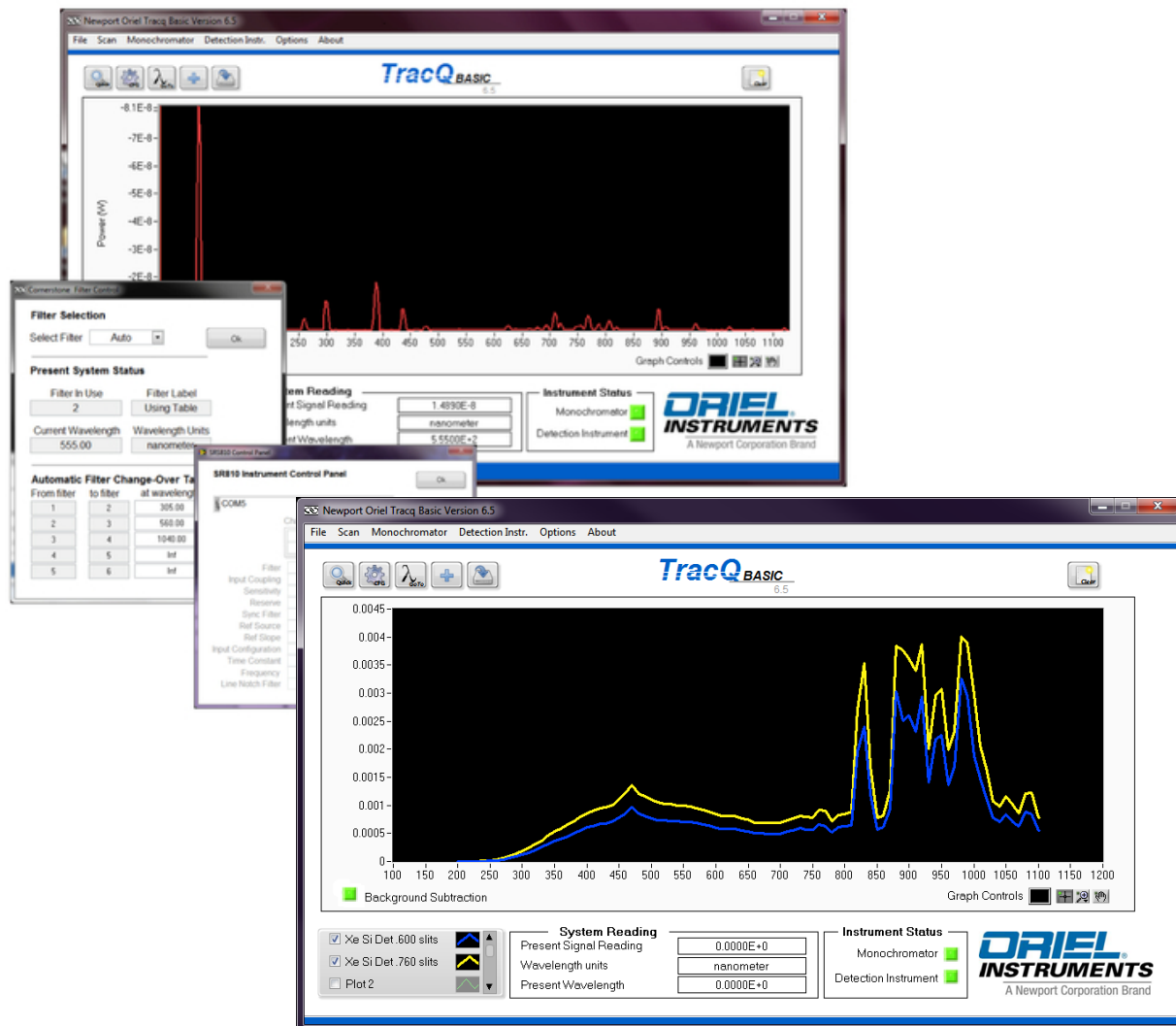


# TracQ™ Basic

## Spectroscopy Software v6.5



User's Manual



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## 1 SAFETY INFORMATION

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Thank you for your purchase of the TracQ™ Basic software application from Oriel Instruments®.

Please carefully read the important safety precautions provided with each instrument that will be controlled by the software, prior to unpacking and operating the equipment. In addition, please refer to the complete User's Manual and all other documentation provided for additional important notes and cautionary statements regarding the use and operation of the instruments.

Do not attempt to operate any system without reading all the information provided with each of the components.

