhancement

Parameters tab page

Edge enhancement is accomplished by mask operations defined by parameters entered on the Parameters tab page. These functions can enhance edges, sharpen or smooth features, or erode or dilate an image. How these images are processed is briefly described below.

A mask is an n × n matrix (n is 3 for all WinSpec/32 operations) that is placed over every n × n subsection of the image. Each parameter in the mask is multiplied by the corresponding value of the image. The results are summed and placed in the central position in the output file. An example will help illustrate the process.

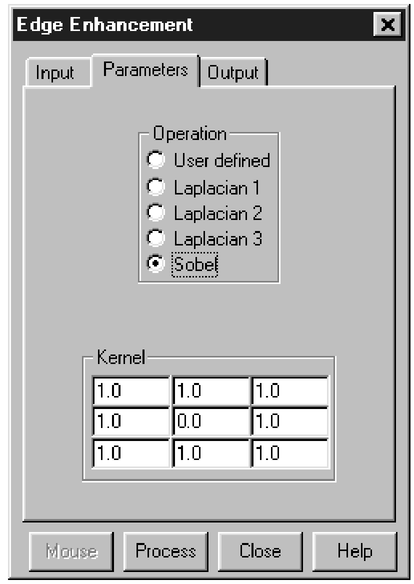


Figure 132. Edge Enhancement Parameters tab page

The following is the Laplacian 1 mask, used to enhance edges.

-1	-1	-1
-1	8	-1
-1	-1	-1

Here is an example of a 3 × 3 subsection of an image. The middle pixel has the coordinates 100, 100.

20	20	19
20	21	20
20	19	20

Multiply each pair of corresponding numbers, and sum the products.

$$(-1 \times 20) + (-1 \times 20) + (-1 \times 19) + (-1 \times 20) + (8 \times 21) + (-1 \times 20) + (-1 \times 20) + (-1 \times 19) + (-1 \times 20) = 10$$

The result is placed at position 100, 100 in the output image file. The mask is now placed over the 9 pixels centered at 101, 100, and the procedure is repeated.

Laplacian masks

The three Laplacian masks on the Edge Enhancement dialog box operate just as described above. Since the sum of the mask coefficients of the Laplacians sum to zero, the result of a Laplacian operation on a region of uniform density is zero. Boundary features are enhanced by varying degrees.

Sobel edge detection

The Sobel edge detection method is more involved, but produces greatly enhanced features. Number the squares of the subregion of the image as follows:

A_0	A_1	A_2
A_7		A_3
A_6	A_5	A_4

The replacement for the center cell, called R, is[1]

$$R = [X^2 + Y^2]^{½}$$

where

$$X = (A_2 + 2A_3 + A_4) - (A_0 + 2A_7 + A_6)$$

$$Y = (A_0 + 2A_1 + A_2) - (A_6 + 2A_5 + A_4)$$

Figure 133 illustrates the effect of edge detection on an image.

Figure 133. Original image (left) and edge-detected image (right)

Edge Enhancement Procedure

Use the following procedure to perform Edge Enhancement on an image.

1. Select **Edge Enhancement** from the Process menu.
2. Enter the Input Image and Output Image names.

---

[1]Pratt, William K., Digital Image Processing, John Wiley & Sons, New York, 1978, pp. 487-488.

3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. Select one of the Operations. Since image features vary widely, it is best to simply try the different operations to determine the best one.
6. To set a specialized 3 × 3 mask, select User Defined and change the Kernal parameters to their new values.
7. Click on **Apply** to begin processing.

Sharpening Functions

Parameters tab page

Sharpening is also accomplished by mask operations, in this case parameters entered on the Sharpening Parameters tab page. These masks, sometimes called high pass filters, enhance regions of high contrast while not affecting regions of low contrast.

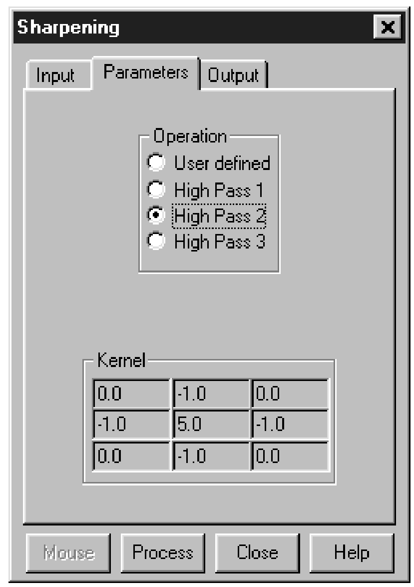


Figure 134. Sharpening Parameters tab page

Sharpening Procedure

Use the following procedure to sharpen an image.

1. Select **Sharpening** from the Process menu.
2. Enter the Input Image and Output Image names.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. Select one of the Operations. Since image features vary widely, it is best to simply try the different operations to determine the best one.
6. To set a specialized 3 × 3 mask, select User Defined and change the Kernal parameters to their new values.
7. Click on **Apply** to begin processing.

Smoothing Functions

Parameters tab page

Smoothing is also accomplished by mask operations, in this case parameters entered on the Smoothing Parameters tab page (Figure 136). These masks, sometimes called low pass filters, attenuate regions with high contrast, while leaving pixels in regions of low contrast almost unchanged. Figure 135 illustrates the smoothing filter effect.

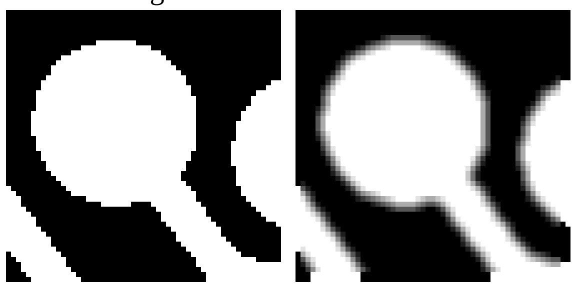


Figure 135. Original image (left) and smoothed image (right)

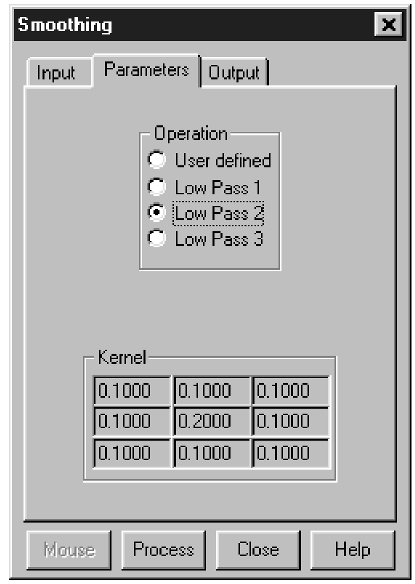


Figure 136. Smoothing Parameters tab page

Smoothing Procedure

Use the following procedure to smooth an image.

1. Select **Smoothing** from the Process menu.
2. Enter the Input Image and Output Image names.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. Select one of the Operations. Since image features vary widely, it is best to simply try the different operations to determine the best one.
6. To set a specialized 3 × 3 mask, select User Defined and change the Kernal parameters to their new values.
7. Click on **Apply** to begin processing.

Morphological Functions

Parameters tab page

Morphological operations are also accomplished by mask operations, in this case parameters entered on the Morphological Parameters tab page. There are two basic morphological mask operations, Erode and Dilate. The effect of the Erode process is to reduce the size of a white region, while Dilation increases it. The number of iterations is user-settable. All the options except for Block and User Defined perform the operation in a specific direction only. Block performs the operation in all directions. Two other choices are Open and Close. Open is simply a number of erodes (specified by Iterations) followed by the same number of dilates. Close performs the dilates first, then the erodes.

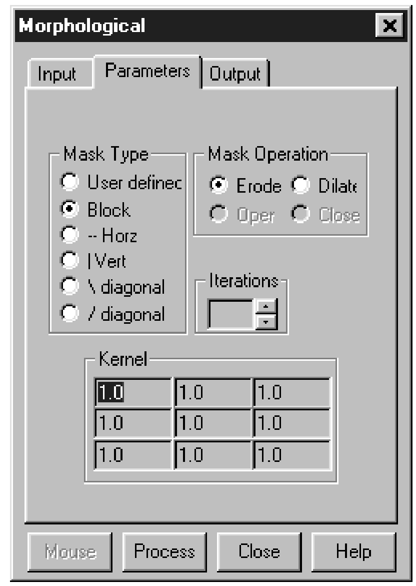


Figure 137. Morphological Parameters tab page

Examples of some morphological operations follow. References are found at the end of this chapter. In each case the same binary image is shown to the left and the morphologically processed image is shown to the right.

Figure 138. Original image (left) and dilated image (right)

Figure 139. Original image (left) and eroded image (right)

Figure 140. Original image (left) and opened image with three iterations (right)

Morphological Procedure

Use the following procedure to morphologically process an image.

1. Select **Morphological** from the Process menu.
2. Enter the Input Image and Output Image names.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. Select the desired Mask Type and Mask Operation.
6. To set a specialized 3 × 3 mask, select User Defined and change the Kernel parameters to their new values.
7. Click on **Apply** to begin processing.

Custom Filter

Filter Matrix tab page

The Custom-Filter Filter-Matrix tab page allows you to set the filter matrix parameter values. The filter is applied to the data-set specified via the Input tab page (page 151). The processed data is saved in the file specified by the Output tab page (page 151).

Filtering is accomplished by mask operations defined by parameters entered in the matrix. These functions can enhance edges, sharpen or smooth features, or erode or dilate an image. How these images are processed is briefly described below.

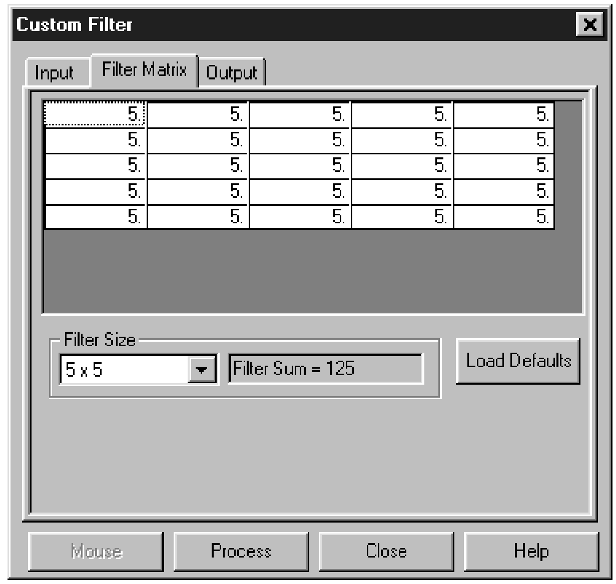


Figure 141. Filter Matrix tab page

A mask is an n × n matrix (n is 5, 7, 9 or 11) that is placed over every n × n subsection of the image. Each parameter in the mask is multiplied by the corresponding value of the image. The results are summed and placed in the central position in the output file. Users can specify the Filter Size (5×5, 7×7, 9×9 or 11×11). The Filter Sum is displayed in the adjacent box.

The **Load Defaults** button sets the matrix parameters to their factory-default values. When you click on this button, you will see a warning message "Will erase Data for ALL Filter Sizes; Continue?" with Yes/No. **"Yes" will erase ALL filter data before loading the factory default values.**

Custom Filter Procedure

Use the following procedure to apply a custom filter to an image.

1. Select **Custom Filter** from the Process menu.
2. Enter the Input Image and Output Image names.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. Define the filter by entering the appropriate values in the Filter Matrix.
6. Click on **Apply** to begin processing.

Look Up Table

Look-Up Table tab page

This page allows the selected input data values to be mapped to different output values using a look-up table (LUT). The data format must be unsigned integer (0 to 65,000) and there can be as many as 65,000 value pairs (Input and Output) in the table. Values below zero are converted to zero. Values above 65 k are converted to 65 k. Minimum and maximum values can be specified. LUTs are ordinary text files. The text entry box and associated browser button facilitate accessing the LUT. However, before a LUT can be used to process data, it must be converted to binary, accomplished by clicking on the **Create Binary LUT** button.

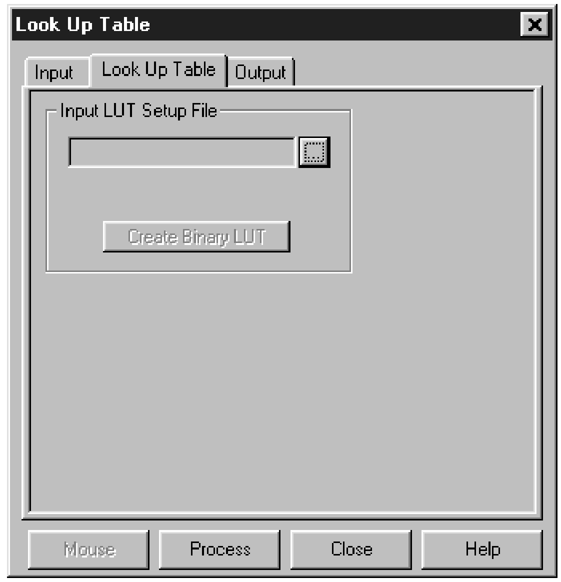


Figure 142. Look-Up Table

Look-Up Table Procedure

Use the following procedure to process data using the LUT.

1. Select **Look Up Table** from the Process menu.
2. Using the **Input** and **Output** tab pages, enter the Input and Output file names.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. Load the LUT. *LUT files must be of the type *.TXT.* The file name can be entered directly or selected by using the browser (clicking on the button at the end of the field opens the browser).
6. Click on the **Create Binary LUT** button to convert the text-LUT to binary.
7. Click on **Apply** to begin convert the input data values to the output values specified per the LUT.

References

To explore in further detail the theory and techniques of digital image processing, we suggest the following texts:

1. *Digital Image Processing*, Gregory A. Baxes, Cascade Press, Denver, CO, 1984. ISBN: 0-945591-00-4.

2. *Digital Image Processing*, R. C. Gonzalez, P. Wintz, Addison-Wesley, Reading, MA, 1977. ISBN: 0-201-11026-1.

3. *Digital Picture Processing*, A. Rosenfeld, A. C. Kak, Vol. 1 & 2, Academic Press, New York, 1982. ISBN (Vol. 1): 0-12-1597-301-2, ISBN (Vol. 2): 0-12-597-302-0.

4. *Digital Image Processing*, W. K. Pratt, John Wiley, New York, 1978. ISBN: 0-471-01888-0.

Chapter 15
Additional Post-Acquisition Processes

Introduction

The processes included in this chapter are accessible from **Processes** menu. These processes all use the same Input and Output tab pages but have unique Parameters tab pages. Since the Input and Output functionality is identical for all of these process, the Input and Output tab pages are described below. The Parameters tab pages are described in the appropriate sections.

Input tab page

The Input tab page (Figure 130) selects the data to be operated on. You can specify the data file, the frames within the file, and the X and Y range on the CCD. The input data-type is reported. Note that the Mouse button at the bottom of the window allows you to use the mouse to specify the region to be processed. Simply drag a box in the data region of the active window and then click on **Mouse**. The **Frame** and **Range** parameters will assume the values of the defined region. *The **Mouse** button is only active when the **Input** tab page is selected.*

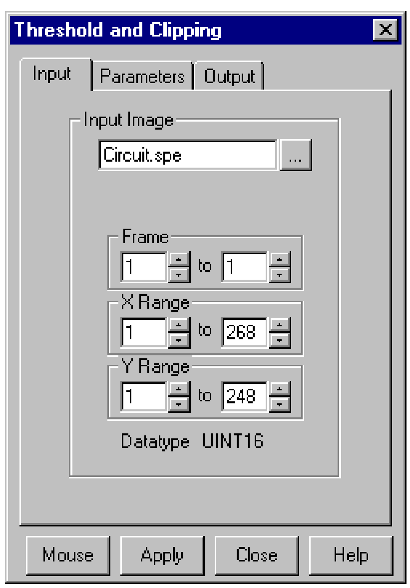


Figure 143. Input tab page

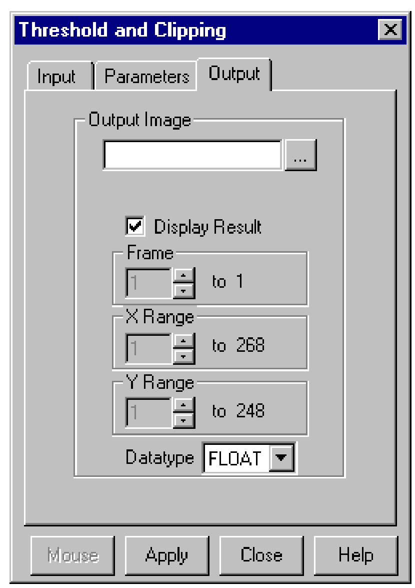


Figure 144. Output tab page

Output tab page

The Output tab page (Figure 131) allows you to name the output file. It additionally allows you to select whether the modified data is to be displayed and to select the data type. The frame and X-Y range are reported information only.

Threshold and Clipping

Clipping an image causes pixels outside the specified range to be changed. When **Clip High** is selected, all pixels with values greater than the Clip High value will be changed to the Clip High value. When **Clip Low** is selected, all pixels with values less than the Clip Low value will be changed to the Clip Low value. Selecting **Clip Both** will use both Clip High and Clip low values during the same processing step.

The **Threshold** function converts an image to binary (black and white). All intensity values below the threshold setting are zero (black). All those above become ones (white).

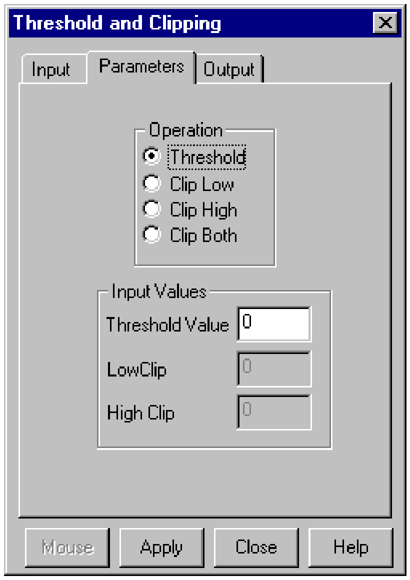


Figure 145. Threshold and Clipping Parameters tab page

Procedure

1. Select **Clipping/Threshold** from the Process menu.
2. On the **Input** tab page, if the correct input image does not appear in the Input Image box, enter the complete file name or search for a file using the browser, accessed by the button to the right of the field.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. On the **Parameters** tab page, if a clipping operation is to be performed, select the clipping option as described above. For a threshold operation, set the threshold level to the desired value.
6. Enter the name of the Output Image on the **Output** tab page. *In later editions of the software, it will additionally be possible to specify an output frame and data range.*
7. Click on **Apply** to begin processing.

Cross Section

Introduction

Selecting **Cross Section** on the Process menu opens the Cross Section window, which allows you to separately display and store horizontal and vertical cross sections of an image. Figure 146 shows two X-axis cross sections based on the same ROI. The upper data is summed; the lower data is averaged.