**Please read all instructions that were provided prior to operation of the system. If there are any questions, please contact Oriel Instruments or the representative through whom the system was purchased.**

## 2 INTRODUCTION

---

Oriel's TracQ Basic Data Acquisition and Radiometry Software is an instrument control package that includes data acquisition and processing. TracQ Basic allows users to acquire spectroscopic measurement data quickly and easily, without requiring any programming knowledge. TracQ Basic is true radiometry software, which enables users to acquire basic voltage measurements or use the built-in algorithms for spectroscopic measurements. Data acquisition and processing occurs in real time.

TracQ Basic is an application integrating Oriel monochromators and spectrographs with various detection instruments. Software prompts guide users through the measurement process. Instruments are controlled and scan parameters are set up through simple, intuitive dialog boxes. The front panel of the software allows one to see instrument status, present wavelength, signal reading and the selected wavelength units.

The following types of measurements are supported by TracQ Basic:

- Voltage vs. wavelength
- Time interval
- Quantum efficiency (QE)
- Lamp radiometry
- Detector radiometry
- Absorbance
- Transmittance

TracQ Basic comes with many features, including:

- Monochromator grating selection
- Automatic bandpass selection
- Motorized filter selection
- Wavelength unit selection
- Wavelength offset
- Output port selection
- Monochromator shutter control
- QE detector and preamplifier gain setups
- Detector spectral responsivity file integration
- Background subtraction

### 2.1 WHAT'S INCLUDED

A USB memory stick is provided to the end user, which includes:

- ✓ TracQ Basic installation software
- ✓ All necessary drivers for compatible USB instruments
- ✓ A copy of this user's manual

## 2.2 COMPATIBLE INSTRUMENTS

The following instruments are compatible with TracQ Basic software. The use of one of the following detection instruments is required in order to use this software. A monochromator or spectrograph is optional, as a laser or broadband light source may also be utilized.

DETECTION INSTRUMENTS		
Model	Interface	Series
70100	RS232	Oriel Merlin Lock-In Digital Amplifiers
70103	GPIB (IEEE-488)	
70104	RS232	
70105	GPIB (IEEE-488)	
1918-C	USB	Newport Power Meters
1918-R	USB	
1936-C	USB	
1936-R	USB	
2936-C	USB	
2936-R	USB	
LIDA-SRS-KIT	GPIB (IEEE-488)	Oriel Lock-In Digital Amplifier Kit
SR810	GPIB (IEEE-488)	Stanford Research Systems Lock-In Digital Amplifier

**Figure 1: Compatible Detection Instruments**

For those who are using the legacy Oriel model 70310 Optical Power Meter, this product is not supported by TracQ Basic v6.5. This instrument is compatible with TracQ Basic v6.3 (Windows XP and Windows 7 32-bit compatible). Please contact Newport or the representative through whom Oriel equipment is purchased for options.

MONOCHROMATORS AND SPECTROGRAPHS		
Series	Model	Interface
Cornerstone 130 Monochromators	74000	RS232 and GPIB (IEEE-488)
	74004	USB 2.0
	CS130-RG-x-xx	RS232 and GPIB (IEEE-488)
	CS130-USB-x-xx	USB 2.0
Cornerstone 260 Monochromators	74100	RS232 and GPIB (IEEE-488)
	74125	USB 2.0
	CS260-RG-x-xx-x	RS232 and GPIB (IEEE-488)
	CS260-USB-x-xx-x	USB 2.0
MS260i Spectrographs	74050	RS232 and GPIB (IEEE-488)
	74055	RS232 and GPIB (IEEE-488)
	74085	USB 2.0
	74086	USB 2.0
	MS260i-RG-x-xx-x	RS232 and GPIB (IEEE-488)
	MS260i-USB-x-xx-x	USB 2.0
MS257 Monochromators	77700	RS232 and optional GPIB (IEEE-488)
	77778	USB 2.0
	77781	USB 2.0 and RS232
MS257 Spectrographs	77702	RS232 and optional GPIB (IEEE-488)
	77780	USB 2.0
	77782	USB 2.0 and RS232
Tunable Light Sources	TLS-xxxx	USB 2.0 and RS232

**Figure 2: Compatible Oriel Monochromators, Spectrographs and Tunable Light Sources**

Prior to using TracQ Basic, please refer to the monochromator or spectrograph's user manual for information on which features are included with the instrument. Not all features included with TracQ Basic are supported by every monochromator and spectrograph. For example, dual output port selection can be used with only those instruments that are configured with slits at two output ports. Automatic bandpass selection can be utilized with monochromators and spectrographs that were calibrated with motorized slits.

If it is desired to add or change the features provided with a monochromator or spectrograph, please contact Newport or the representative through whom the instrument was purchased. In many cases, it is possible to modify and recalibrate the instrument.

Please note that when speaking generally about monochromators and spectrographs, the term "monochromator" shall be used throughout the rest of this manual.

## 2.3 SYSTEM REQUIREMENTS

Prior to installing the software, it is important to determine the type of operating system installed on the computer. The computer user performing the software installation must be logged in with Administrator privileges if using the Windows 7 operating system.

A USB port is required to access the installation software and user manual provided on the USB memory stick. The computer to be used for TracQ Basic must have enough USB ports to allow all desired instruments to be connected.

The user manual is provided as a .pdf file, which requires Adobe Acrobat Reader to open. It is suggested to save a copy of the user manual onto the computer that will be used for TracQ Basic. The manual will then be in a convenient location to use as a reference document in the future.

TRACQ BASIC SYSTEM REQUIREMENTS	
Operating System	Microsoft Windows 7 (32-bit or 64-bit) Microsoft Windows XP (Service Pack 3) .NET Framework 4.0
Processor	2 GB minimum
RAM	1 GB minimum
Peripheral	USB Port
Hard Drive Space	800 MB minimum

**Figure 3: Minimum System Requirements**

The communication interfaces are listed for each instrument in Figure 1 and Figure 2. If it is desired to connect an RS232 or GPIB instrument to a computer's USB port, a commercially available USB/GPIB or USB/RS232 converter cable such as those offered by National Instruments may be utilized.

The converter cable must be compatible with TracQ Basic, which is a LabVIEW™ based software application. The driver for the converter cable must be installed prior to using the cable with the instrument. The computer must meet the system requirements for the cable's driver.

## 3 SOFTWARE INSTALLATION

---

### 3.1 OVERVIEW

The TracQ Basic installer shall add the following items to the computer:

- TracQ Basic v6.5
- Newport Power Meter application v3.0.2, driver v4.0.3
- National Instruments Measurement and Automation Explorer
- LabVIEW Runtime Engine

The following steps outline the steps required to install and configure TracQ Basic.

1. Determine whether computer meets minimum system requirements per Section 2.3
2. Determine computer operating system per Section 3.2
3. Log onto computer using Administrator privileges
4. If the Newport power meter application is installed on the computer, save the data in a safe location and uninstall this application (it will be reinstalled during the TracQ Basic installation)
5. If a previous version of TracQ Basic is installed on the computer, save the data in a safe location and uninstall this application
6. If a USB converter cable is being used, install its driver per the manufacturer's instructions
7. Install the TracQ Basic software application per Section 3.3
8. Connect any USB instruments and update the drivers per Section 3.4
9. Connect any RS232 or GPIB instruments and determine the COM ports or addresses being utilized per Section 3.5

Please note that the installation procedure shown in this user manual is based on a Windows 7 32-bit operating system, with all files installed into default directories. The installation procedure and driver update process will differ slightly when using the Windows XP operating system.

TracQ Basic was developed in National Instruments LabVIEW. This software is not required to use TracQ Basic. When installing TracQ software, a LabVIEW runtime engine is installed, allowing any computer meeting the minimum system requirements to operate this software. If the appropriate version of the runtime engine is already installed onto the computer, the installation screens may differ slightly from what is shown in this user manual.

Before beginning the installation procedure, turn off and disconnect all instruments from the computer, then close all applications. Install the TracQ Basic USB memory stick into the computer's USB port when ready to begin installing the software.

### 3.2 DETERMINING OPERATING SYSTEM

For Windows 7 users, determine the operating system prior to installing the software. Open the Computer icon on the desktop or in the Start menu. Click on “System properties”.