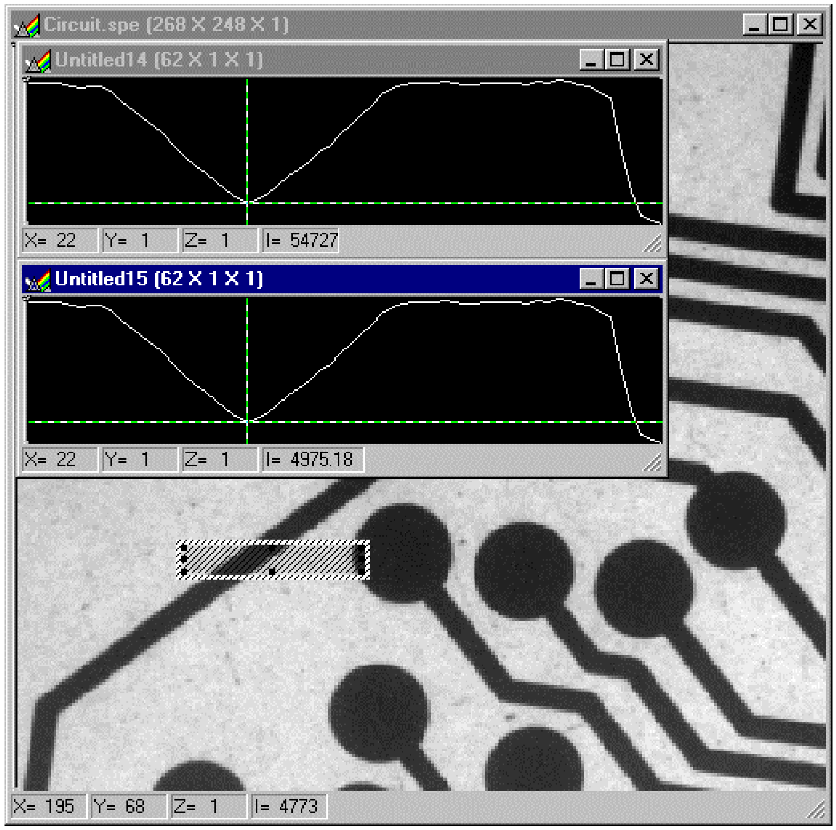


Figure 146. Example Cross Sections of an ROI

Procedure

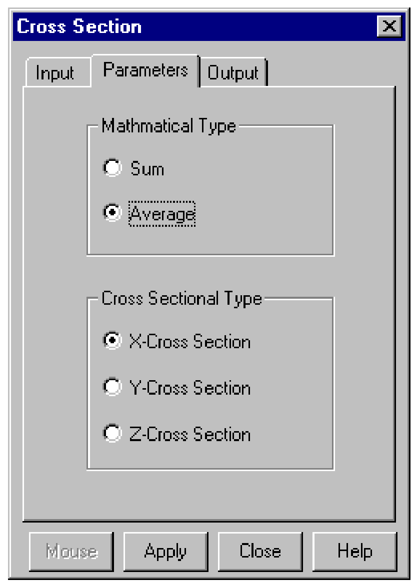


Figure 147. Cross Section Parameters tab page

1. Select **Cross Section** from the Process menu.
2. On the **Input** tab page, if the correct input image does not appear in the Input Image box, enter the complete file name or search for a file using the browser, accessed by the button to the right of the field.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, draw an ROI in the active window using the mouse and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. On the **Parameters** tab page, select either **Sum** or **Average**. If Sum is selected, all pixel values in the X, Y, or Z direction, according to whether X-Cross Section, Y-Cross Section or Z-Cross Section is selected, will be summed to generate the output. If Average is selected, the average

of all of the pixel values in the X, Y, or Z direction will be summed to produce the output.

6. On the Parameters tab page, select either **X-Cross Section, Y-Cross Section** or **Z-Cross Section**, whichever is wanted.
7. Enter the name of the Output file on the **Output** tab page. *In later editions of the software, it will additionally be possible to specify an output frame and data range.*
8. Click on **Apply** to begin processing.

Binning and Skipping

Introduction

Selecting **Binning** on the Process menu opens the Binning and Skipping window, which allows binning to be accomplished in software after the data has been collected. The Parameters tab page allows the bin size to be set independently in the X and Y directions. The Skipping parameter allows you to define the interval between binned regions. The Skipping parameter size can be independently set for X and Y. There is also provision for either averaging or summing the binned data points. If Average is selected, each output data value will be the average of the binned data values in each region. If Average is unselected, each output data value will be the sum of the binned data values. The procedure follows.

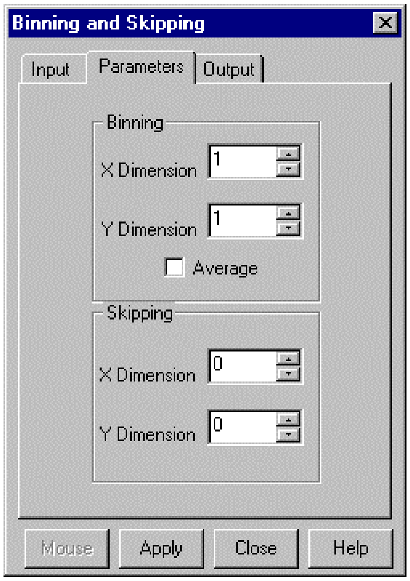


Figure 148. Postprocessing Binning and Skipping Parameters tab page

Procedure

1. Select **Binning and Skipping** from the Process menu.
2. On the **Input** tab page, if the correct input image does not appear in the Input Image box, enter the complete file name or search for a file using the browser, accessed by the button to the right of the field.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. On the **Parameters** tab page, set the X and Y bin size.
6. On the Parameters tab page, select **Average** if the binned data values are to be averaged. If the Average box is left unchecked, the binned values will be summed.
7. On the Parameters tab page, set the Skip X and Y values. Data points that fall in the skip zones do not contribute to the output. Skip values of zero are allowable, that is, no points will be skipped. Left over points at the end of a strip or column are discarded.

8. Enter the name of the Output file on the **Output** tab page. *In later editions of the software, it will additionally be possible to specify an output frame and data range.*
9. Click on **Apply** to begin processing.

Restrictions and limitations

The following are some restrictions and limitations of the Binning and Skipping function.

- This function can resize an image down to a minimum of 1 pixel but WinSpec/32 cannot display an image less than 2 × 2 pixels.
- May cause data overflow in the output image if the output data type is selected as "integer". If data to be binned will exceed 32,000 counts select Unint or Long.
- The maximum binning and skipping size is the size of the input image. When the maximum is reached, to increase the binning size you must first decrease the skipping size, then increase the binning size.

Histogram Calculation

Introduction

Two types of histograms are available for graphing the distribution of intensities of an image. The **Histogram** operation groups pixels of a similar intensity together. The X-axis indicates the intensity, and the Y-axis displays the number of pixels in that intensity range.

The **Cumulative Histogram** operation groups pixels of a similar intensity together, once again using the X-axis to show intensity. This time, however, the Y-axis indicates the total number of pixels with intensity less than or equal to the range. Thus the Cumulative Histogram is always an increasing function.

Procedure

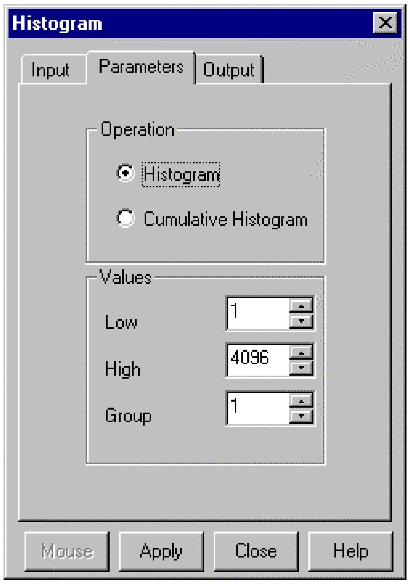


Figure 149. Postprocessing Histogram Parameter tab page

1. Select **Histogram** from the Process menu.
2. On the **Input** tab page, if the correct input image does not appear in the Input Image box, enter the complete file name or search for a file using the browser, accessed by the button to the right of the field.
3. On the **Input** tab page, select the data frame containing the data on which the operation is to be performed.
4. If you want to process only part of the Input Image, enter the appropriate X-Y range values. Alternatively, use the mouse to draw an ROI in the active window and click the **Mouse** button at the bottom of the dialog box to enter those values.
5. On the **Parameters** tab page, select either **Histogram** or **Cumulative Histogram**, whichever is wanted.
6. On the Parameters tab page, under **Values**, enter the **Low Intensity** and **High Intensity** values. These are the Y-Max and Y-min. Then enter the **Group Size**, which is the range of intensity that the software will group together as a single data point. In other words, if the Group Size is 50, pixels having an intensity in the range of 1-50 will be counted and graphed as a single point on the histogram.
7. Enter the name of the Output file on the **Output** tab page. *In later editions of the software, it will additionally be possible to specify an output frame and data range.*
8. Click on **Apply** to begin processing.

Chapter 16

Printing

Introduction

WinSpec/32 can be used to print images directly. Methods are listed below both for direct printing and for using the clipboard to transfer the image to another program for printing.

Setting up the Printer

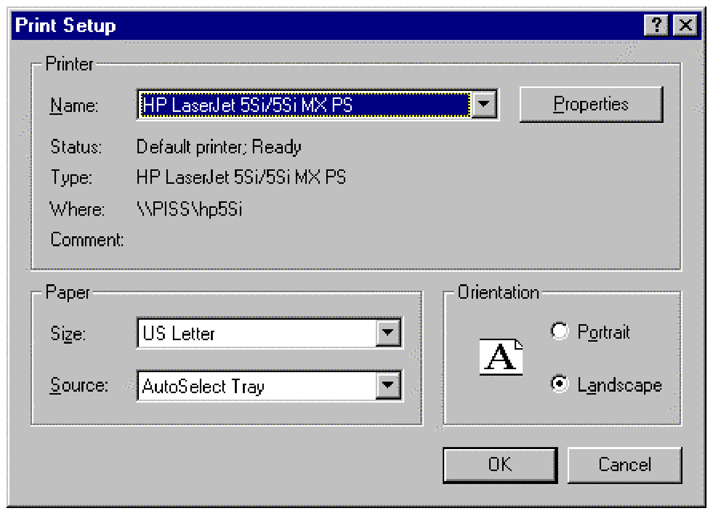


Figure 150. Print Setup dialog box

1. Open the file you want to print. Make sure that window is the active one. From the File menu, open the Print Setup dialog box (Figure 150).

2. The Print Setup dialog box is similar to that found in many Windows programs. You can use the default printer or select a specific printer from the list of installed devices. For information on installing printer drivers, consult the Windows documentation. The Options button shows more features of the selected printer driver – again, a standard Windows feature.

3. Select the Paper Size and Source. The Landscape format (where the paper is wider than it is tall) is probably the best way to print out data.

4. Click on **OK** to execute the printer setup selections or **Cancel** to exit the dialog leaving the original settings unchanged.

Printing Directly from WinSpec/32

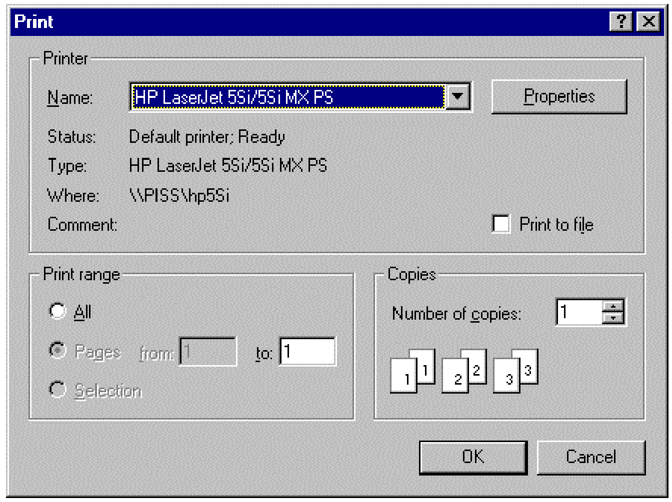


Figure 151. Print dialog box

This procedure assumes you have already set up the printer you will be using.

1. From the File menu, open the Print dialog box (Figure 151).
2. Select the number of copies and pages (if a file contains multiple frames, each will be printed as a separate page).
3. Click on **OK** to initiate the print.

Notes:

Once the Print Setup is properly configured, you can print the active window simply by selecting Print from the File menu (shortcut Alt, F, P) or by clicking on the Print button in the standard toolbar.

Color mapping to the printer may differ from that shown on the screen. To obtain the desired output color mapping, you may wish to do a screen capture and then paste the image into a graphics program for final adjustment before printing.

Print Preview

The Print Preview function gives you a quick idea of how the printed image will look. It produces an “on-screen print” that looks as closely as possible like a “real” print, allowing changes in the printer setup to be made quickly and conveniently. Figure 152 illustrates the Print Preview window.

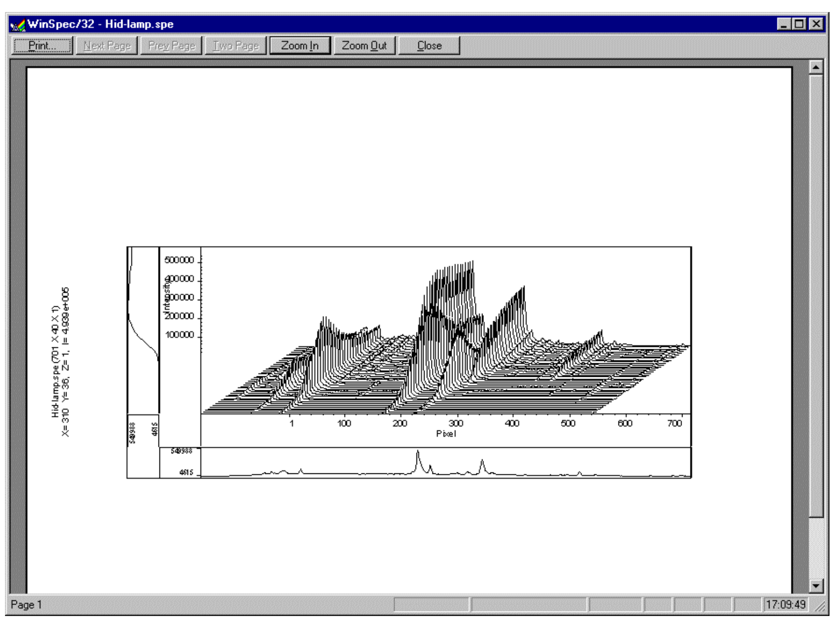


Figure 152. Print Preview window

The button functions are as follows.

Print…: Opens the Print screen so a print can be initiated.

Next Page: If the file contains multiple frames, each one will occupy a different page. The Next Page button allows you to step forward sequentially through all available pages. If the file contains only one image, the Next Page button will be grayed out.

Prev Page: Allows you to step backwards sequentially through the pages of a multiple image file.

Two Page: Causes two pages to be displayed at a time in a side-by-side layout.

Zoom In: Allows you to zoom in on the previewed page, allowing a selected area to be examined in detail. There are two zoom levels. Note that, if not at full zoom, the cursor becomes a “magnifying glass” if positioned on the image area.

Zoom Out: Allows you to return to the normal (unzoomed) preview display.

Close: Closes the Preview window and returns you to the normal WinSpec/32 display.

Printing a Screen Capture

It is also possible to do a screen capture of the entire WinSpec/32 window. This is the best way to capture such information as cross sections, scaling, and color lookup tables. A limitation of screen shots is that the resulting image is based on the resolution of the monitor, not the resolution of the image. For a 1 million pixel CCD, even a 600 × 800 video mode is not enough to show all the pixel information.

1. Display the desired image or images in WinSpec/32. Click once on the title bar of WinSpec/32 to make this the active window.
2. Press **Alt** + **Print Screen**. This copies the entire contents of the WinSpec/32 window, including image or graph displays and dialog windows, to the clipboard.

   Note: Alternatively, press **Ctrl**+**C** or select Copy on the Edit menu to copy an image to the clipboard. *This function only works on image displays and only on the image itself, i.e., scales and cross section information is not transferred However, it has an advantage in that the full resolution of the image is retained.*

Many text editors and graphics programs allow images to be pasted directly from the clipboard. Paint Shop Pro, a shareware program, is one example of an inexpensive program that can edit and save clipboard screen shots.

1. Open the application. Open a new file within that application.
2. Select **Paste** from the Edit menu. This will place the contents of the clipboard into the application. If the image seems cut off, try opening a bigger blank image before pasting the clipboard. The image is now an 8-bit color or grayscale image.
3. Crop the image, if desired. This feature is available in almost any image editing program.
4. Select **Print** from the File menu. Print the file.
5. Save the file, if desired. TIFF is an excellent image format for either grayscale or color shots.

Note: Screen-capture images lose the high dynamic range of the original. The Copy function (**Ctrl+C**) retains the full resolution of the data file.

Saving as TIF and Printing

It is also possible to save an image file directly to the TIFF format by using the Save As function on the File menu. The resulting *.tif file could then be copied to a graphics editing program for further processing and then printed.

Chapter 17
Pulser Operation

Introduction

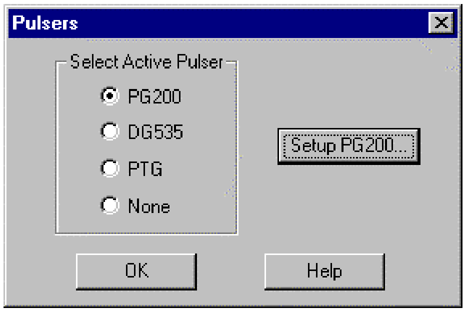


Figure 153. Pulsers dialog box

Three different pulser/timing generators are available for use with WinSpec/32. To be available, pulser support must have been installed as described in the Installation chapter. Pulser support is then accessed by selecting **Pulsers** on the **Setup** menu and then selecting the pulser to be used with the system. Available selections include the Princeton Instruments brand PG200 Pulser, the Princeton Instruments brand Programmable Timing Generator (PTG) plug-in module for the ST-133 (high power ver 3+) and the Stanford Research Systems DG535 Digital Delay/Pulse Generator with Inhibit Option.

The Model PG200 is available for all Princeton Instruments intensified detectors except the PI-MAX Intensified CCD Camera, which requires the PTG or DG535. All three pulser/timing generators are programmable from WinSpec/32. Consult the applicable hardware manuals for detailed instructions on setup and connection to other devices.

PG200 Programmable Pulse Generator

The PG200 is programmed via one of the serial ports of the computer, such as COM1 or COM2. The choices provided by the tab pages are the same ones that are available using the PG200 front panel. Basic PG200 operation is reviewed in the following procedure.

1. Make sure the PG200 is connected to one of the serial ports of the computer. Later you will tell WinSpec/32 the name of this port (COM1, COM2, etc.). The software cannot automatically detect the location of the PG200.

2. Following the intensifier precautions listed in the hardware manuals, turn on the PG200 Pulser and wait for it to initialize. If the PG200 isn't turned on, the WinSpec/32 software cannot program it.

3. Select **Setup**, then **Pulsers**, then **PG200**. Then click on the **Setup PG200** button to open the PG200 dialog. *If PG200 is grayed out on the **Pulsers** dialog box, PG200 pulser support has not been installed.*

4. Click on the **Comm Port** tab.

5. Select the Comm Port type, **Serial** or **Demo**. **Serial** must be selected to control the PG200.

6. Select the PG200 Comm Port. Generally, the mouse is connected to COM1 and the Pulser is connected to COM2. COM ports 1 through 8 can be selected.
7. Once you have selected the correct port, click on **Initialize Port**, which will cause the software to search for the pulser. If it can't find the pulser on the specified port, such as would occur if the pulser were not turned on or if it were connected to a different port, you will get an error message. If this happens, check the cable connections, check that the pulser is powered, or try a different Comm port.