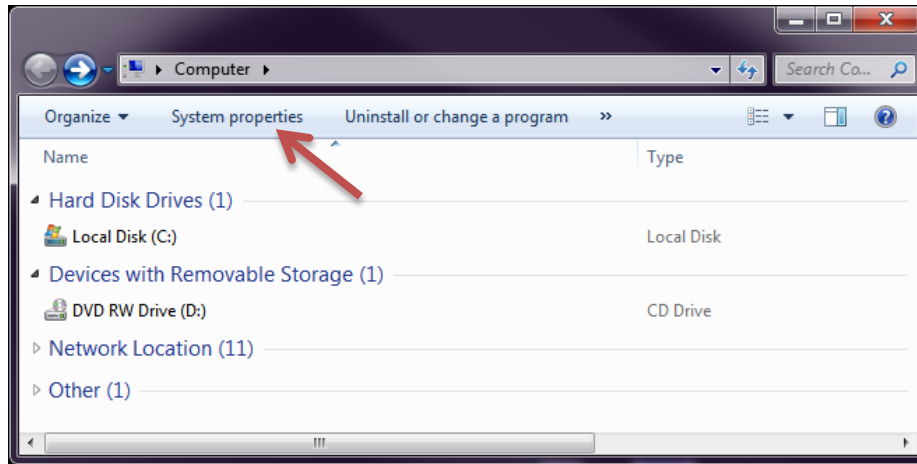


Figure 4: System Properties

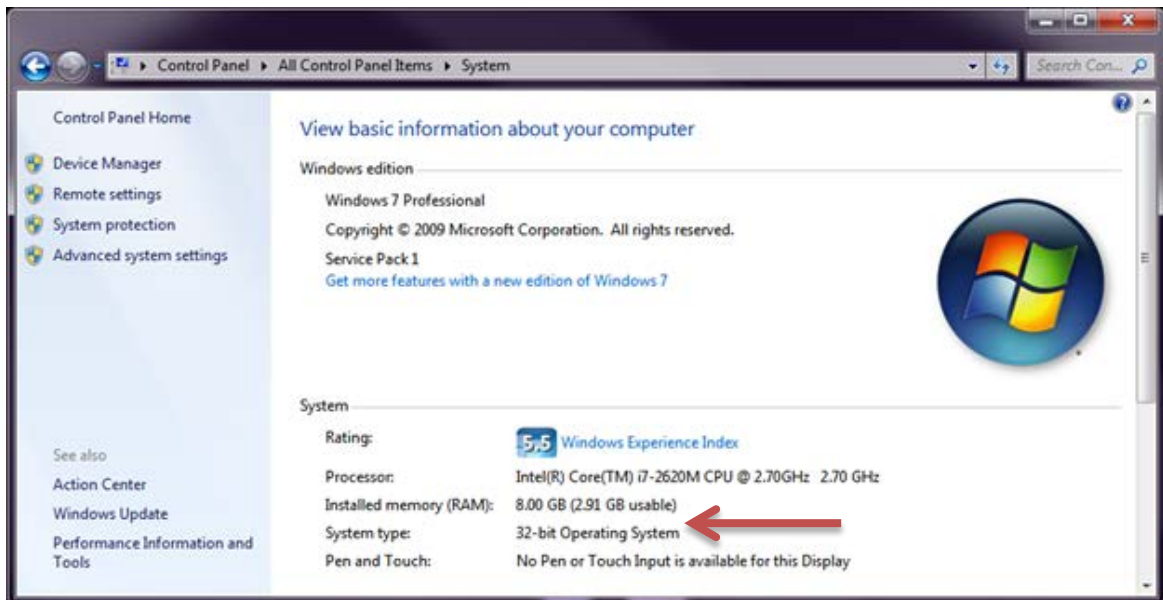


Figure 5: Windows 7 Operating System

### 3.3 INSTALLATION PROCEDURE

Insert the USB memory stick into the computer's USB port and open its contents. Double click on the setup application to begin the installation procedure.

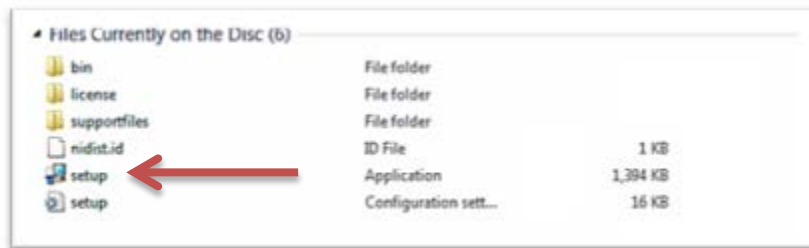


Figure 6: Setup.exe Application

Select the destination directories for TracQ Basic and the National Instruments software.

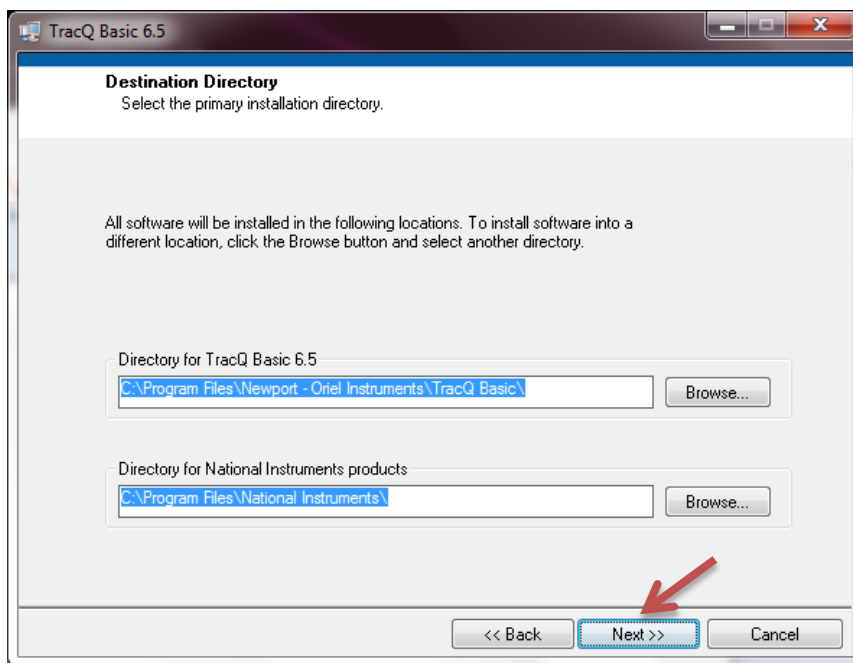


Figure 7: Destination Directories



Accept all license agreements and click "Next".

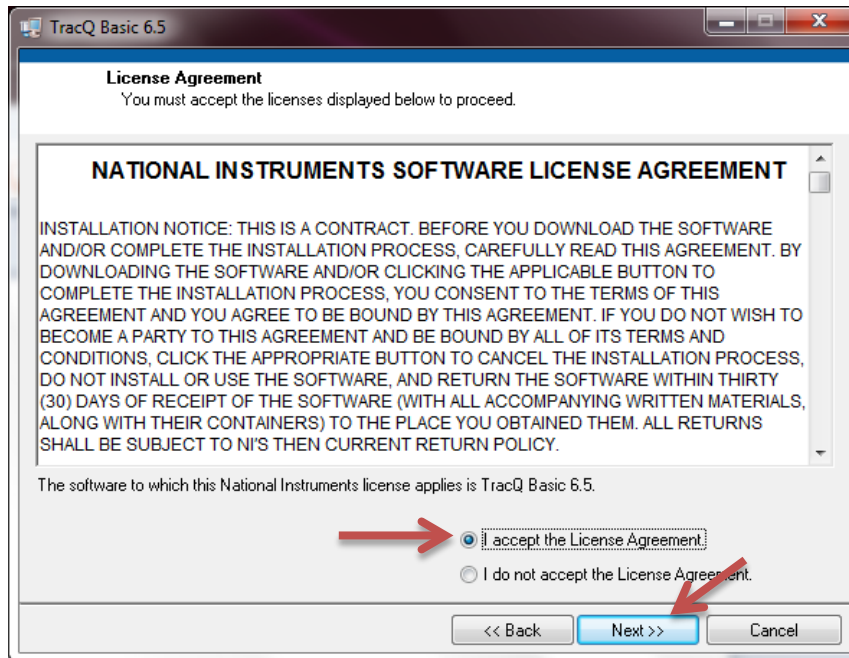


Figure 8: License Agreement

Review the installation summary and click "Next" to begin the installation process.