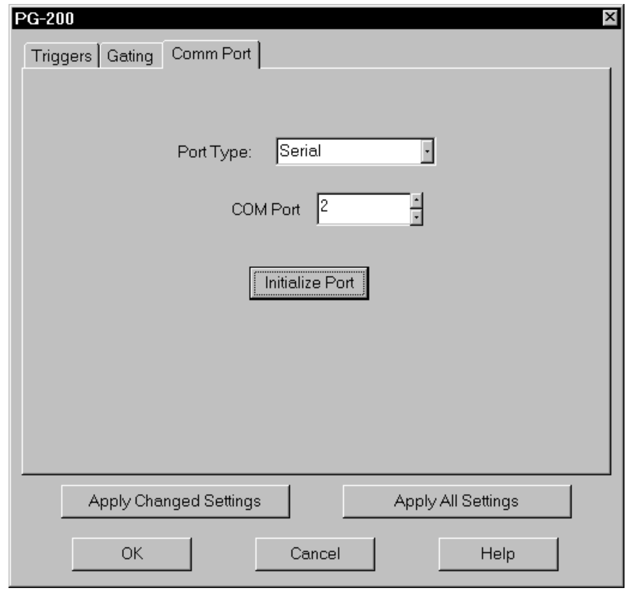


Figure 154. PG200 Comm Port tab page

8. Click on the **Triggers** tab (Figure 155).
9. Select the Trigger mode, either **Internal**, in which the PG200 free runs, or **External**, in which it is triggered from an external source.
10. If operating in the Internal trigger mode, set the **Trigger Frequency** in Hz. Consult the PG200 Manual to determine the maximum Trigger Frequency for a given set of conditions.

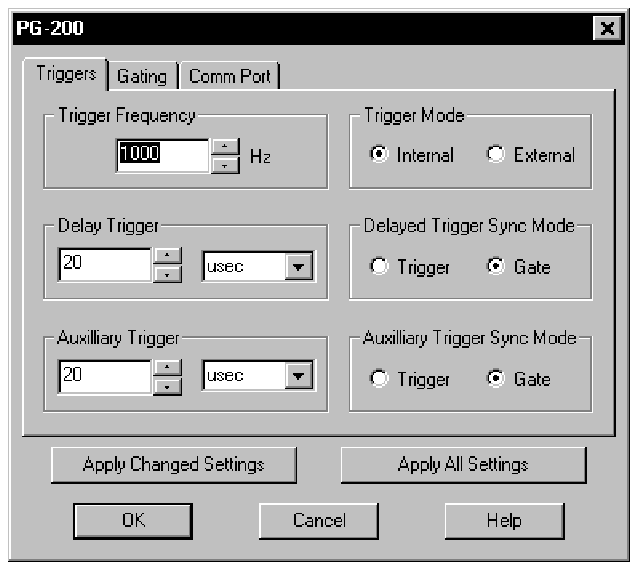


Figure 155. PG200 Triggers tab page

The PG200 **Delay Trigger** and **Auxiliary Trigger** outputs, are programmed from the Triggers tab page. They produce trigger outputs that are synchronized to and delayed from the trigger (**Trigger** Sync mode) or from the trailing edge of the gate pulse (**Gate** Sync mode). In the Gate Sync mode, as the gate pulse changes its position and width, the trigger outputs remain synchronized with the gate, moving with it. In the Trigger Sync mode, the trigger outputs do not sweep with the gate but maintain their initial position. The Delayed Trigger and Auxiliary Trigger outputs are independently programmable.

1. Set the **Delay Trigger** and **Aux Trigger** initial delay.
2. Set the **Delay Trigger** output to be synchronized to either the **Trigger** or the **Gate** pulse.

3. Set the **Aux Trigger** output to be synchronized to either the **Trigger** or the **Gate** pulse.

4. Click on the **Gating** tab (Figure 156).

5. Select **Repetitive** or **Sequential** and then click on the adjacent **Setup** button. *For safety, the **Gating Mode (HV Pulsing)** selection should be **Disabled**.*

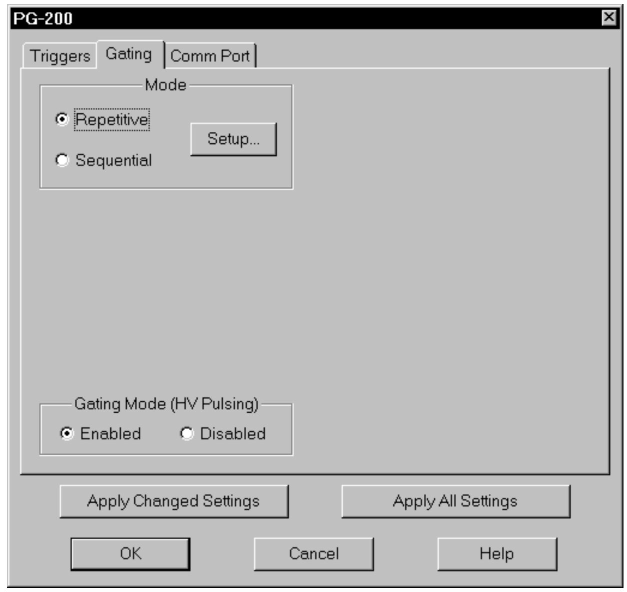


Figure 156. PG200 Gating tab page

Note: In setting the PG200 gating parameters, whether for Repetitive or Sequential operation, see your PG200 Manual for pulse width and delay limitations. Note that gate pulses are capacitively coupled in many Princeton Instruments intensified detector heads, so high duty cycles and gate widths longer than 1 ms may lead to reduced gating efficiency.

Repetitive Mode

If **Repetitive** is selected, the Repetitive Gating setup dialog box will appear as shown in Figure 157. In the Repetitive gating mode, the Gate Width and Gate Delay remain constant over the course of the measurement. Set the Gate Width and Gate Delay to the desired values and click on **OK**. The Repetitive Gating Setup dialog box will close and you will return to the PG200 dialog box.

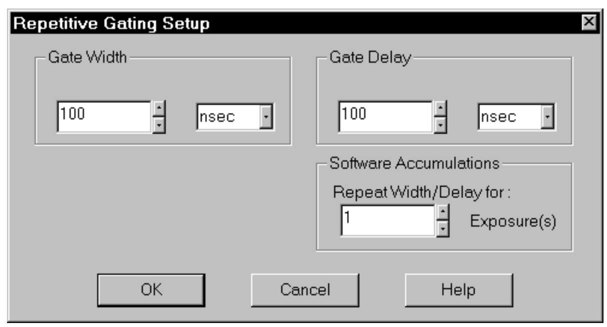


Figure 157. Repetitive Gating Setup dialog box

Sequential Mode

If Sequential is selected, the Sequential Gating Setup dialog box will appear as shown in Figure 158. In the Sequential Gating mode, the Gate Width and Gate Delay do not remain constant but change either linearly (**Fixed**) or exponentially as the measurement progresses. **Fixed** is suited to sweeping over a time interval to locate and recover an event that takes place at the same time with each iteration. **Exponential** is well suited to fluorescence decay experiments where the effect under study changes rapidly at the start of an experiment and then slower and slower, following a logarithmic curve, as the experiment progresses.

If the measurement is to be done in the sequential gating mode, set the pulsing parameters as appropriate for your intended measurement and click on **OK**. The Sequential Gating Setup dialog box will close and you return to the PG200 dialog box.

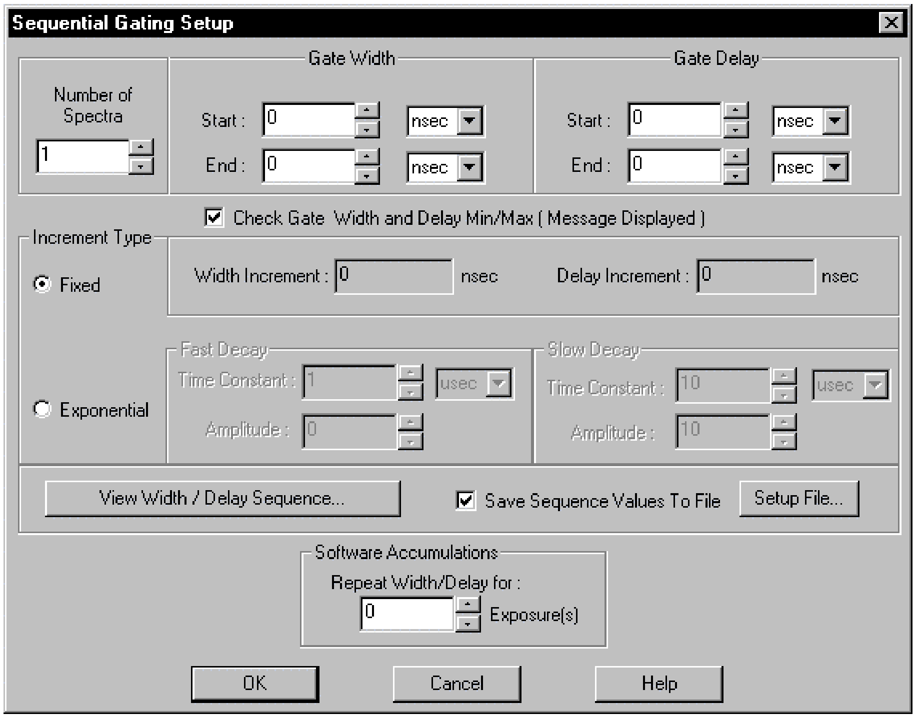


Figure 158. Sequential Gating Setup dialog box

1. Click on the **Gating** tab.
2. Select **Gating Mode (HV Pulsing) Enabled** to start gating the intensifier. Be sure you have followed all intensifier precautions stated in the hardware manuals before making this selection.
3. Click the **Apply Changed Settings** button. This writes all changed parameters to the PG200. It may take several seconds, depending on the number of parameters that have been changed. To set ***all*** of the parameters, click on the **Apply All Settings** button.
4. Click on **OK** to close the dialog box.

Programmable Timing Generator (PTG)

Unlike the PG200 and the DG535, the PTG is not a free-standing instrument but rather a plug-in module designed for installation in a special version of the ST-133 Controller. This novel and highly integrated approach to timing generator design, with its advanced high-speed electronics, low insertion delay and programmable functions, achieves superior performance as the ultimate gate controller for the PI-MAX Intensified Camera.

Basic PTG operation is reviewed in the following procedure. The individual tab page selections are discussed in detail in the online Help topics.

Note: The gate functions of the PI-MAX camera are controlled by the PTG. If the system is equipped with a PI-MAX camera, the Camera State dialog box (Figure 159) will appear when the software is started. Although the software always initially places the PI-MAX in Safe mode, you have the option of restarting with the last settings or reverting to the factory defaults, which are:

Mode: Safe
Exposure Time: 10 ms
Intensifier Gain: precisely midrange (128 on arbitrary 1 to 256 Intensifier Gain scale).

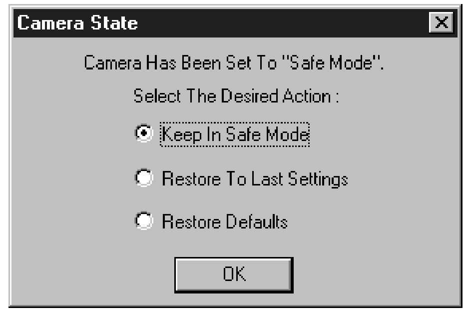


Figure 159. Camera State dialog box

1. Following the intensifier precautions stated in the hardware manuals, turn on the Controller (PTG installed). *If the Controller isn't turned on, the WinSpec/32 software won't be able to control the PTG.*
2. On the **Setup** menu select **Pulsers** to open the Pulsers dialog box.
3. Select **PTG**. Then click on the **Setup Pulser** button. The PTG dialog box (Figure 161) will open. *If PTG is grayed out on the* ***Pulsers*** *dialog box, PTG support has not been installed.*
4. Select the Trigger mode, either **Internal**, in which the PTG free runs, or **External**, in which it is triggered from an external source.
5. If operating in the **Internal** trigger mode, set the trigger **Frequency** in Hz.
6. If operating in the **External** trigger mode, specify the **Threshold**, **Slope**, **Coupling** and **Impedance** appropriate for the trigger source.

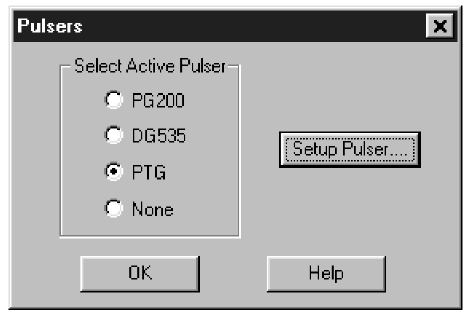


Figure 160. Pulsers dialog box

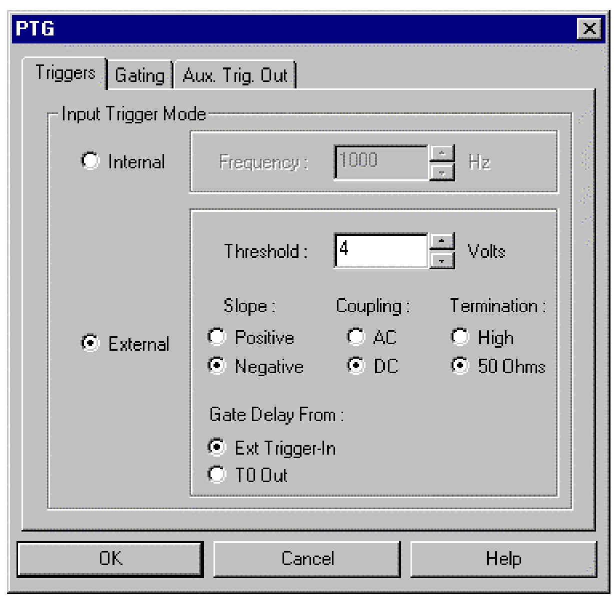


Figure 161. PTG Triggers tab page

7. Click on the **Gating** tab (Figure 162).

8. Select **Bracket Pulsing On** or **Off**.

   Note: Bracket pulsing is only useful in low duty factor gated measurements in the UV with the PI-MAX camera. See your PI-MAX manual for detailed information.

9. If you select Bracket Pulsing **ON**, next select Anticipator **ON** or **OFF**. If **ON** is selected, then set the Anticipator time.

   Note: The Anticipator allows Bracket Pulsing with repetitive external trigger sources. The Anticipator measures the trigger period and then turns on the bracketing pulse timed to lead the photocathode gate pulse by the set interval. For proper operation, the bracketing pulse must begin at least 500 ns before the gate pulse.

   The minimum Anticipator Time is 500 ns (or the minimum PI-MAX bracket lead time from EEPROM) ***minus*** the minimum Gate Delay time. For example, with a minimum Gate Delay time of 200 ns, the software would automatically set the Anticipator time to 300 ns.

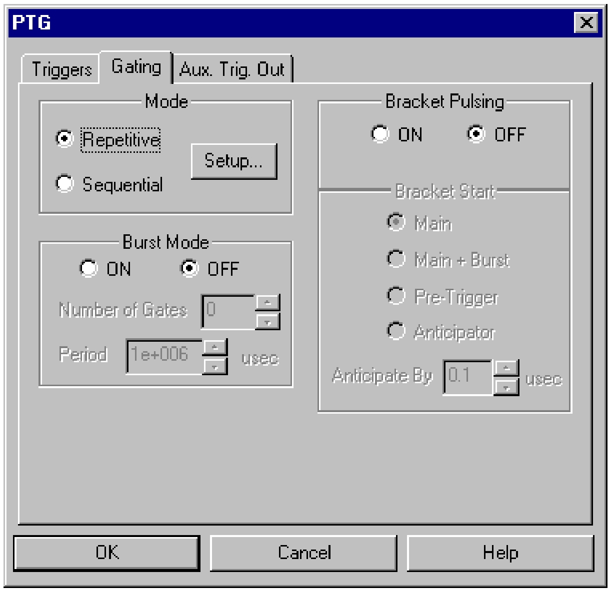


Figure 162. PTG Gating tab page

10. For Burst operation, in which each trigger initiates a burst of gate pulses, select Burst Mode ON and set the number of pulses in the burst and their period.

    Note: If bracket pulsing and Burst Mode are both selected, the entire burst will be bracketed but not the individual pulses within a burst.

11. Select **Repetitive** or **Sequential** and then click on the adjacent **Setup** button.

Repetitive Mode

If Repetitive is selected, the Repetitive Gating setup dialog box will appear as shown in Figure 163. In the Repetitive gating mode, the Gate Width and Gate Delay remain constant over the course of the measurement. If operating in the Repetitive Gating mode, simply set the Gate Width and Gate Delay to the desired values and click on **OK**. The Repetitive Gating Setup dialog box will close and you will return to the PTG dialog box.

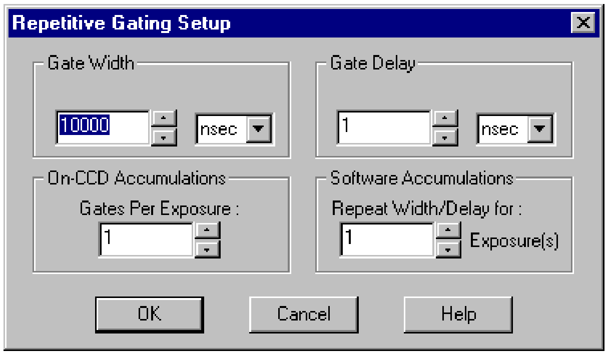


Figure 163. Repetitive Gating Setup

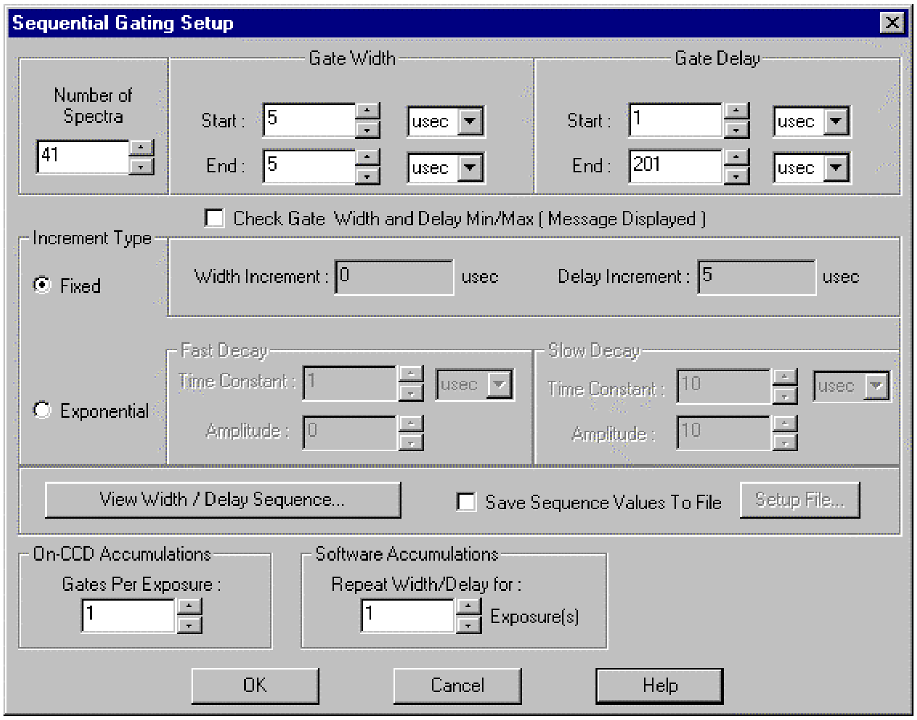


Figure 164. Sequential Gating Setup box

Sequential Mode

If Sequential is selected, the Sequential Gating Setup dialog box will appear as shown in Figure 164. In the Sequential Gating mode, the Gate Width and Gate Delay do not remain constant but change either linearly (**Fixed**) or exponentially as the measurement progresses.

Fixed is suited to sweeping over a time interval to locate and recover and event that takes place at the same time with each iteration. **Exponential** is well suited to fluorescence decay experiments where the effect under study changes rapidly at the start of an experiment and then slower and slower, following a logarithmic curve, as the experiment progresses. *Refer to the online help for a detailed discussion of the Sequential Gating setup parameters.* In any case, if the measurement is to be done in the sequential gating mode, set the gating parameters as appropriate for your intended measurement and click on **OK**. The Sequential Gating Setup dialog box will close and you return to the PTG dialog box.