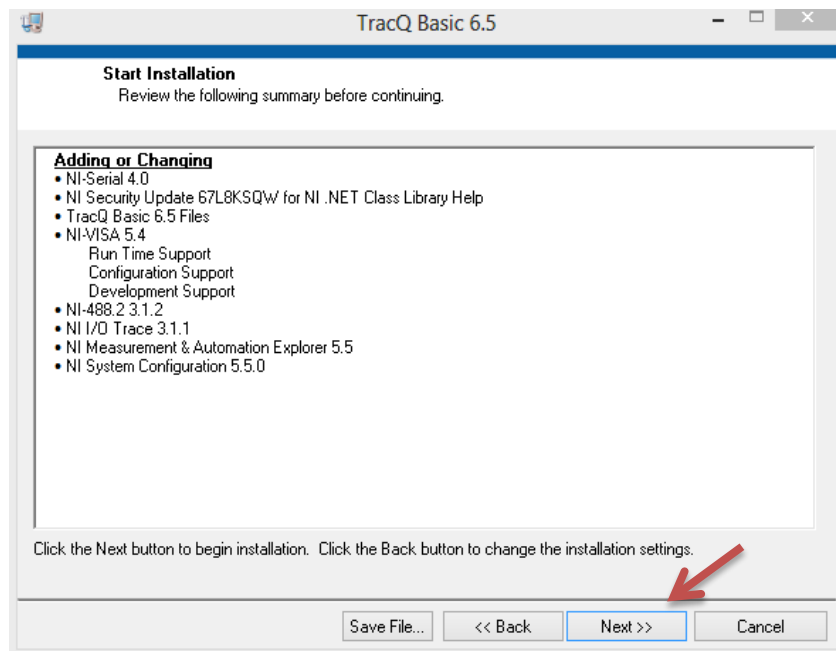
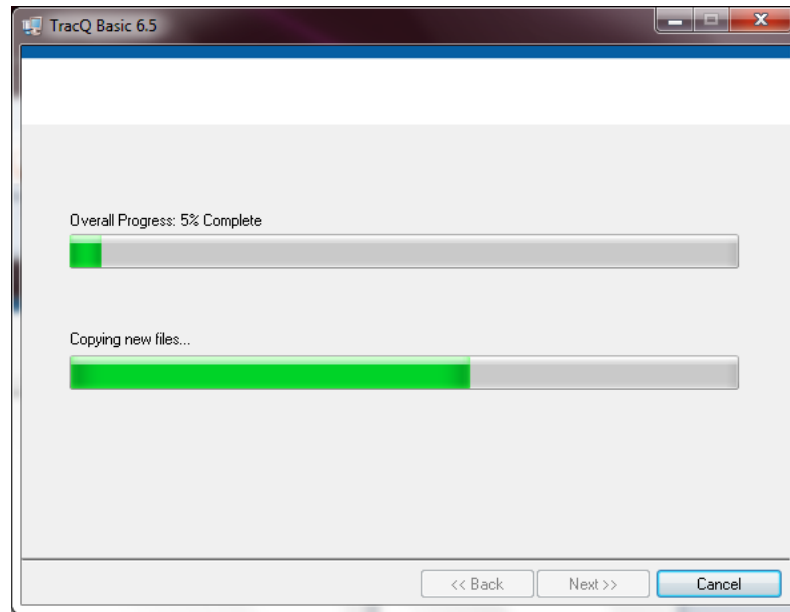


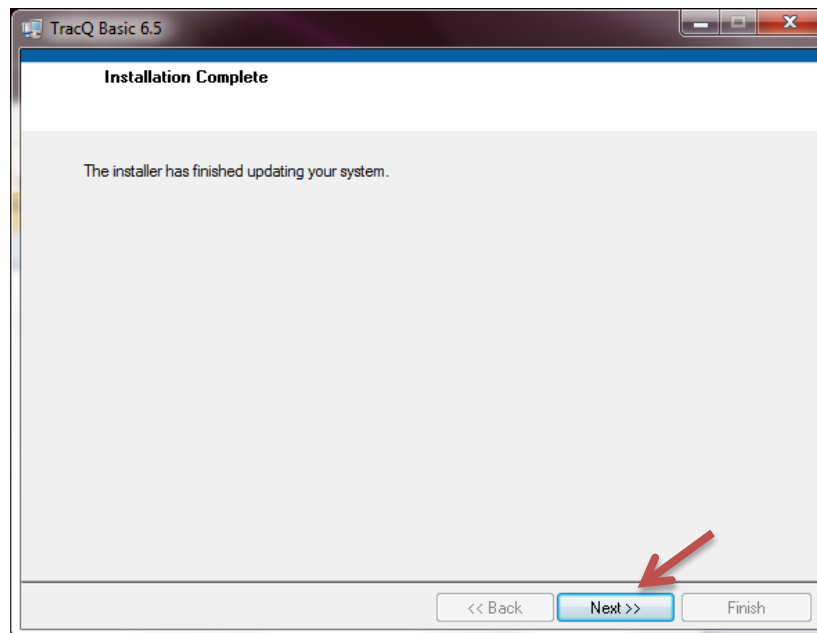
Figure 9: Installation Summary

Click “Cancel” at any time to stop the installation process.



**Figure 10: Installation in Progress**

Click “Next” to continue installing the Newport Power Meter application. This application must be installed together with TracQ Basic in order for the 19xx power meters to work in TracQ Basic. It is strongly suggested to install the application now, even if a Newport power meter will not be utilized immediately. This allows the power meter to be purchased and used at a future date without the need to uninstall and reinstall TracQ Basic.



**Figure 11: TracQ Installation Complete**

Windows XP users must select “32-bit Operating System”. Windows 7 users need to select “32-bit mode on a 64-bit Operating System”. After selecting the appropriate installation type, click “OK”.