12. Click the **OK** button. This writes all of the parameter values to the PTG.

> **Note:** The PTG can also be controlled interactively as data is being collected. For more information, see the discussion of this feature starting on page 184.

DG535 Digital Delay/Pulse Generator

The DG535 is programmed via the IEEE-488 GPIB port of the computer (default GPIB address is 15). The choices provided by the tab pages are the same ones that are available using the DG535 front panel. Basic DG535 operation is reviewed in the following procedure. The individual tab page selections are discussed in detail in the online Help topics.

Note: The DG535 is used to control the PI-MAX gate functions. If the system is equipped with a PI-MAX camera, the Camera State dialog box (Figure 165) will appear when the software is started. Although the software always initially places the PI-MAX in Safe mode, you have the option of restarting with the last settings or reverting to the factory defaults, which are:

Mode: Safe
Exposure Time: 10 ms
Intensifier Gain: precisely midrange (128 on arbitrary 1 to 256 Intensifier Gain scale).

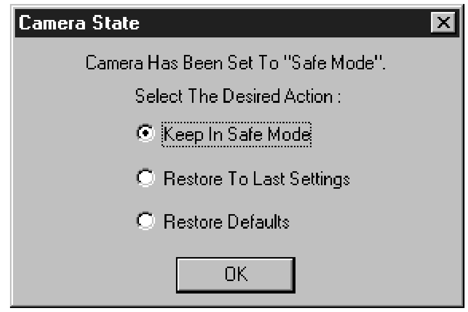


Figure 165. Camera State dialog box

1. Make sure the DG535 is connected to the computer's IEEE-488 GPIB port. Later you will tell WinSpec/32 the DG535's GPIB address. *The default setting is 15.*

2. Following all intensifier precautions listed in the hardware manuals, turn on the DG535 and wait for it to initialize. If the DG535 isn't turned on, the WinSpec/32 software won't be able to program it.

3. Select **Setup** and then **Pulsers** to open the Pulsers dialog box.

4. Select **DG535**. Then click on the **Setup DG535** button. The DG535 dialog box will open.

5. Click on the **Comm Port** tab (Figure 167).

6. For the Port Type select GPIB. Then set the **Port Address** to the GPIB address of the DG535. *Default setting is 15.*

7. Once you have selected the correct port address, click on **Initialize Port**. If the software cannot find the pulser on this port, such as if the pulser is not turned on or if the address setting incorrect, you will get an error

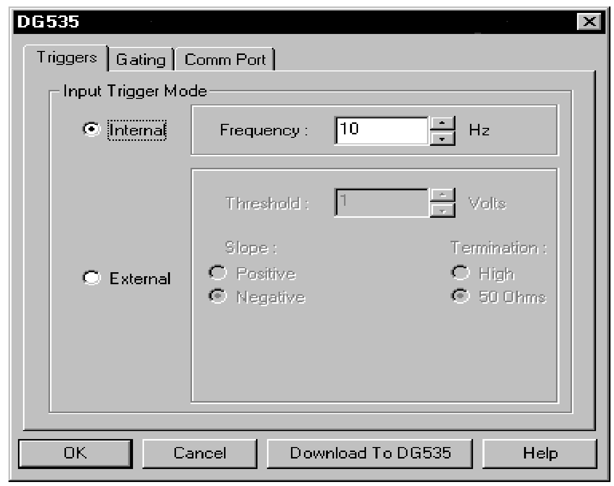


Figure 166. DG535 dialog box

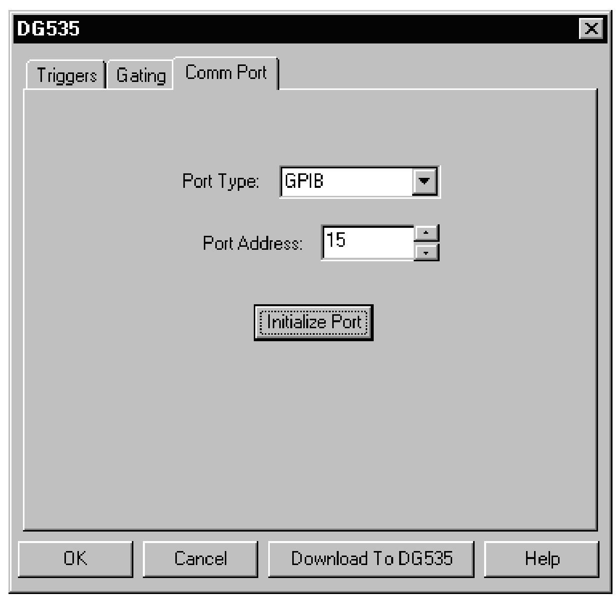


Figure 167. DG535 Comm Port tab page

message. If this happens, check the address, check the cable connections and check that the pulser is powered.

8. Click on the **Triggers** tab Figure 168.

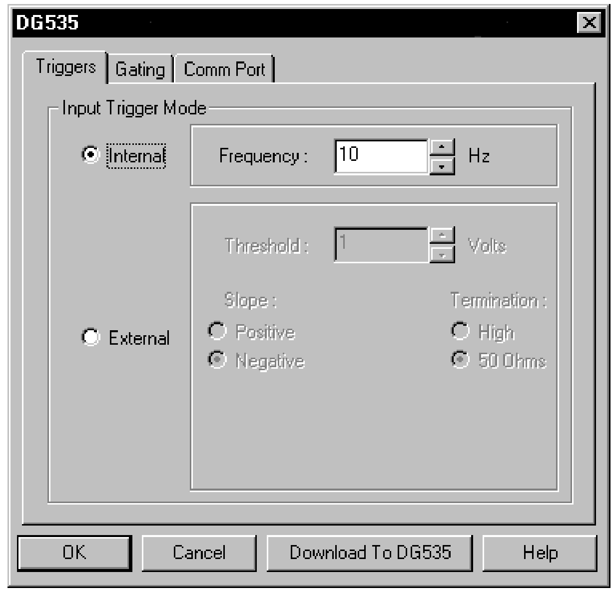


Figure 168. DG535 Triggers tab page

9. Select the Trigger mode, either **Internal**, in which the DG535 free runs, or **External**, in which it is triggered from an external source.

10. If operating in the **Internal** trigger mode, set the **Trigger Frequency** in Hz. Consult the DG535 Manual to determine the maximum Trigger Frequency that can be used in your application.

11. If operating in the **External** trigger mode, specify the **Slope**, **Threshold**, and **Termination** appropriate for the trigger source.

12. Click on the **Gating** tab to bring the Gating tab page to the front.

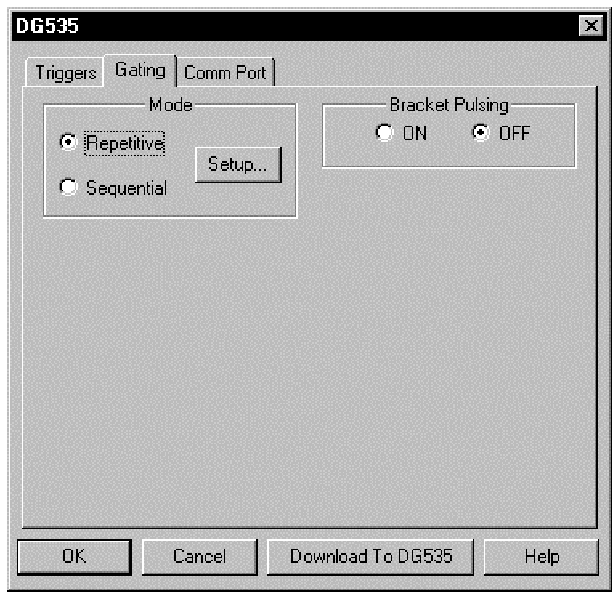


Figure 169. DG535 Gating tab page

13. Select **Bracket Pulsing On** or **Off**.

    Note: Bracket pulsing is only useful in low duty factor gated measurements in the UV with the PI-MAX camera. See your PI-MAX manual for detailed information.

14. Select **Repetitive** or **Sequential** and then click on the adjacent **Setup** button.

Repetitive Mode

If Repetitive is selected, the Repetitive Gating setup dialog box will appear (Figure 170). In this mode, the Gate Width and Gate Delay remain constant over the course of the measurement.

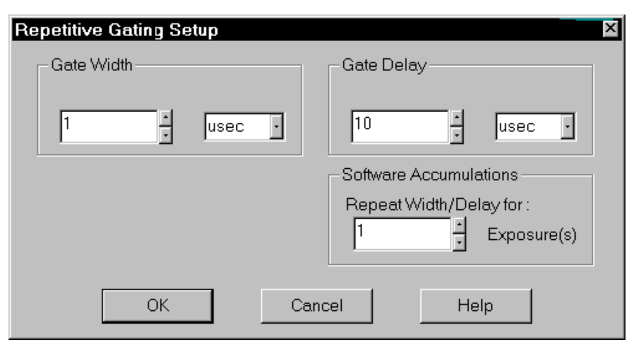


Figure 170. Repetitive Gating Setup

If operating in the Repetitive Gating mode, simply set the Gate Width and Gate Delay to the desired values and click on **OK**. The Repetitive Gating Setup dialog box will close and you will return to the DG535 dialog box.

Sequential Mode

If Sequential is selected, the Sequential Gating Setup dialog box will appear as shown in Figure 171. In the Sequential Gating mode, the Gate Width and Gate Delay do not remain constant but change either linearly or exponentially as the measurement progresses. **Linear** is suited to sweeping over a time interval to locate and recover and event that takes place at the same time with each iteration. **Exponential** is well suited to fluorescence decay experiments where the effect under study changes rapidly at the start of an experiment and then slower and slower, following a logarithmic curve, as the experiment progresses. The resulting data points can be spline-fitted to generate the complete curve so that the decay constant can be calculated, even where the data derives from two decay processes occurring simultaneousely.

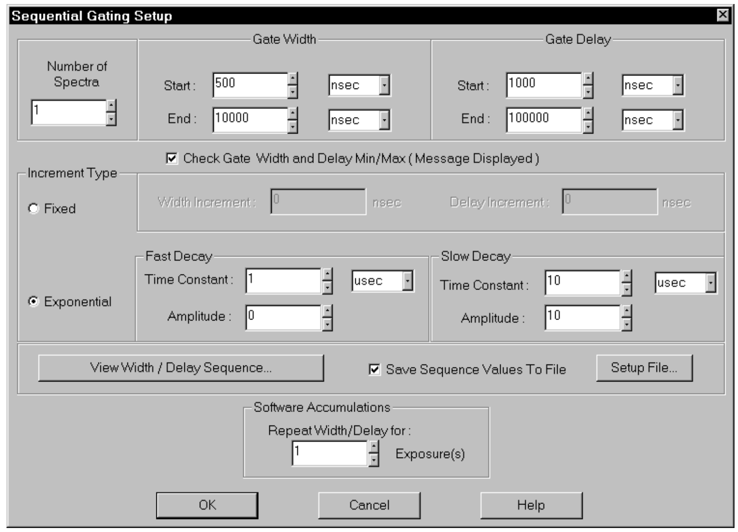


Figure 171. Sequential Gating Setup dialog box

If the measurement is to be done in the sequential gating mode, set the pulsing parameters as appropriate for your intended measurement and click on **OK**. The Sequential Gating Setup dialog box will close and you return to the DG535 dialog box.

Parameters

Number of Spectra: *With an Accumulations setting of one*, Number of Spectra equals the number of exposures, each of which is followed by a readout. After each exposure, the Gate Width and Gate Delay change as programmed before the next exposure occurs. *If multiple Accumulations are programmed*, each exposure is repeated ***n*** times, where ***n*** is the number of accumulations specified. Every accumulation is processed before the gate delay and width change for the next shot. The total number of exposures equals the specified Number of Spectra times the number of Accumulations.

ATTENTION

> Accumulations can be set on the DG535 Sequential Gating Setup dialog box and on the Experiment Setup Main tab page. **The two settings must be the same for proper operation.**

Gate Width: The starting and ending gate widths are independently set. The first Shot will have the **Starting** gate width and the last Shot will have the **Ending** gate width. This is true for both the Fixed and Exponential increment type.

Gate Delay: The starting and ending gate delay values are independently set. The first Shot will be taken at the **Starting** delay with respect to T_0 and the last Shot will occur at the **Ending** delay with respect to T_0. This is true for both the Fixed and Exponential increment type.

ATTENTION

> Although the T_0 output of the DG535 marks the start of each DG535 timing cycle, the precise timing of both the gate and signal at the camera will additionally depend on a number of different delay mechanisms that can significantly affect the experiment. These are discussed for the PI-MAX camera in some detail in *Tips and Tricks* chapter of the PI-MAX instruction manual.

Check Gate Width and Delay Min/Max (Message Displayed): If this box is checked and you specify a gate width or delay outside the allowable range, a warning message (Figure 172) will be displayed. Clicking **Yes** will cause the parameter in question to be set to the limit value. Clicking **No** will cause the parameter *setting* to be retained, but the *actual* value will still be the applicable minimum or maximum. If the box isn't checked, the applicable minimum or maximum will be established automatically.

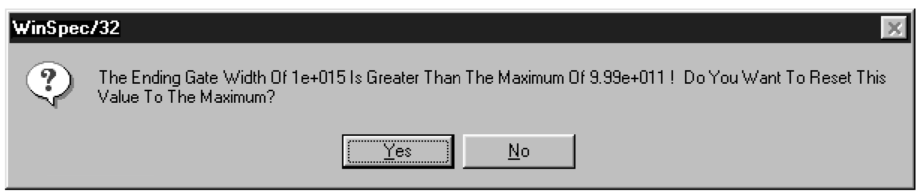


Figure 172. Range Limits Exceeded warning

Fixed Increment Type: With this selection, the increment or change in Gate Width and Gate Delay is the same from shot to shot. The actual increments depend on the specified starting and ending values and on the Number of Spectra. The increment values are calculated and reported in the associated fields.

Exponential Increment Type: With this selection, the increment or change in Gate Width and Gate Delay changes from shot to shot. The precise delay and width of each shot with respect to T_0 is determined by the values entered for the Fast Decay and Slow Decay **Time Constant** and **Amplitude** parameters. In fluorescent decay experiments, for example, there will typically be two species contributing to the output data, one of which decays much faster than the other. For example, there might be a fast fluorophor with a decay time of at most a few nanoseconds, and a slower one with a decay time of perhaps a hundred nanoseconds. By sweeping both the delay *and* the width, and making provision for entering time constant and amplitude information for two species, the sequential exponential algorithm is ideally suited to making this type of measurement. At the start of the decay where the amplitude is high but the decay is rapid, the gate pulses are narrow and close together. Towards the end of the decay where the decay is slow, the gate pulses are further apart but much wider to accommodate the lower signal amplitude. The result is output data that is relatively constant in intensity over the decay time. This data can be easily normalized by dividing each point by the exposure time and then using a spline fit to recover the curve. The logarithm (base *e*) can then be taken to obtain a straight line (or two lines successive line segments, each with a different slope for two species). Tangents can be fitted to each segment to determine the rate constant for each species.

Fast Decay

Time Constant: In a two species system, enter the ***decay time*** of the faster of the two species. Note that it is not *essential* that you enter a value. If you have the decay time information, you will get better data if the information is entered, but acceptable results can be obtained in many situations by using the default. If there is only one species, or if you want to discard the fast decay process, simply enter zero for the *Amplitude.*

Note that the Gate Width and Gate Delay values need to be selected with some care in fluorescence decay experiments. Typically the starting gate width will be very narrow, perhaps 2 ns, and the final gate width should be wider by about the ratio of the anticipated signal amplitude decrease over the course of the measurement timebase. Similarly, the starting gate delay has to take the various insertion delays into account, and the final delay value might typically be set to a value on the order of five times the anticipated decay time of the process.

Amplitude: This is the *relative* amplitude of the fast decay with respect to the slow one. For example, if you know that the amplitude of the fast decay signal is typically five times the amplitude of the slow decay signal, you could enter “5” for the fast decay amplitude and “1” for the slow decay amplitude. Keep in mind that it is the *ratio* that is being expressed. For example, there is no difference between entering fast and slow amplitude values of “5” and “1” and entering fast and slow amplitude values of “50” and “10.” Note that the default values will give satisfactory results in many measurements.

Slow Decay

Time Constant: In a two species system, enter the ***decay time*** of the slower of the two species. Note that it is not *essential* that you enter a value. If you have the decay time information, you will get better data if the information is entered, but acceptable results can be obtained in many situations by using the default. If there is only one species, or if you want to discard the fast decay process, simply enter zero for the *fast decay Amplitude.*

Amplitude: This is the *relative* amplitude of the slow decay with respect to the fast one. For example, if you know that the amplitude of the slow decay signal is typically one fifth the amplitude of the fast decay signal, you could enter “1” for the slow decay amplitude and “5” for the fast decay amplitude. Keep in mind that it is the *ratio* that is being expressed. For example, there is no difference between entering slow and fast amplitude values of “1” and “5” and entering fast and slow amplitude values of “10” and “50.”

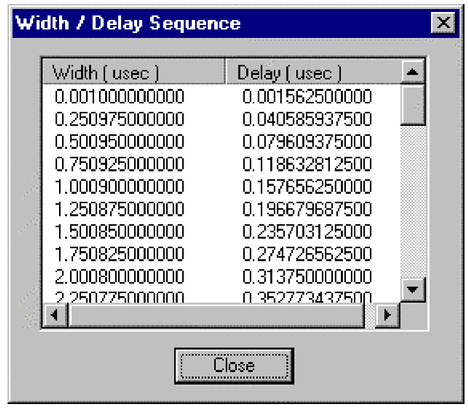


Figure 173. Gate Width/Delay sequence dialog box

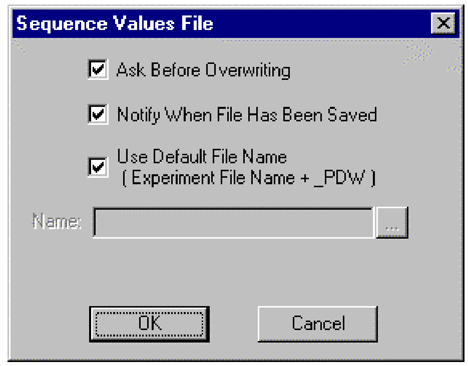


Figure 174. Sequence Values File dialog box

View Width/Delay Sequence: Opens a dialog box listing the currently programmed sequence of gate width and gate delay values.

Save Sequence Values to File: When this box is checked, the sequence values will be saved ***on completion of the run***. The values saved are those actually used to take the data. The file could be recalled later and used for data normalization or other purposes.

Setup File: Opens the Sequence Values File dialog box (Figure 174), which enables the following:

Ask Before Overwriting: If checked, you will be queried before a new sequence value file overwrites an existing one. If unchecked, overwriting can occur without warning.

Notify When File Has Been Saved: The file is saved at the end of the data-acquisition run. You will be notified that this has occurred if this box is checked.

Use Default File Name: If checked, sequence value file name will be experiment file name, but with the extension **PDW**. If unchecked, you must enter the name in the **Name** field.

Name: If not using the default name for the sequence value file, enter the file name in the provided field. The button at the end of the box opens a browser to facilitate assigning the file location.

Software Accumulations: Sets the number of exposures to be taken for each Shot. Note that the number of Accumulations set here must be the same as the value set on the Experiment Setup Main tab page for proper operation.

15. Click on **Download to DG535**. This writes all of the parameter values to the DG535.
16. Click on **OK** to close the window.

Note: The DG535 can also be controlled interactively as data is being collected.

Timing Generator Interactive Trigger Setup

The  button on the **Custom Toolbar**, allows you to select the PTG or DG535 trigger mode (**Internal** or **External**) while acquiring data.

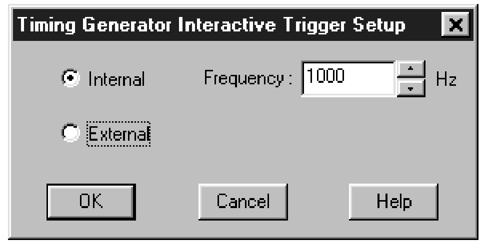


Figure 175. Timing Generator Interactive Trigger Setup

Internal: The Timing Generator will create its own trigger signals at the selected frequency.

External: The Timing Generator will be triggerd by trigger signals that originate in an external piece of equipment.

Chapter 18
Custom Toolbar Settings

Introduction

The Custom Toolbar feature of WinSpec/32 allows you one-button access to many features or combinations of features available through the software. The Custom Toolbar layout and the number of buttons displayed on the Custom Toolbar can easily be changed.

Displaying the Custom Toolbar

1. To make the Custom Toolbar visible, select **Toolbars** and then **Custom** on the View menu. The Custom Toolbar will appear on the desktop and its default configuration will be as shown in Figure 176.
2. You can change position of the Custom Toolbar, its layout, and the number of buttons it contains.

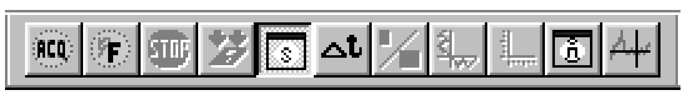


Figure 176. Default Custom Toolbar

Customizing the Toolbar

Although the **Custom Toolbar** defaults with the buttons shown in Figure 176, many additional buttons are in fact available and can be added to the button using the Customize Toolbar dialog box (Figure 177). Buttons can be added or removed at any time and the new configuration will be saved when the dialog box is closed.

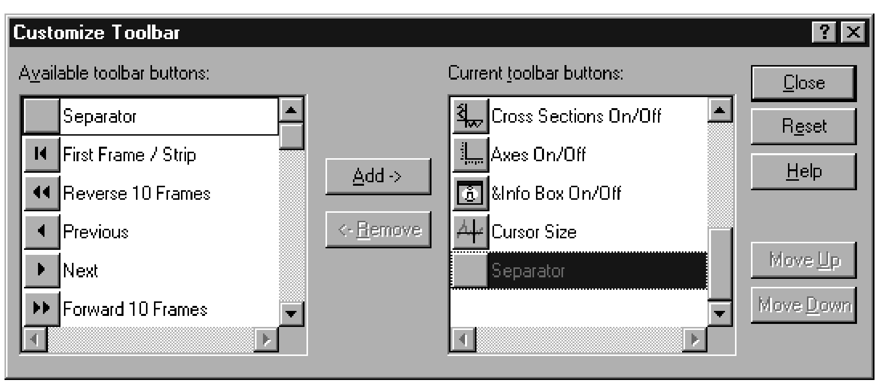


Figure 177. Customize Toolbar dialog box

Adding an Available Button

1. Open the **Customize Toolbar** dialog by clicking on **Custom Toolbar** in the Setup menu.
2. Referring to Figure 177, note that the buttons available for placement on the **Custom Toolbar** are listed on the left. Buttons already on the toolbar are on the right.
3. To add an available button to the **Custom Toolbar**, first select it from the left-hand list. You may have to scroll through the list of available buttons to find the one you want. You can choose where to place the button by selecting a button on the *right* side (which will then be highlighted). The new button will be placed *before* the highlighted one.
4. Click on the **Add** button. The button will disappear from the list of Available buttons and will be added to the list of Toolbar buttons.
5. Click on **Close** to close the dialog box.

Removing a Button

1. Open the Customize Toolbar dialog by clicking on Customize Toolbar in the Setup menu.
2. Referring to Figure 177, note that buttons already on the toolbar are listed on the right. Available but unused buttons are listed on the left.
3. To remove an available button from the **Custom Toolbar**, first select it from the right-hand list. You may have to scroll through the listed buttons to find the one you want.
4. Click on the **Remove** button. The button will disappear from the list of Toolbar buttons and will be added to the list of Available buttons.
5. Click on **Close** to close the dialog box.

Individual Dialog Item Descriptions

Available Buttons: You can select the button you wish to add to the Custom Toolbar from this section. Many buttons, each with its own preassigned function as described below, are available.

Toolbar Buttons: These are the buttons that will actually appear on the Custom Toolbar.

Add: Causes the selected button on the Available buttons list to be transferred to the Toolbar buttons list before the selected button.

Remove: Causes the selected button on the Toolbar list to be transferred to the Available buttons list.

Close: This button closes the Custom Toolbar Assignment dialog box and implements changes made to the Custom Toolbar.

Reset: Restores the default Custom Toolbar configuration.

Help: Opens the context-sensitive help for the Custom Toolbar.

Move Up: Together with Move Down, Move Up determines the position of a given button on the Custom Toolbar. Each time this button is clicked, the selected button on the Toolbar buttons list moves up one position.

Move Down: Together with Move Up, Move Down determines the position of a given button on the Custom Toolbar. Each time this button is clicked, the selected button on the Toolbar buttons list moves down one position.

This page intentionally left blank.

Chapter 19

Custom Chip

User Defined Chip

Introduction

Selecting **User Defined Chip** on the Controller/Camera tab page makes the Custom Chip tab page appear. If brought to the front, the Custom Chip selections become available as shown in Figure 178. The default values conform to the physical layout of the CCD array and are optimum for most measurements.

CAUTION

Roper Scientific does not encourage users to change these parameter settings. For most applications, the default settings will give the best results. We ***strongly advise*** contacting the factory for guidance before customizing the chip definition.

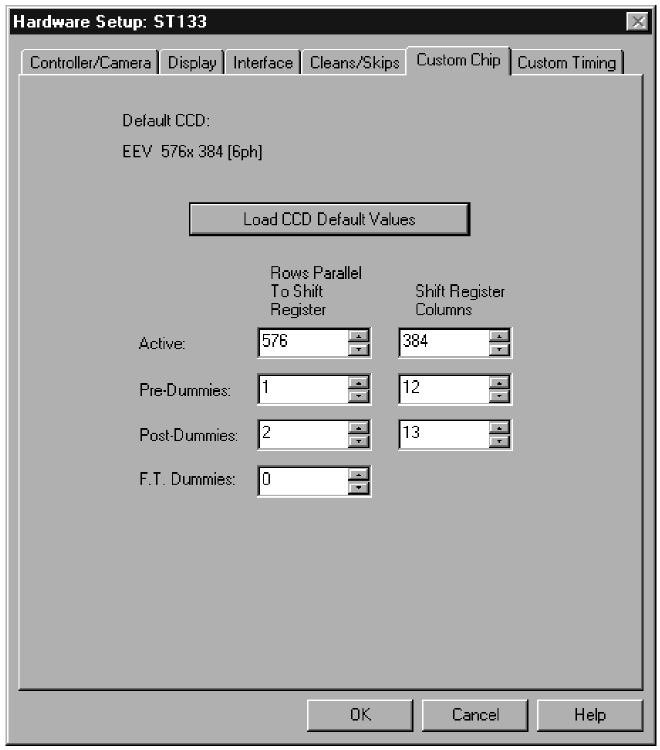


Figure 178. Custom Chip tab page

Normally, not all of the pixels in a CCD array are exposed and read out: a frame of “dummy” pixels bounds the active area. These dummy pixels are usually masked and are not normally read out. However, they could be read out by changing the chip definition in software. For example, in the case of the EEV 576 × 384 chip illustrated in Figure 178, the 576 active rows are preceded by one dummy row and followed by 2 dummy rows. In addition, there are 12 dummy columns on one side of the active region and 13 dummy columns on the other side. By changing the chip definition to increase the active area while decreasing the dummy settings, the dummy cells would be read out. By doing so, one could measure the dark charge with every readout. (Note that F.T. Dummies are chip-specific and are dummy rows at the boundary of the masked and visible areas of a frame transfer device.)

It is also possible to increase image acquisition speed by reducing the size of the active area in the definition. The result will be faster but lower resolution data acquisition. Operating in this mode would ordinarily require that the chip be masked so that only the reduced active area is exposed. This will prevent unwanted charge from spilling into the active area or being transferred to the shift register.

Chapter 20

Custom Timing

User Defined Timing

Introduction

Selecting **User Defined Timing** on a Controller/Camera (or Controller/Detector) tab page causes the Custom Timing tab page to appear. If brought to the front, the Custom Timing selections become available as shown in Figure 179. The default timing parameter values have been determined to give the fastest possible performance without compromising data acquisition performance.

CAUTION

Roper Scientific does not encourage users to change these parameter settings. For most applications, the default settings will give the best results. We ***strongly advise*** contacting the factory for guidance before customizing the chip timing parameters.

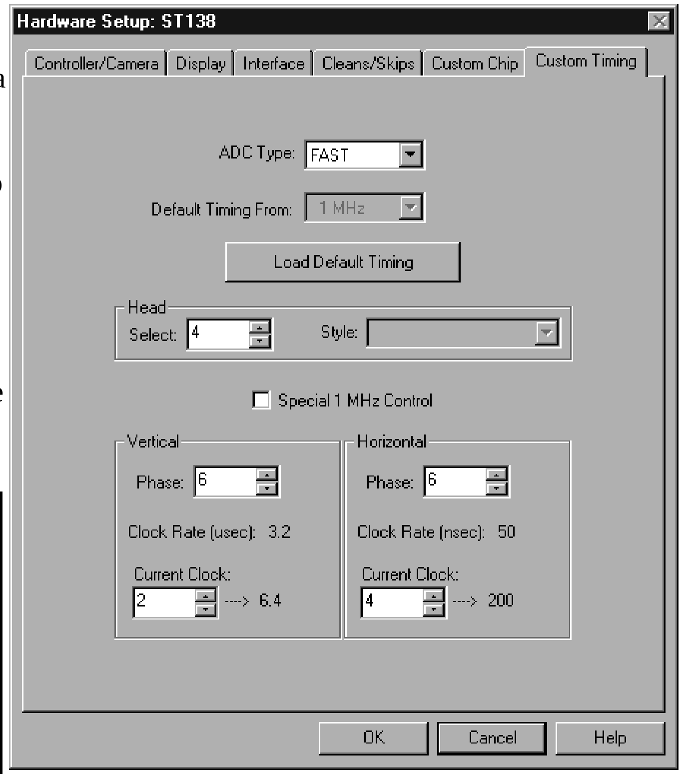


Figure 179. Custom Timing tab page

This page intentionally left blank.

Part 3
Reference

This page intentionally left blank.

Appendix A
System and Camera Nomenclature

System, Controller Type, and Camera Type Cross-Reference

Use the cross-reference table below if you need to determine the controller type and/or camera/CCD type used by your system. This table is based on the Princeton Instruments brand systems that are currently being sold by Roper Scientific, Inc. Many of these systems incorporate non-volatile RAM (NVRAM) that has been factory programmed with the default hardware setup parameters for the controller, camera, and CCD array included in your system. If you know the controller type used by your system, you should be able to download these default parameters. However, if this functionality is not available for your system, you will need to manually enter the information.

System	Controller Type	Camera/CCD Type
I-PentaMAX (GenIV)	PentaMAX*	EEV 512x512FT
MicroMAX: 512EBFT	ST-133	EEV 512x512FT CCD57
MicroMAX: 782Y	ST-133	PID 582x782
MicroMAX: 782YHS	MicroMAX-5 MHz	PID 582x782
MicroMAX: 1024B	ST-133	EEV 1024x1024 CCD 47_10
MicroMAX: 1300B	ST-133	EEV 1300x1340B
MicroMAX: 1300Y	ST-133	PID 1030x1300
MicroMAX: 1300YHS	MicroMAX-5 MHz	PID1030x1300
MicroMAX: 1300YHS-DIF	MicroMAX-5 MHz	PID1030x1300
OMA V:InGaAs 256	ST-133	InGaAs 1x256
OMA V:InGaAs 512	ST-133	InGaAs 1x512
PDA	ST-121*[*]	Diode Array 1024
PI-LCX: 400	ST-133	EEV 400x1340F

[*] Does not support NVRAM function.

System	Controller Type	Camera/CCD Type
PI-LCX: 576	ST-133	EEV 576x384 (3 ph)
PI-LCX: 1242	ST-133	EEV 1152x1242 (3 ph)
PI-MAX: 512HQ	ST-133	THM 512x512
PI-MAX: 512RB	ST-133	THM 512x512
PI-MAX: 512SB	ST-133	THM 512x512
PI-MAX: 512UV	ST-133	THM 512x512
PI-MAX: 1024HQ	ST-133	EEV 256x1024F CCD30
PI-MAX: 1024RB	ST-133	EEV 256x1024F CCD30
PI-MAX: 1024SB	ST-133	EEV 256x1024F CCD30
PI-MAX: 1024UV	ST-133	EEV 256x1024F CCD30
PI-SCX: 1242	ST-133	EEV 1152x1242(6 ph)
PI-SCX: 1300	ST-133	EEV 1300x1340F
PI-SX: 400	ST-133	EEV 400x1340B
PI-SX: 512	ST-133	TEK 512x512DB
PI-SX: 1024	ST-133	TEK 1024x1024DB
PI-SX: 1300	ST-133	EEV 1300x1340B
Spec-10: 100	ST-133	EEV 100x1340F
Spec-10: 100B	ST-133	EEV 100x1340B
Spec-10: 100BR	ST-133	EEV 100x1340B
Spec-10: 100R	ST-133	EEV 100x1340F
Spec-10: 120	ST-133	HAM 124x1024
Spec-10: 120B	ST-133	HAM 122x1024B
Spec-10: 256	ST-133	EEV 256x1024F CCD30
Spec-10: 256B	ST-133	EEV 256x1024B CCD30
Spec-10: 256E	ST-133	EEV 256x1024OE CCD30
Spec-10: 400	ST-133	EEV 400x1340F
Spec-10: 400B	ST-133	EEV 400x1340B

System	Controller Type	Camera/CCD Type
Spec-10: 400BR	ST-133	EEV 400x1340B
Spec-10: 400R	ST-133	EEV 400x1340F
Spec10-250	ST-133	HAM 252x1024
Spec10-250B	ST-133	HAM 250x1024B
VersArray: 512B	ST-133	TEK 512x512DB
VersArray: 512F	ST-133	TEK 512x512DF
VersArray: 1024B	ST-133	TEK 1024x1024DB
VersArray: 1024F	ST-133	TEK 1024x1024DF
VersArray: 1300B	ST-133	EEV 1300x1340B
VersArray: 1300F	ST-133	EEV 1300x1340F

System and System Component Descriptions

The following information briefly describes Princeton Instruments brand systems and the system components. For more information, contact your Roper Scientific representative or Customer Support.

Systems:

LCX: High-performance photon counting system. Medium X-ray, direct detection

MicroMAX: Name used for some ST-133 based imaging systems, usually with an RTE head.

MicroMAX 5 MHz: 5 MHz controller, characterized by duplex head cable.

OMA V: Cyrogenically cooled Photodiode array (PDA) based system for spectroscopy applications.

PDA: Low-cost spectroscopy system uses ST-121 controller.

PentaMAX: A/D electronics are in the head so no controller is necessary. Runs with PCI card only. Both unintensified and intensified versions are available

PI-MAX: ICCD design with internal high voltage power and gating. Controller is ST-133, and gating timing is provided by a DG535, PTG or other TTL timing source.

PI-SCX: X-ray diffraction, fiberoptically-coupled detector.

PI-SX: High-sensitivity, deep-vacuum interface for soft X-ray acquisition.

SPEC-10: High performance, spectroscopy system. Wide variety of CCD arrays. Thermoelectric or cryogenic cooling available.

SpectroMAX: Name used for some ST-133 based spectroscopy systems, usually with an RTE head.

VersArray: High-performance, general purpose imaging system.Wide variety of CCD arrays in imaging formats. Thermoelectric or cryogenic cooling available.

Controllers:

ST-121: Diode array controllers shipped with diode array detectors, controlled by an ISA or PCI card.

ST-130: Obsolete controller but still supported in the WinSpec/32 software.

ST-133: Controller that can run the vast majority of Princeton Instruments brand cameras, including MicroMAX, PI-MAX, Spec-10, LCX, PI-SCX, PI-SX, OMA V, and VersArray. Different hardware types are needed to run different detectors (for example, liquid nitrogen-cooled vs. thermoelectrically-cooled).

ST-138: Older controller for TE, LN, ICCD, and ITE units. It offers a few special features such as hardware accumulator. In general, this controller is being phased out.

Cameras/Detectors:

HCTE/CCD: See **NTE/CCD and NTE 2**.

RTE/CCD: Round thermoelectrically cooled camera, can be run with ST-133 controllers.

TE/CCD: Water cooled camera, can be run with ST-138 or some ST-133 controllers.

TEA/CCD: Forced air cooled camera, can be run with ST-138 or some ST-133 controllers.

MTE 2: Miniature liquid cooled camera, designed for in vacuum chamber operation, can be run with ST-133 controller.

LN/CCD: Liquid nitrogen cooled detector, 1.5 liter dewar is standard, can be run with ST-138 or ST-133.

NTE/CCD and **NTE 2:** Stands for new TE head. More cube shaped than the TE, designed for maximum cooling. NTE 2 requires high-power version of ST-133.

ICCD: Standard, “classic” intensified camera, requires purging, has internal high voltage power but requires external high voltage pulses for gating. Controlled by ST-133 or ST-138.

V/ICCD: Video intensified detector. Always shipped with it’s own control box, produces standard video out so no interface card or software required. As of Version 2.5, this detector will not be supported by WinSpec.

LN/InGaAs: Indium gallium arsenide detector controlled by a ST-133 controller

Pulsers:

FG-100: Pulser with 5 nsec - 3 μsec gating, Gen II intensifiers only.

FG-101: Obsolete version of an ICCD unit, with internal high voltage power and gating.

PG-10: Pulser with 200 nsec to 6 msec gating, Gen II intensifiers only.

PG200: Software programmable pulser with 5 nsec to 80 msec gating. Highest performance pulser with the most features, Gen II intensifiers only

PTG: Dedicated "programmable delay generator" board which generates TTL level pulses to control intensifier gating in PI-MAX models. It is an option that sits in the third slot of an ST-133 controller.

High-Voltage Power Supplies:

IIC-100: High voltage power supply for intensified cameras without internal high voltage supplies (intensified PentaMAX, ITE, or lens-coupled intensified systems) for CW operation only. Not necessary for ICCD or PI-MAX cameras. For gated operation of intensified PentaMAX or ITE cameras buy the board version of the IIC-100, called the MCP-100, built into the pulser. During manufacture, a Model IIC-100 is configured for operation with a Gen II intensifier or with a Gen IV intensifier, ***but not for operation with both types***.

IIC-200: Compact high voltage power supply for intensified cameras without internal high voltage supplies (intensified PentaMAX, ITE, or lens-coupled intensified systems) for gated and CW/Shutter operation. During manufacture, a Model IIC-200 is configured for operation with a Gen II intensifier or with a Gen IV intensifier, ***but not for operation with both types***.

IIC-300: Combined image intensifier power supply and moderate performance gating pulse generator. Gated and CW/Shutter operation. PIV version available. During manufacture, a Model IIC-300 is configured for operation with a Gen II intensifier or with a Gen IV intensifier, ***but not for operation with both types***.

Miscellaneous Components:

OFA: An adapter for connecting a fiber optic input to a spectrometer. Two versions are available for the best possible f/# matching, see the price list for details.