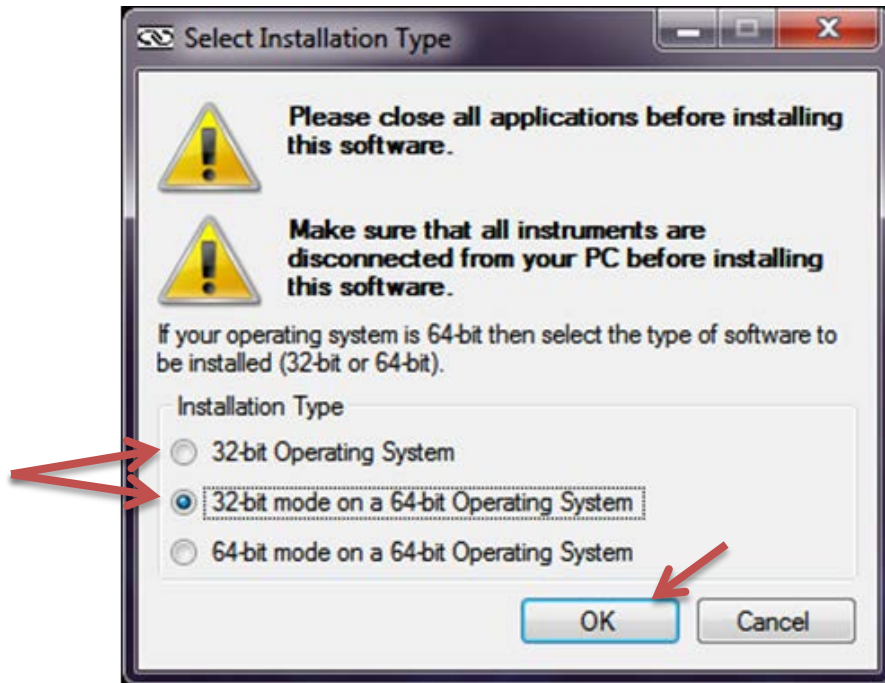


Figure 12: Select Operating System

Two windows shall appear at the same time. Ignore the bottom window and do not select “Restart” at this time. Click “Install” to proceed with the power meter application setup.

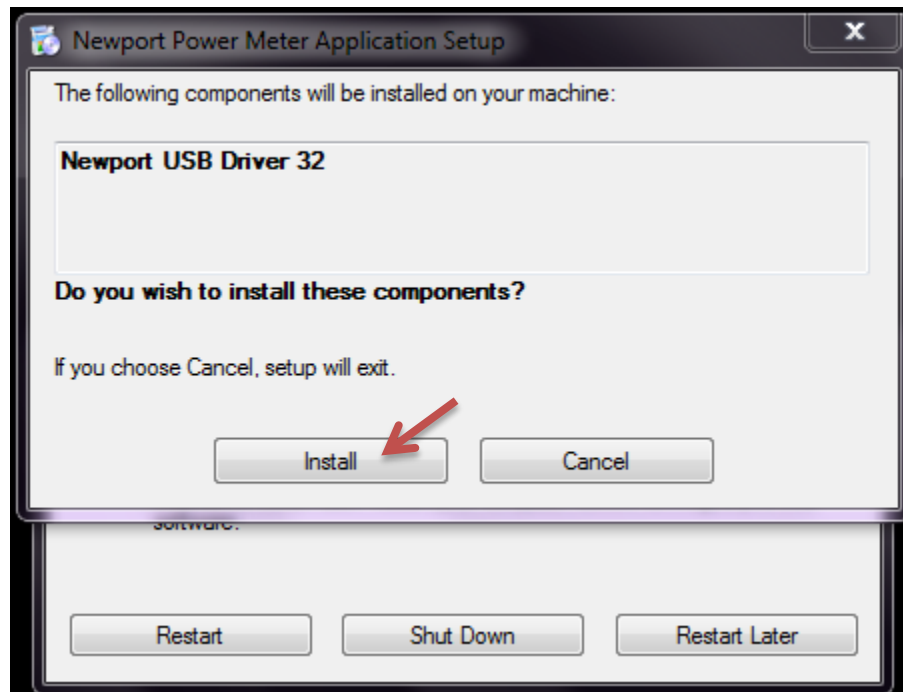
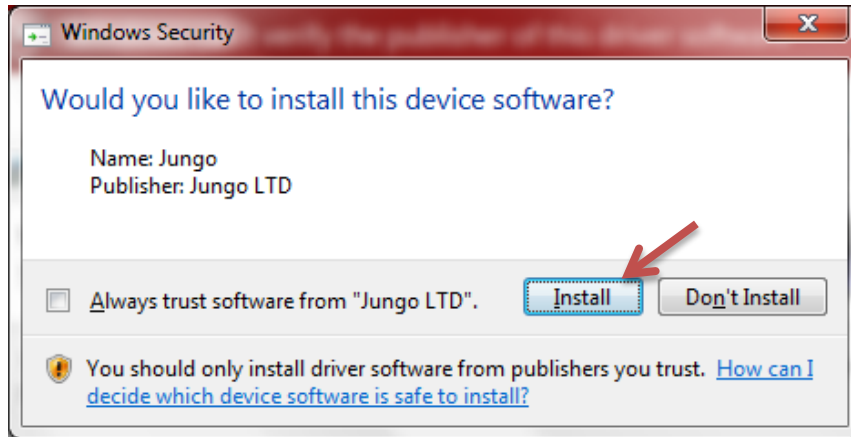