CC-100: Closed coolant circulator (not a chiller) designed for TE, TEA, or ICCD cameras

UV Lens: f/1.2 catadioptric lens only for ICCD or PI-MAX cameras

CCD Array Designators

The following list of designators are often used on camera serial labels to identify the CCD array in the camera.

B: Back-illuminated CCD

DDA: Dual diode array CCD

F: Front illuminated CCD, in many cases no letter is used

E: CCD made by EEV

T: CCD made by Thomson

K: CCD made by Kodak

H: CCD made by Hamamatsu

HS: “High speed” MicroMAX system runs at 5 MHz

FT: Frame transfer detector

M: MPP (multi-pin phasing) CCD

P: (Usually) CCD offered exclusively by Roper Scientific

PDA: Photodiode array

R: Deep depletion

S: Usually refers to SITe arrays, also see TK

TK: CCD made by SITe (formerly Tektronix), sometimes labeled S

UV: UV-to-VIS standard lumogen coating for UV-response to 195 nm

UVAR: Permanent UV-to-NIR A/R coating on some SITe CCDs (not lumogen/metachrome)

VISAR: Permanent VIS to NIR A/R coating on some SITe CCDs (not lumogen/metachrome)

Y: Interline CCD made by Sony

/1: grade 1 CCD

/2: grade 2 CCD

/3: grade 3 CCD

64: array format is 1024 x 64 pixels

100: array format is 1340 x 100 pixels

128: array format is 1024 x 128 pixels

400: array format is 1340 x 400 pixels

256: 256 element linear array

512: array format is 512 x 512 pixels; or 512 elements for linear arrays

576: array format is 576 x 384 pixels

768: array format is 768 x 512 pixels

782: array format is 782 x 582 pixels

1024: array format is 1024 x 256 (EEV or Hamamatsu) or 1024 x 1024 (SITe)

1280: array format is 1280 x 1024 pixels

1300: array format is 1300 x 1030 pixels (Sony) or 1300 x 1340 pixels (EEV)

1000: array format is 1000 x 800 pixels

1100: array format is 1100 x 330 pixels

1340: array format is 1340 x 100, 400, or 1300; family is exclusive to Roper Scientific

1242: array format is 1152 x 1242 pixels

1317: array format is 1317 x 1035 pixels

1536: array format is 1536 x 1032 pixels

2032: array format is 2025 x 2032 pixels

3072: array format is 3072 x 2048 pixels

2500: array format is 2500 x 600, rectangular pixels

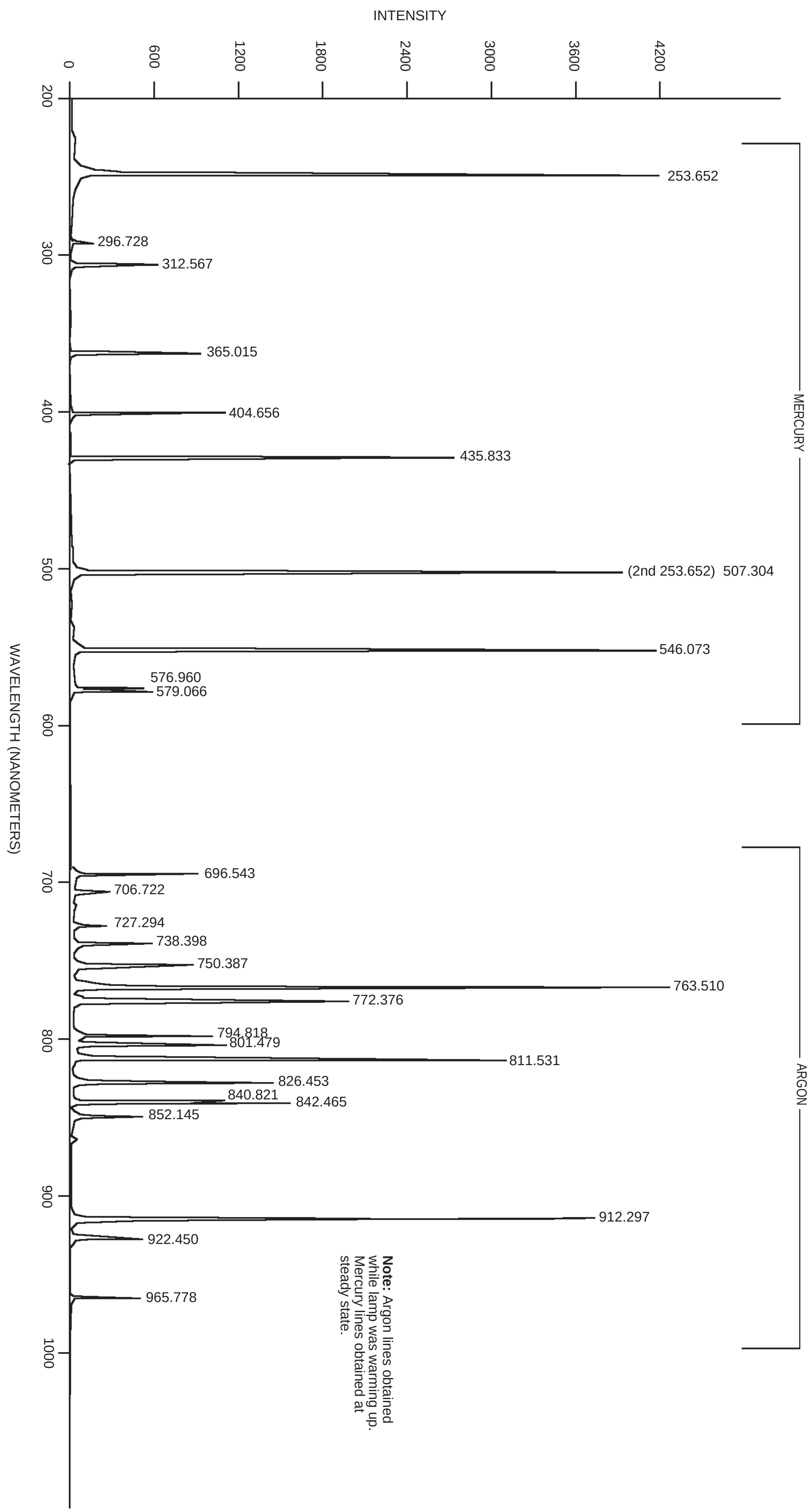
This page intentionally left blank.

Appendix B
Calibration Lines

MERCURY	184.91 194.17	226.22 237.83 248.20 253.65** 265.20 280.35 289.36 296.73	302.15 312.57* 313.17 334.15 365.02* 365.44 366.33	404.66* 407.78 434.75 435.84*	507.30* (2x253.65) 546.07* 576.96 579.07	625.14 (2x312.57) 626.34 (2x313.17)	730.04 (2x365.02) 760.95 (3x253.65)	
ARGON			394.90	404.44 415.86* 416.42 418.19 419.10 420.07* 425.94 427.22 430.01 433.36		696.54*	706.72 727.29 738.40 750.39 751.46 763.51** 772.38* 794.82	800.62 801.48 810.37 811.53* 826.45 840.82 842.46
NEON			336.99 341.79 344.77 346.66 347.26 352.05* 359.35		533.08 534.11 540.06 585.25** 588.19 594.48 597.55	603.00 607.43 609.62* 614.31* 616.36 621.73 626.65 630.48 633.44 638.30* 640.23* 650.65* 653.29 659.90 667.83* 671.70 692.95	702.41 703.24* 705.91 717.39 724.52 743.89 748.89 753.58 754.41	837.76 849.54 863.46 865.44 878.20 878.38 885.39
	100	200	300	400	500	600	700	800

Table 1. Wavelength Calibration Lines (in nanometers)
** indicates strong line within a wavelength group*
***indicates strongest line for the element*
() indicates 2^{nd} or 3^{rd} order

Figure 180. Wavelength calibration spectrum



Appendix C
Data Structure

Version 1.43 Header

All WinView or WinSpec files (version 1.43) must begin with the following 4100 byte header:

```
              typedef WINXHEAD {
0             int dioden;          /* CCD X dimension.                         */
2             int avgexp;          /* Not used by WinView                      */
4             int exposure;        /* exposure if -1 see lexpos                */
6             int datarange;       /* Not used by WinView                      */
8             int mode;            /* Not used by WinView                      */
10            float wexsy;         /* Not used by WinView                      */
14            int asyavg;          /* Not used by WinView                      */
16            int asyseq;          /* Not used by WinView                      */
18            int linefreq;        /* Not used by WinView                      */
20            int date0;           /* Not used by WinView                      */
22            int date1;           /* Not used by WinView                      */
24            int date2;           /* Not used by WinView                      */
26            int date3;           /* Not used by WinView                      */
28            int date4;           /* Not used by WinView                      */
30            int ehour;           /* Not used by WinView                      */
32            int eminute;         /* Not used by WinView                      */
34            int noscan;          /* # of stripes collected if -1 see         */
                                   /* lnoscan.                                 */
36            int fastacc;         /* Not used by WinView                      */
38            int avgtime;         /* Not used by WinView                      */
40            int dmatotal;        /* Not used by WinView                      */
42            int faccount;        /* X dimension : Actual dim of image.       */
44            int stdiode;         /* Not used by WinView                      */
46            float nanox;         /* Not used by WinView                      */
50            float calibdio[10];  /* Not used by WinView                      */
90            char fastfile[16];   /* fast access file. Not used by WinView    */
106           int asynen;          /* Not used by WinView                      */
108           int datatype;        /* 0 -> float (4 byte)                      */
                                   /* 1 -> long integer (4 byte)               */
                                   /* 2 -> integer (2 byte)                    */
                                   /* 3 -> unsigned integer (2 byte)           */
                                   /* 4 -> String/char (1 byte)                */
                                   /* 5 -> double (8 bytes) Not implemented    */
                                   /* 6 -> byte (1 byte)                       */
                                   /* 7 -> unsigned byte (1 byte)              */
110           float calibnan[10];  /* Not used by WinView                      */
150           int rtanum;          /* Not used by WinView                      */
152           int astdiode;        /* Not used by WinView                      */
```

```
154          int int78;          /* Not used by WinView                     */
156          int int79;          /* Not used by WinView                     */
158          double calibpol[4]; /* Not used by WinView                     */
190          int int96;          /* Not used by WinView                     */
192          int int97;          /* Not used by WinView                     */
194          int int98;          /* Not used by WinView                     */
196          int int99;          /* Not used by WinView                     */
198          int int100;         /* Not used by WinView                     */
200          char exprem[5][80]; /* comments                                */
600          int int301;         /* Not used by WinView                     */
602          char label[16];     /* Not used by WinView                     */
618          int gsize;          /* Not used by WinView                     */
620          int lfloat;         /* Not used by WinView                     */
622          char califile[16];  /* calibration file. Not used by WinView  */
638          char bkgdfile[16];  /* background file. Not used by WinView   */
654          int srccmp;         /* Not used by WinView                     */
656          int stripe;         /* number of stripes per frame             */
658          int scramble;       /* 0 - scramble, 1 - unscramble            */
660          long lexpos;        /* exposure val 32-bits(when exposure=-1) */
664          long lnoscan;       /* no. of scan 32-bits(when noscan = -1)  */
668          long lavgexp;       /* no. of accum 32-bits(when avgexp = -1) */
672          char stripfil[16];  /* strip file. Not used by WinView        */
688          char version[16];   /* SW version & date "01.000 02/01/90"    */
704          int controller_type; /* 1-new st120, 2-old st120,             */
                                 /* 3-st130 type 1, 4-st130 type 2,        */
                                 /* 5-st138, 6-DC131, and ST133.           */

            /*  YT_FILE_HEADER  */
            /* The YT variables are not used by WinView.                   */
706          int    yt_file_defined;      /* set TRUE for YT data file     */
708          int    yt_fh_calib_mode;     /* calibration type              */
710          int    yt_fh_calib_type;     /* time-unit (calibration type)  */
712          int    yt_fh_element[12];    /* element number                */
736          double yt_fh_calib_data[12]; /* data                          */
832          float  yt_fh_time_factor;    /* time-factor                   */
836          float  yt_fh_start_time;     /* start time                    */
840      int    reverse_flag;             /* set to 1 if data should be    */
                                          /* reversed, 0 don't reverse     */
        };
```

Version 1.6 Header

All WinView/WinSpec files (version1.6) and WinView/32 and WinSpec/32 data files must begin with the following 4100 byte header. Data files created under previous versions of WinView/WinSpec *can still be read correctly*. However, files created under the new versions (1.6 and higher) ***cannot*** be read by previous versions of WinView/WinSpec.

Header Structure Listing

```
                                  Decimal Byte
                                     Offset
                                  -----------
unsigned int  dioden;           /*    0  num of physical pixels (X axis)    */
```

```
int           avgexp;           /*   2  number of accumulations per scan   */
                                /*        if > 32767, set to -1 and        */
                                /*        see lavgexp below (668)          */
int           exposure;         /*   4  exposure time (in milliseconds)    */
                                /*        if > 32767, set to -1 and        */
                                /*        see lexpos below (660)           */
unsigned int  xDimDet;          /*   6  Detector x dimension of chip       */
int           mode;             /*   8  timing mode                        */
float         exp_sec;          /*  10  alternative exposure, in secs.     */
int           asyavg;           /*  14  number of asynchron averages       */
int           asyseq;           /*  16  number of asynchron sequential     */
unsigned int  yDimDet;          /*  18  y dimension of CCD or detector.    */
char          date[10];         /*  20  date as MM/DD/YY                   */
int           ehour;            /*  30  Experiment Time: Hours (as binary) */
int           eminute;          /*  32  Experiment Time: Minutes(as binary)*/
int           noscan;           /*  34  number of multiple scans           */
                                /*      if noscan == -1 use lnoscan        */
int           fastacc;          /*  36                                     */
int           seconds;          /*  38  Experiment Time: Seconds(as binary)*/
int           DetType;          /*  40  CCD/DiodeArray type                */
unsigned int  xdim;             /*  42  actual # of pixels on x axis       */
int           stdiode;          /*  44  trigger diode                      */
float         nanox;            /*  46                                     */
float         calibdio[10];     /*  50  calibration diodes                 */
char          fastfile[16];     /*  90  name of pixel control file         */
int           asynen;           /* 106  asynchron enable flag  0 = off     */
int           datatype;         /* 108  experiment data type               */
                                /*        0 =   FLOATING POINT             */
                                /*        1 =   LONG INTEGER               */
                                /*        2 =   INTEGER                    */
                                /*        3 =   UNSIGNED INTEGER           */
float         calibnan[10];     /* 110  calibration nanometer              */
int           BackGrndApplied;  /* 150  set to 1 if background sub done    */
int           astdiode;         /* 152                                     */
unsigned int  minblk;           /* 154  min. # of strips per skips         */
unsigned int  numminblk;        /* 156  # of min-blocks before geo skps    */
double        calibpol[4];      /* 158  calibration coefficients
*/
unsigned int  ADCrate;          /* 190  ADC rate                           */
unsigned int  ADCtype;          /* 192  ADC type                           */
unsigned int  ADCresolution;    /* 194  ADC resolution                     */
unsigned int  ADCbitAdjust;     /* 196  ADC bit adjust                     */
unsigned int  gain;             /* 198  gain                               */
char          exprem[5][80];    /* 200  experiment remarks                 */
unsigned int  geometric;        /* 600  geometric operations rotate 0x01   */
                                /*      reverse 0x02, flip 0x04            */
char          xlabel[16];       /* 602  Intensity display string           */
unsigned int  cleans;           /* 618  cleans                             */
unsigned int  NumSkpPerCln;     /* 620 number of skips per clean.          */
char          califile[16];     /* 622  calibration file name (CSMA)       */
char          bkgdfile[16];     /* 638  background file name              */
int           srccmp;           /* 654  number of source comp. diodes      */
unsigned int  ydim;             /* 656  y dimension of raw data.           */
int           scramble;         /* 658  0 = scrambled, 1 = unscrambled     */
```

```
long          lexpos;           /*  660  long exposure in milliseconds      */
                                /*         used if exposure set to -1       */
long          lnoscan;          /*  664  long num of scans                  */
                                /*         used if noscan set to -1         */
long          lavgexp;          /*  668  long num of accumulations          */
                                /*         used if avgexp set to -1         */
char          stripfil[16];     /*  672  stripe file (st130)                */
char          version[16];      /*  688  version & date:"01.000 02/01/90"   */
int           type;             /*  704   1 = new120 (Type II)              */
                                /*        2 = old120 (Type I )              */
                                /*        3 = ST130                         */
                                /*        4 = ST121                         */
                                /*        5 = ST138                         */
                                /*        6 = DC131 (PentaMAX)              */
                                /*        7 = ST133 (MicroMAX/SpectroMax),  */
                                /*        8 = ST135 (GPIB)                  */
                                /*        9 = VICCD                         */
                                /*       10 = ST116 (GPIB)                  */
                                /*       11 = OMA3 (GPIB)                   */
                                /*       12 = OMA4                          */
int           flatFieldApplied; /*  706  Set to 1 if flat field was applied */
int           spare[8];         /*  708  reserved                           */
int           kin_trig_mode     /*  724  Kinetics Trigger Mode              */
char          empty[702];       /*  726  EMPTY BLOCK FOR EXPANSION          */
float         clkspd_us;        /* 1428 Vert Clock Speed in micro-sec       */
int           HWaccumFlag;      /* 1432 set to 1 if accum done by Hardware  */
int           StoreSync;        /* 1434 set to 1 if store sync used.        */
int           BlemishApplied;   /* 1436 set to 1 if blemish removal applied */
int           CosmicApplied;    /* 1438 set to 1 if cosmic ray removal done */
int           CosmicType;       /* 1440 if cosmic ray applied, this is type */
float         CosmicThreshold;  /* 1442 Threshold of cosmic ray removal.    */
long          NumFrames;        /* 1446 number of frames in file.           */
float         MaxIntensity;     /* 1450 max intensity of data (future)      */
float         MinIntensity;     /* 1454 min intensity of data (future)      */
char          ylabel[LABELMAX]; /* 1458 y axis label.                       */
unsigned int  ShutterType;      /* 1474 shutter type.                       */
float         shutterComp;      /* 1476 shutter compensation time.          */
unsigned int  readoutMode;      /* 1480 Readout mode, full, kinetics, etc.
*/
unsigned int  WindowSize;       /* 1482 window size for kinetics only.      */
unsigned int  clkspd;           /* 1484 clock speed for kinetics &          */
                                /*      frame transfer.                     */
unsigned int  interface_type;   /* 1486 computer interface (isa-taxi,       */
                                /*      pci, eisa, etc.)                    */
unsigned long ioAdd1;           /* 1488 I/O address of interface card.       */
unsigned long ioAdd2;           /* 1492 if more than one address for card.  */
unsigned long ioAdd3;           /* 1496                                     */
unsigned int  intLevel;         /* 1500 interrupt level interface card      */
unsigned int  GPIBadd;          /* 1502  GPIB address (if used)             */
unsigned int  ControlAdd;       /* 1504  GPIB controller address (if used)  */
unsigned int  controllerNum;    /* 1506  if multiple controller system will */
                                /*       have controller # data came from.  */
                                /*       (Future Item)                      */
unsigned int  SWmade;           /* 1508  Software which created this file   */
```

```
int          NumROI;            /* 1510  number of ROIs used. if 0 assume 1 */
                                /* 1512 - 1630  ROI information             */
struct ROIinfo {                /*                                          */
 unsigned int startx;           /* left x start value.                      */
 unsigned int endx;             /* right x value.                           */
 unsigned int groupx;           /* amount x is binned/grouped in hw.        */
 unsigned int starty;           /* top y start value.                       */
 unsigned int endy;             /* bottom y value.                          */
 unsigned int groupy;           /* amount y is binned/grouped in hw.        */
} ROIinfoblk[10];               /*    ROI Starting Offsets:                 */
                                /*            ROI  1 = 1512                 */
                                /*            ROI  2 = 1524                 */
                                /*            ROI  3 = 1536                 */
                                /*            ROI  4 = 1548                 */
                                /*            ROI  5 = 1560                 */
                                /*            ROI  6 = 1572                 */
                                /*            ROI  7 = 1584                 */
                                /*            ROI  8 = 1596                 */
                                /*            ROI  9 = 1608                 */
                                /*            ROI 10 = 1620                 */
char         FlatField[120];    /* 1632 Flat field file name.               */
char         background[120];   /* 1752 Background sub. file name.          */
char         blemish[120];      /* 1872 Blemish file name.                  */
float        software_ver;      /* 1992 Software version.                   */
char         UserInfo[1000];    /* 1996-2995 user data.                     */
long         WinView_id;        /* 2996 Set to 0x01234567L if file was      */
                                /*      created by WinX                     */

-------------------------------------------------------------------------------
```

Calibration Structures

There are three structures for the calibrations

- The Area Inside the Calibration Structure (below) is repeated two times.

```
    xcalibration,               /* 3000 - 3488 x axis calibration           */
    ycalibration,               /* 3489 - 3977 y axis calibration           */
```

Start of X Calibration Structure

```
double       offset;            /* 3000  offset for absolute data scaling   */
double       factor;            /* 3008  factor for absolute data scaling   */
char         current_unit;      /* 3016  selected scaling unit              */
char         reserved1;         /* 3017  reserved                           */
char         string[40];        /* 3018  special string for scaling         */
char         reserved2[40];     /* 3058  reserved                           */
char         calib_valid;       /* 3098  flag if calibration is valid       */
char         input_unit;        /* 3099  current input units for            */
                                /*       "calib_value"                      */
char         polynom_unit;      /* 3100  linear UNIT and used               */
                                /*       in the "polynom_coeff"             */
```

```
char          polynom_order;     /* 3101  ORDER of calibration POLYNOM       */
char          calib_count;       /* 3102  valid calibration data pairs       */
double        pixel_position[10];/* 3103  pixel pos. of calibration data     */
double        calib_value[10];   /* 3183  calibration VALUE at above pos     */
double        polynom_coeff[6];  /* 3263  polynom COEFFICIENTS               */
double        laser_position;    /* 3311  laser wavenumber for relativ WN    */
char          reserved3;         /* 3319  reserved                           */
unsigned char new_calib_flag;    /* 3320  If set to 200, valid label below   */
char          calib_label[81];   /* 3321  Calibration label (NULL term'd)    */
char          expansion[87];     /* 3402  Calibration Expansion area         */

-------------------------------------------------------------------------------
```

Start of Y Calibration Structure

```
double        offset;            /* 3489  offset for absolute data scaling   */
double        factor;            /* 3497  factor for absolute data scaling   */
char          current_unit;      /* 3505  selected scaling unit              */
char          reserved1;         /* 3506  reserved                           */
char          string[40];        /* 3507  special string for scaling         */
char          reserved2[40];     /* 3547  reserved                           */
char          calib_valid;       /* 3587  flag if calibration is valid       */
char          input_unit;        /* 3588  current input units for            */
                                 /*       "calib_value"                      */
char          polynom_unit;      /* 3589  linear UNIT and used               */
                                 /*       in the "polynom_coeff"             */
char          polynom_order;     /* 3590  ORDER of calibration POLYNOM       */
char          calib_count;       /* 3591  valid calibration data pairs       */
double        pixel_position[10];/* 3592  pixel pos. of calibration data     */
double        calib_value[10];   /* 3672  calibration VALUE at above pos     */
double        polynom_coeff[6];  /* 3752  polynom COEFFICIENTS               */
double        laser_position;    /* 3800  laser wavenumber for relativ WN    */
char          reserved3;         /* 3808  reserved                           */
unsigned char new_calib_flag;    /* 3809  If set to 200, valid label below   */
char          calib_label[81];   /* 3810  Calibration label (NULL term'd)    */
char          expansion[87];     /* 3891  Calibration Expansion area         */

-------------------------------------------------------------------------------
```

End of Calibration Structures

```
char          Istring[40];       /* 3978  special Intensity scaling string   */
char          empty3[80];        /* 4018  empty block to reach 4100 bytes    */
int           lastvalue;         /* 4098 Always the LAST value in the header */
```

WINX Header Structure (with actual offsets)

(12-June-96)

```
dioden .......................    0     0
avgexp .......................    2     2
exposure .....................    4     4
xDimDet ......................    6     6
mode .........................    8     8
exp_sec ......................   10     A
```

asyavg	14	E
asyseq	16	10
yDimDet	18	12
date	20	14
ehour	30	1E
eminute	32	20
noscan	34	22
fastacc	36	24
seconds	38	26
DetType	40	28
xdim	42	2A
stdiode	44	2C
nanox	46	2E
calibdio (10 x float)..........	50	32
fastfile	90	5A
asynen	106	6A
datatype	108	6C
calibnan (10 x float)..........	110	6E
BackGrndApplied	150	96
astdiode	152	98
minblk	154	9A
numminblk	156	9C
calibpol (4 x double)..........	158	9E
ADCrate	190	BE
ADCtype	192	C0
ADCresolution	194	C2
ADCbitAdjust	196	C4
gain	198	C6
exprem[0] (comment 1)..........	200	C8
exprem[1] (comment 2)..........	280	118
exprem[2] (comment 3)..........	360	168
exprem[3] (comment 4)..........	440	1B8
exprem[4] (comment 5)..........	520	208
geometric	600	258
xlabel	602	25A
cleans	618	26A
NumSkpPerCln	620	26C
califile	622	26E
bkgdfile	638	27E
srccmp	654	28E
ydim	656	290
scramble	658	292
lexpos	660	294
lnoscan	664	298
lavgexp	668	29C
stripfil	672	2A0
version	688	2B0
type	704	2C0
flatFieldApplied	706	2C2
spare	708	2C4
kin_trig_mode	724	2D4
empty	726	2D6
clkspd_us	1428	594
HWaccumFlag	1432	598
StoreSync	1434	59A
BlemishApplied	1436	59C
CosmicApplied	1438	59E
CosmicType	1440	5A0
CosmicThreshold	1442	5A2
NumFrames	1446	5A6
MaxIntensity	1450	5AA
MinIntensity	1454	5AE
ylabel	1458	5B2
ShutterType	1474	5C2
shutterComp	1476	5C4
readoutMode	1480	5C8

```
WindowSize ................... 1482   5CA
clkspd ....................... 1484   5CC
interface_type ............... 1486   5CE
ioAdd1 ....................... 1488   5D0
ioAdd2 ....................... 1492   5D4
ioAdd3 ....................... 1496   5D8
intLevel ..................... 1500   5DC
GPIBadd ...................... 1502   5DE
ControlAdd ................... 1504   5E0
controllerNum ................ 1506   5E2
SWmade ....................... 1508   5E4
NumROI ....................... 1510   5E6
ROIinfoblk[1]  - startx ....... 1512   5E8
ROIinfoblk[1]  - endx ......... 1514   5EA
ROIinfoblk[1]  - groupx ....... 1516   5EC
ROIinfoblk[1]  - starty ....... 1518   5EE
ROIinfoblk[1]  - endy ......... 1520   5F0
ROIinfoblk[1]  - groupy ....... 1522   5F2
ROIinfoblk[2]  - startx ....... 1524   5F4
ROIinfoblk[2]  - endx ......... 1526   5F6
ROIinfoblk[2]  - groupx ....... 1528   5F8
ROIinfoblk[2]  - starty ....... 1530   5FA
ROIinfoblk[2]  - endy ......... 1532   5FC
ROIinfoblk[2]  - groupy ....... 1534   5FE
ROIinfoblk[3]  - startx ....... 1536   600
ROIinfoblk[3]  - endx ......... 1538   602
ROIinfoblk[3]  - groupx ....... 1540   604
ROIinfoblk[3]  - starty ....... 1542   606
ROIinfoblk[3]  - endy ......... 1544   608
ROIinfoblk[3]  - groupy ....... 1546   60A
ROIinfoblk[4]  - startx ....... 1548   60C
ROIinfoblk[4]  - endx ......... 1550   60E
ROIinfoblk[4]  - groupx ....... 1552   610
ROIinfoblk[4]  - starty ....... 1554   612
ROIinfoblk[4]  - endy ......... 1556   614
ROIinfoblk[4]  - groupy ....... 1558   616
ROIinfoblk[5]  - startx ....... 1560   618
ROIinfoblk[5]  - endx ......... 1562   61A
ROIinfoblk[5]  - groupx ....... 1564   61C
ROIinfoblk[5]  - starty ....... 1566   61E
ROIinfoblk[5]  - endy ......... 1568   620
ROIinfoblk[5]  - groupy ....... 1570   622
ROIinfoblk[6]  - startx ....... 1572   624
ROIinfoblk[6]  - endx ......... 1574   626
ROIinfoblk[6]  - groupx ....... 1576   628
ROIinfoblk[6]  - starty ....... 1578   62A
ROIinfoblk[6]  - endy ......... 1580   62C
ROIinfoblk[6]  - groupy ....... 1582   62E
ROIinfoblk[7]  - startx ....... 1584   630
ROIinfoblk[7]  - endx ......... 1586   632
ROIinfoblk[7]  - groupx ....... 1588   634
ROIinfoblk[7]  - starty ....... 1590   636
ROIinfoblk[7]  - endy ......... 1592   638
ROIinfoblk[7]  - groupy ....... 1594   63A
ROIinfoblk[8]  - startx ....... 1596   63C
ROIinfoblk[8]  - endx ......... 1598   63E
ROIinfoblk[8]  - groupx ....... 1600   640
ROIinfoblk[8]  - starty ....... 1602   642
ROIinfoblk[8]  - endy ......... 1604   644
ROIinfoblk[8]  - groupy ....... 1606   646
ROIinfoblk[9]  - startx ....... 1608   648
ROIinfoblk[9]  - endx ......... 1610   64A
ROIinfoblk[9]  - groupx ....... 1612   64C
ROIinfoblk[9]  - starty ....... 1614   64E
ROIinfoblk[9]  - endy ......... 1616   650
ROIinfoblk[9]  - groupy ....... 1618   652
```

```
ROIinfoblk[10] - startx ....... 1620   654
ROIinfoblk[10] - endx ......... 1622   656
ROIinfoblk[10] - groupx ....... 1624   658
ROIinfoblk[10] - starty ....... 1626   65A
ROIinfoblk[10] - endy ......... 1628   65C
ROIinfoblk[10] - groupy ....... 1630   65E
FlatField ..................... 1632   660
background .................... 1752   6D8
blemish ....................... 1872   750
software_ver .................. 1992   7C8
UserInfo ...................... 1996   7CC
WinView_id .................... 2996   BB4
X Calib: offset ............... 3000   BB8
X Calib: factor ............... 3008   BC0
X Calib: current_unit ......... 3016   BC8
X Calib: reserved1 ............ 3017   BC9
X Calib: string ............... 3018   BCA
X Calib: reserved2 ............ 3058   BF2
X Calib: calib_valid .......... 3098   C1A
X Calib: input_unit ........... 3099   C1B
X Calib: polynom_unit ......... 3100   C1C
X Calib: polynom_order ........ 3101   C1D
X Calib: calib_count .......... 3102   C1E
X Calib: pixel_position[1] .... 3103   C1F
X Calib: pixel_position[2] .... 3111   C27
X Calib: pixel_position[3] .... 3119   C2F
X Calib: pixel_position[4] .... 3127   C37
X Calib: pixel_position[5] .... 3135   C3F
X Calib: pixel_position[6] .... 3143   C47
X Calib: pixel_position[7] .... 3151   C4F
X Calib: pixel_position[8] .... 3159   C57
X Calib: pixel_position[9] .... 3167   C5F
X Calib: pixel_position[10] ... 3175   C67
X Calib: calib_value[1] ....... 3183   C6F
X Calib: calib_value[2] ....... 3191   C77
X Calib: calib_value[3] ....... 3199   C7F
X Calib: calib_value[4] ....... 3207   C87
X Calib: calib_value[5] ....... 3215   C8F
X Calib: calib_value[6] ....... 3223   C97
X Calib: calib_value[7] ....... 3231   C9F
X Calib: calib_value[8] ....... 3239   CA7
X Calib: calib_value[9] ....... 3247   CAF
X Calib: calib_value[10] ...... 3255   CB7
X Calib: polynom_coeff[1] ..... 3263   CBF
X Calib: polynom_coeff[2] ..... 3271   CC7
X Calib: polynom_coeff[3] ..... 3279   CCF
X Calib: polynom_coeff[4] ..... 3287   CD7
X Calib: polynom_coeff[5] ..... 3295   CDF
X Calib: polynom_coeff[6] ..... 3303   CE7
X Calib: laser_position ....... 3311   CEF
X Calib: reserved3 ............ 3319   CF7
X Calib: new_calib_flag ....... 3320   CF8
X Calib: calib_label .......... 3321   CF9
X Calib: expansion ............ 3402   D4A
Y Calib: offset ............... 3489   DA1
Y Calib: factor ............... 3497   DA9
Y Calib: current_unit ......... 3505   DB1
Y Calib: reserved1 ............ 3506   DB2
Y Calib: string ............... 3507   DB3
Y Calib: reserved2 ............ 3547   DDB
Y Calib: calib_valid .......... 3587   E03
Y Calib: input_unit ........... 3588   E04
Y Calib: polynom_unit ......... 3589   E05
Y Calib: polynom_order ........ 3590   E06
Y Calib: calib_count .......... 3591   E07
Y Calib: pixel_position[1] .... 3592   E08
```

```
Y Calib: pixel_position[2] .... 3600   E10
Y Calib: pixel_position[3] .... 3608   E18
Y Calib: pixel_position[4] .... 3616   E20
Y Calib: pixel_position[5] .... 3624   E28
Y Calib: pixel_position[6] .... 3632   E30
Y Calib: pixel_position[7] .... 3640   E38
Y Calib: pixel_position[8] .... 3648   E40
Y Calib: pixel_position[9] .... 3656   E48
Y Calib: pixel_position[10] ... 3664   E50
Y Calib: calib_value[1] ....... 3672   E58
Y Calib: calib_value[2] ....... 3680   E60
Y Calib: calib_value[3] ....... 3688   E68
Y Calib: calib_value[4] ....... 3696   E70
Y Calib: calib_value[5] ....... 3704   E78
Y Calib: calib_value[6] ....... 3712   E80
Y Calib: calib_value[7] ....... 3720   E88
Y Calib: calib_value[8] ....... 3728   E90
Y Calib: calib_value[9] ....... 3736   E98
Y Calib: calib_value[10] ...... 3744   EA0
Y Calib: polynom_coeff[1] ..... 3752   EA8
Y Calib: polynom_coeff[2] ..... 3760   EB0
Y Calib: polynom_coeff[3] ..... 3768   EB8
Y Calib: polynom_coeff[4] ..... 3776   EC0
Y Calib: polynom_coeff[5] ..... 3784   EC8
Y Calib: polynom_coeff[6] ..... 3792   ED0
Y Calib: laser_position ....... 3800   ED8
Y Calib: reserved3 ............ 3808   EE0
Y Calib: new_calib_flag ....... 3809   EE1
Y Calib: calib_label .......... 3810   EE2
Y Calib: expansion ............ 3891   F33
Istring ....................... 3978   F8A
empty3 ........................ 4018   FB2
lastvalue ..................... 4098  1002
```

Start of Data

The data follows the header beginning at offset 4100.

In WinView/WinSpec, the data is always stored exactly as it is collected. The order of the data depends on the placement of the shift register.

In the diagram below, the shift register is on the RIGHT SIDE of the chip. Each COLUMN of data is first shifted RIGHT into the shift register and then DOWN. The data is read (and stored) in this order:

```
First column read:    XnYm, XnYm-1, ... XnY2, XnY1

Last column read :    X1Ym, X1Ym-1, ... X1Y2, X1Y1

 .-----------------------------------------.---.
 |   X1Y1       X2Y1       ...       XnY1   | S |
 |   X1Y2       X2Y2       ...       XnY2   | H |  |
 |     :          :                   :     | I |  |
 |   X1Ym-1     X2Ym-1     ...       XnYm-1 | F |  V
 |   X1Ym       X2Ym       ...       XnYm   | T |
 `-----------------------------------------|---|
                   ------>                 | | |
                                             |
```

```
                                                          `-----> A/D
```

In the diagram below, the shift register is on the BOTTOM of the chip. Each ROW of data is first shifted DOWN into the shift register and then RIGHT. The data is read (and stored) in this order:

```
First row read:    XnYm, ... X2Ym, X1Ym

Last row read :    XnY1, ... X2Y1, X1Y1

 .-------------------------------------------.
 |   X1Y1       X2Y1       ...       XnY1    |
 |   X1Y2       X2Y2       ...       XnY2    |   |
 |     :          :                    :     |   |
 |   X1Ym-1     X2Ym-1     ...       XnYm-1  |   V
 |   X1Ym       X2Ym       ...       XnYm    |
 `-------------------------------------------|---.
 |              SHIFT REGISTER               | | |
                   ----->                      |
                                               `-----> A/D
```

This page intentionally left blank.

Appendix D

Auto-Spectro Wavelength Calibration

Equations used in WinSpec Wavelength Calibration

WinSpec/32 wavelength calibration is based on the grating equation for Czerny-Turner or Ebert spectrographs (see Figure 181).

$$(m/d)\lambda = \sin\alpha + \sin\beta, \text{ or } \lambda = (d/m)(\sin\alpha + \sin\beta), \quad (1)$$

where: λ = wavelength at the center of the image plane,

m = diffraction order

d = distance between grooves (the inverse of grooves per mm), and

α, β = angles of the incident and exit beam relative to the grating normal.

The angles α and β are related to the inclusion angle, γ, and the rotational angle of the grating, ψ:

$\alpha = \psi - \gamma/2$, and $\beta = \psi + \gamma/2$.

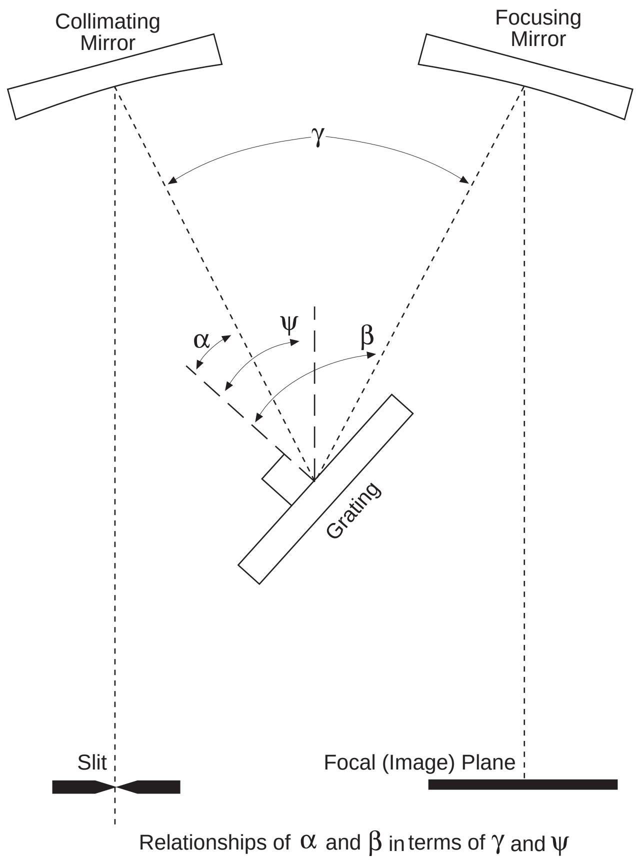
Thus the grating equation can be written as:

$(m/d)\,\lambda = \sin(\psi - \gamma/2) + \sin(\psi + \gamma/2) = 2\sin\psi\cos(\gamma/2)$,

and the grating angle is given by:

$$\psi = \operatorname{asin}\{m\lambda / (2d\cos(\gamma/2))\}. \quad (2)$$

Figure 181. Relationships of α and β in terms of ψ and γ



Note that the wavelength at the **center** of the exit plane does not depend on the focal length, **f**. However, the wavelength at points off center depends on both the focal length and the detector angle, δ (the angle of the image plane relative to the plane perpendicular to the spectrograph focal axis at the center of the image plane; see Figure 182). For some wavelength λ' relatively close to λ (at the same grating angle),

$$\lambda' = (\mathbf{d}/\mathbf{m})(\mathbf{sin}\ \alpha + \mathbf{sin}\ \beta') = (\mathbf{d}/\mathbf{m})(\mathbf{sin}\ \alpha + \mathbf{sin}\ (\beta + \xi))$$

$$= (\mathbf{d}/\mathbf{m})\{\mathbf{sin}\ (\psi - \gamma/\mathbf{2}) + \mathbf{sin}\ (\psi + \gamma/\mathbf{2} + \xi)\}. \quad (3)$$

The angle ξ depends on the focal length **f**, the detector angle δ, and the distance of λ' from the center of the image plane, **nx**, where **n** is the number of pixels from the center and **x** is the pixel width; the relationship is given by:

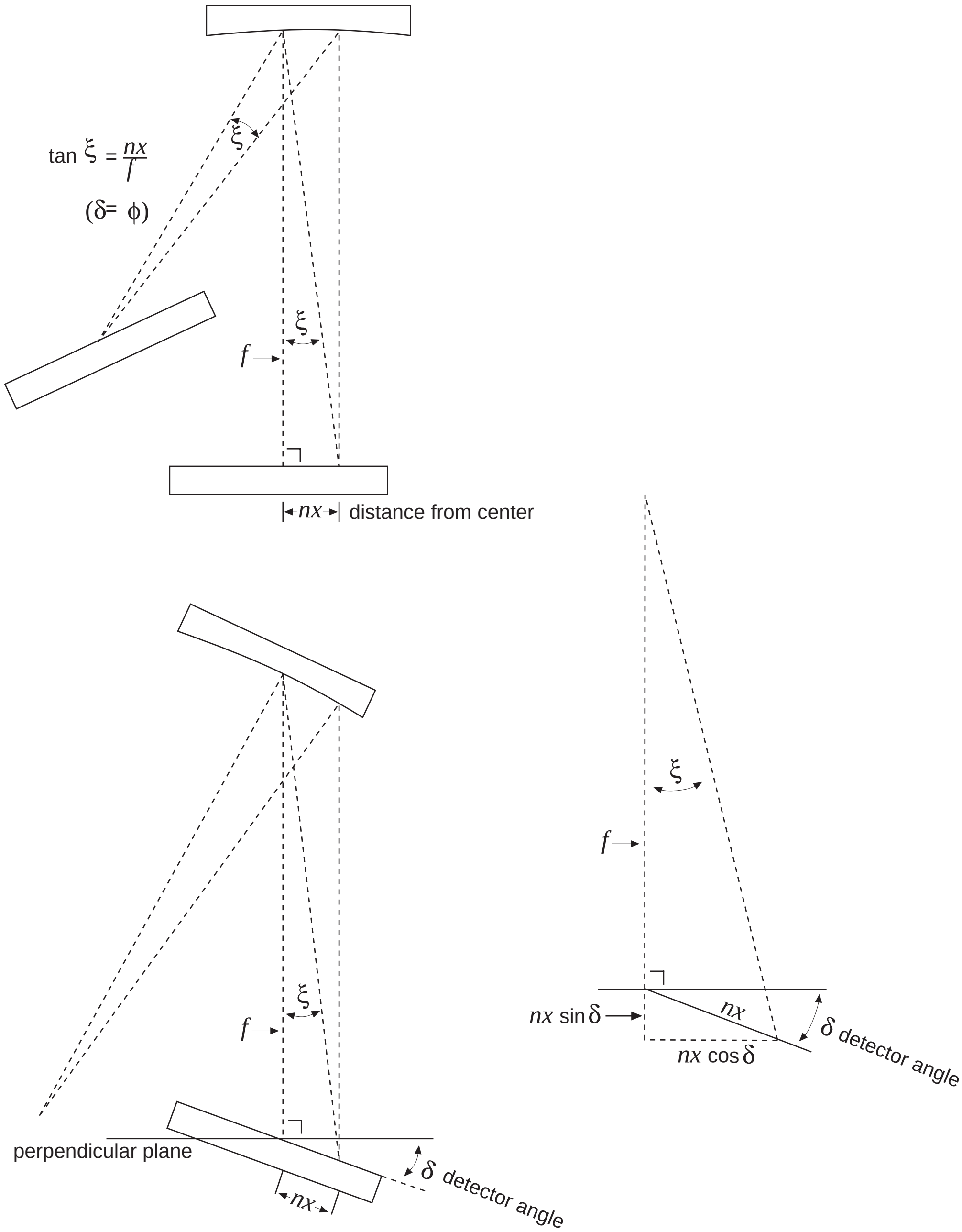
$$\mathbf{tan}\ \xi = (\mathbf{nx}\ \mathbf{cos}\ \delta) / (\mathbf{f} + \mathbf{nx}\ \mathbf{sin}\ \delta), \text{ as shown in Figure 182.} \quad (4)$$

When the image plane is perpendicular, $\delta = 0$, and this reduces to:

$$\mathbf{tan}\ \xi = (\mathbf{nx} / \mathbf{f})$$

Using the known parameters of focal length **f**, detector angle δ, number of pixels from center **n**, and pixel width **x**, first calculate the angle ξ from equation **4**. The grating angle ψ can be calculated using the known parameters center wavelength λ, diffraction order **m**, grating grooves per mm **1/d**, and inclusion angle γ, from equation **2**. Finally, the wavelength at pixel **n** is calculated using equation **3**.

Figure 182. Relationship between ξ and the focal length, detector angle, and the distance of λ' from image plane



WinSpec X Axis Auto Calibration

When “Calibration Usage” is set to “Auto Spectro” in WinSpec/32, the X Axis calibration is done in the following steps after a wavelength change. First the wavelength is calculated at each end of the array using the method above. Then these two points, plus the third center wavelength point, are automatically fit to a 2nd order polynomial using the wavelength calibration functions.

This page intentionally left blank.

Appendix E

CD ROM Failure Work-Arounds

Although not common, there are CD drives that are not compatible with the Win ’95 long filename convention. Attempting to install on such a system causes the filenames to be truncated and the install fails, causing a message like:

An error occurred during the move data process: -113
Component: Application\WinXSystem
File Group: WinXSystem

Fortunately there are a couple of workarounds, both involving copying the install files to the customer’s hard drive first, then installing the software from that location.

1. If possible, copy the files to the customer’s hard drive via another computer that supports long file names. If the customer’s computer is part of a network then the files can be copied first to the hard drive of a computer that supports long file names, then transferred through the network to the customer’s hard drive. Check the list of files below to make sure that the long filenames remain intact. Then install the software from this location on the hard drive.
2. Copy the files to the customer’s hard drive from the customer’s CD-ROM, then fix the names of the files that were truncated. There are only 7 files that are not DOS compatible (8 + 3), so this at most a 10 minute job. Here are their abbreviated and full filenames. (Not all of these files are used in the standard installation but all are present on the CD.)
   - CLSSNA~1.CLS, rename to clsSnapIn.cls
   - PIXCMT~1.DLL, rename to PIXCMTXT32.dll
   - WINX_R~1.DOC, rename to WinX_readme.doc
   - WINX32~1.BAS, rename to Winx32Test.bas
   - WINX32~1.DOC, rename to Winx32 Automation - VB Version.doc
   - WINX32~1.FRM, rename to Winx32Test.frm
   - WINX32~1.FRX, rename to Winx32Test.frx

This page intentionally left blank.

Appendix F
WinSpec/32 Repair and Maintenance

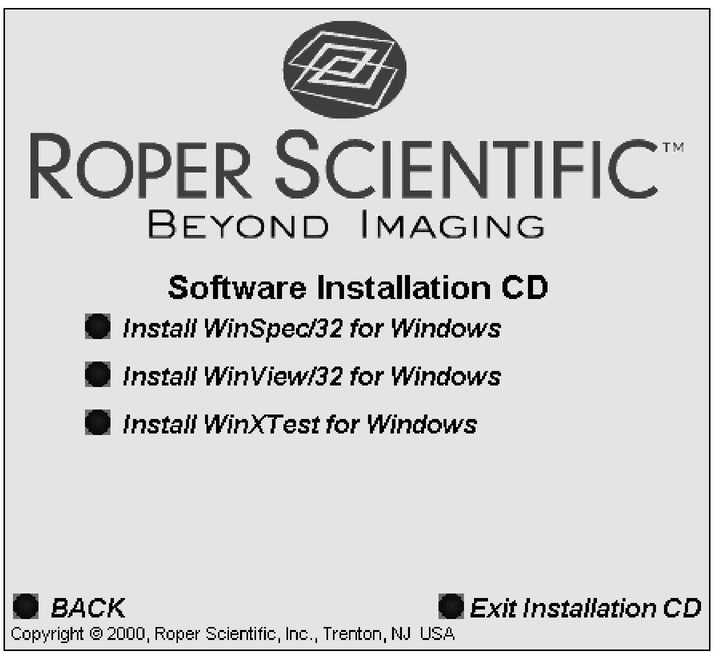
Note: When WinSpec/32 is installed, it modifies the Windows Registry file. If for any reason you reinstall Windows, the Registry file may be replaced, and WinSpec/32 may not run correctly. Reinstall WinSpec/32 to correct this problem.

Install/Uninstall WinSpec/32 Components at a Later Time

After you have installed WinSpec/32, you may want to install additional WinSpec/32 files or to uninstall selected files. To do so:

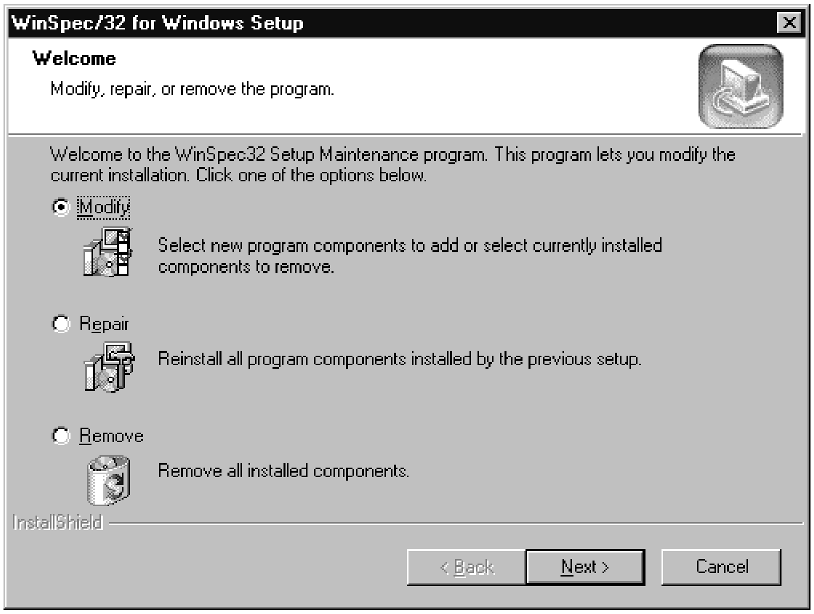
1. Start the installation program and on the **WinSpec, WinView, WinXTest Selection** dialog box (Figure 183), select **Install WinSpec/32 for Windows**.

Figure 183. WinSpec, WinView, or WinXTest Selection dialog box



2. Because WinSpec/32 was previously installed, the **WinSpec Maintenance** dialog box (Figure 184) will be displayed.

Figure 184. Maintenance dialog box



3. Select the **Modify** radio button and click on **Next**.

Figure 185. Media Password dialog box

4. On the **Media Password** dialog box, enter the password and click on **Next**.

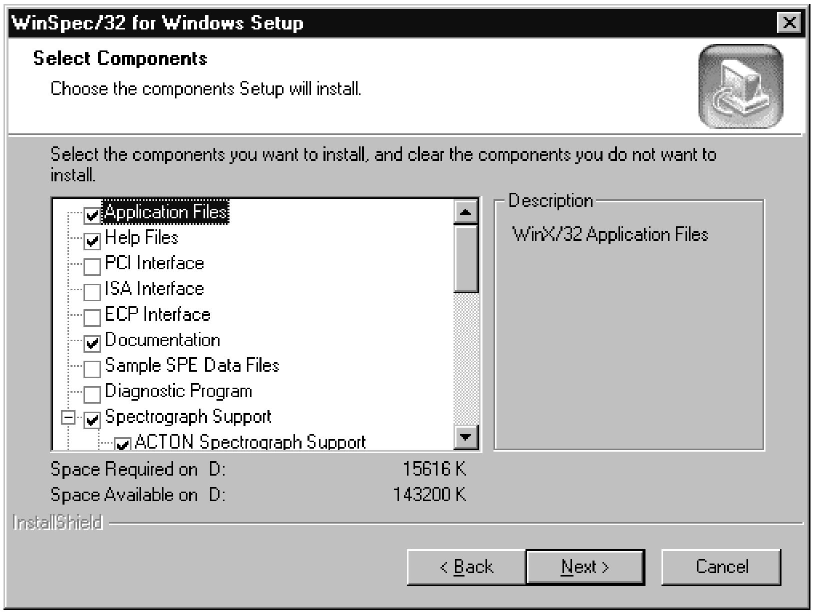


Figure 186. Select Components dialog box

5. On the **Select Components** dialog box, put a check in the box for each item you want to install and uncheck the box for each item you want to uninstall.
6. Then click on **Next** and follow the instructions on the dialog boxes.
7. Click on the **Finish** button when the **Maintenance Complete** dialog box is displayed. The **WinSpec, WinView, WinXTest Install** dialog box will be displayed after the changes have been made.
8. Exit from the installation program or choose another program to install, perform maintenance on, or uninstall.

Installing More than One Version of WinSpec/32

You can install more than one version of WinSpec/32, WinView/32 or any combination of the two on a single computer. When the Choose Destination Location dialog box is displayed, simply change the path to a new directory. If necessary, the install program will automatically create the new directory.

CAUTION Do not install both the WinSpec/32 and WinView/32 software packages in the same directory.

CAUTION Although several different versions of WinSpec/32 and/or WinView/32 can be installed on the same computer without conflicts, you should not run more than one version at any one time. The manner in which Roper Scientific software allocates memory for data collection precludes collecting data using two software packages at once.

It is also possible to install both 16-bit and 32-bit versions of the software in the same computer. However, keep in mind that WinSpec/32 will not operate under Windows 3.1 or 3.11. Similarly, the device drivers for the 16-bit version of WinSpec will not function properly under Win 95 or NT.

PIHWDEF.INI & SESSION.DAT

WinSpec/16 and PIHWDEF.INI: The hardware initialization file PIHWDEF.INI, is included with *16-bit versions of WinSpec software*. The file contains all of the hardware settings necessary to get started and is read the first time WinSpec is executed. At the end of the first operating session, the settings in effect are written to SESSION.DAT, which is read the next time WinSpec software is operated so that the new session will begin with the same settings that were in effect at the end of the previous one.

WinSpec/32 and the Windows Registry: WinSpec/32 doesn't require PIHWDEF.INI or SESSION.DAT, but rather automatically stores the settings in the registry at the end of each operating session. However, WinSpec/32 will read the WinSpec/16 PIHWDEF.INI or SESSION.DAT if they are copied to the directory containing the WinSpec/32 software. This allows users who are upgrading from a 16-bit version of WinSpec to WinSpec/32 to readily transfer their previous operating settings to the new software. However, there are constraints. If there are settings in the registry, that is, if WinSpec/32 has been operated at least once, the software won't read PIHWDEF.INI or SESSION.DAT unless the file date is newer than the date of the stored registry settings. This problem can be avoided by simply copying PIHWDEF.INI or SESSION.DAT to the WinSpec/32 directory *before* operating it the first time. If that opportunity is lost, a newer SESSION.DAT can be created by booting the 16-bit WinSpec software and then exiting the program in the usual manner. Similarly, a text editor could be used to open/edit a copy of PIHWDEF.INI and then save it so that it has the current date.

Uninstalling and Reinstalling

If you suspect any of the WinSpec/32 files have become corrupt, you should first delete all WinSpec/32 files, then reinstall the software from the CD or the FTP site. Follow the steps below to remove WinSpec/32. Note that some files may remain. They will have to be removed manually. *To reinstall, follow the procedure as described beginning on page 21.*

To uninstall WinSpec/32 from your computer:

1. Open the **Windows Control Panel**.
2. Double-click on **Add/Remove Programs**.
3. Highlight the WinSpec/32 version to uninstall and click on **Add/Remove**.
4. Follow the instructions on the dialog boxes.

Notes:

The directory in which WinSpec/32 was originally installed will remain, as will any files it contains that were not placed there during the original installation.

The Data directory created during the original installation may also be deleted. Any data files you want to save should be copied to a safe location before uninstalling.

The Version # and User identification will be removed from the registry. However, the registry also contains much information that was placed there in the course of setting up and operating the software. That information will remain and will be available for use if WinSpec/32 is later reinstalled.

To later reinstall the software, follow the Installing WinSpec/32 instructions provided earlier in this chapter. Use the original installation CD and any options disks purchased separately.

This page intentionally left blank.

Appendix G

Glossary

Anti-blooming: Blooming is caused by saturation of one or more CCD pixels. This can occur if the incoming light is too bright or when extensive serial and parallel binning is being performed. When this saturation happens, the excess charge overflows into the adjacent pixels and results in a streak or a blob appearing on the image. Anti-blooming is traditionally controlled by specific CCD architecture designs that drain the excess charge.

Backlash: Applied to the movement of gratings or slits, this is the amount of play between gears when changing the direction of travel.

Binning: Hardware binning is the process of combining the charge from adjacent pixels in a CCD *before* the signal is read out by the preamplifier. A binning of 1 in both directions reads out each pixel at full X-axis resolution. A binning of 2 in both directions combines four pixels, cutting the X-axis resolution in half, but quadrupling the light-collecting area. If the CCD chip shift register is being saturated due to hardware binning, you can use software binning instead by checking **Use Software Binning** on the ROI Setup tab page. Note that software binning is not as fast as hardware binning.

Cancel button: Exits a dialog box without performing any processing. Any changes to the dialog are lost.

Close button: Closes the dialog box or window with no action taken.

Help button: Opens the context-sensitive help for the active tab page or dialog box.

Mouse button: Allows you to specify a region to be processed using the mouse. Simply drag a box in the data region of the active window and then click on **Mouse**. The **Frame** and **Range** parameters will assume the values of the defined region. Note that the **Mouse** button is only active when the **Input** tab page is selected.

NVRAM: Non-Volatile Random Access Memory. NVRAM contains factory-programmed information about the controller and, in many cases, the camera/detector.

Process button: Causes the specified operation or process to be performed. The process is performed on the data specified on the Input tab page and saved using the file name and data type specified on the Output tab page.

Shutter Compensation Time: The time it takes for a mechanical shutter to open or close. This time needs to be accounted for during hardware setup so the software can allow enough time for the shutter to open befor starting data acquisition and allow enough time for it to close before the reading out the array.

This page intentionally left blank.

Index