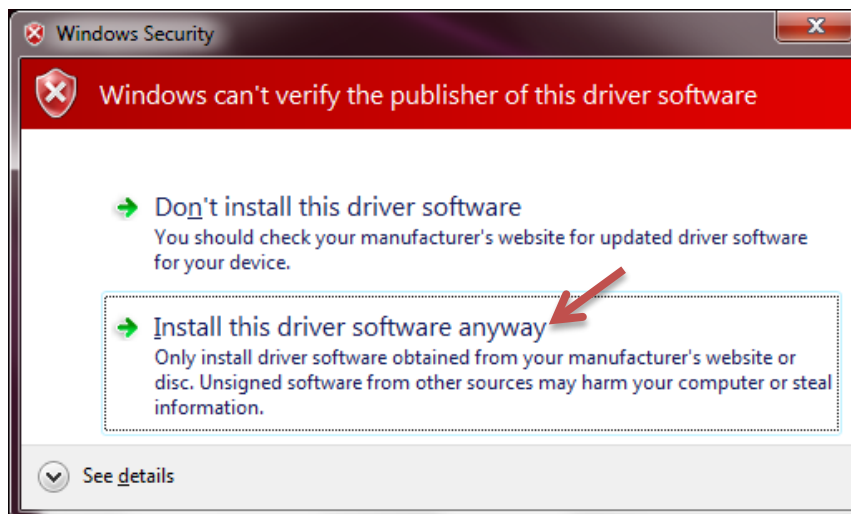
Figure 13: Install Newport Power Meter Driver

A Windows security message may appear. Click "Install".



**Figure 14: Windows Security Message**

A second Windows security message may appear. Click "Install this driver software anyway".



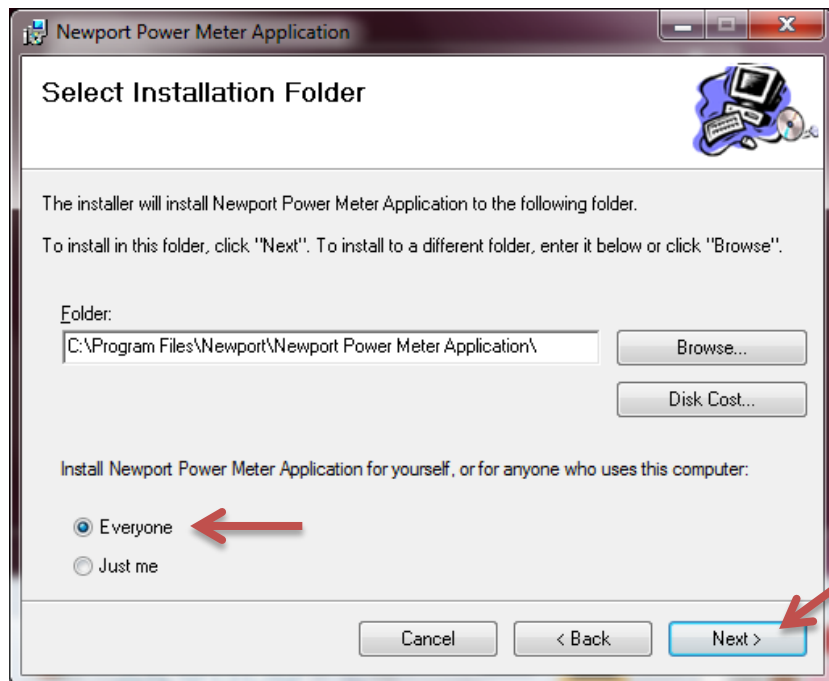
**Figure 15: Driver Software Publisher Message**

Click “Next” to continue the setup wizard that shall install the Newport power meter application software.



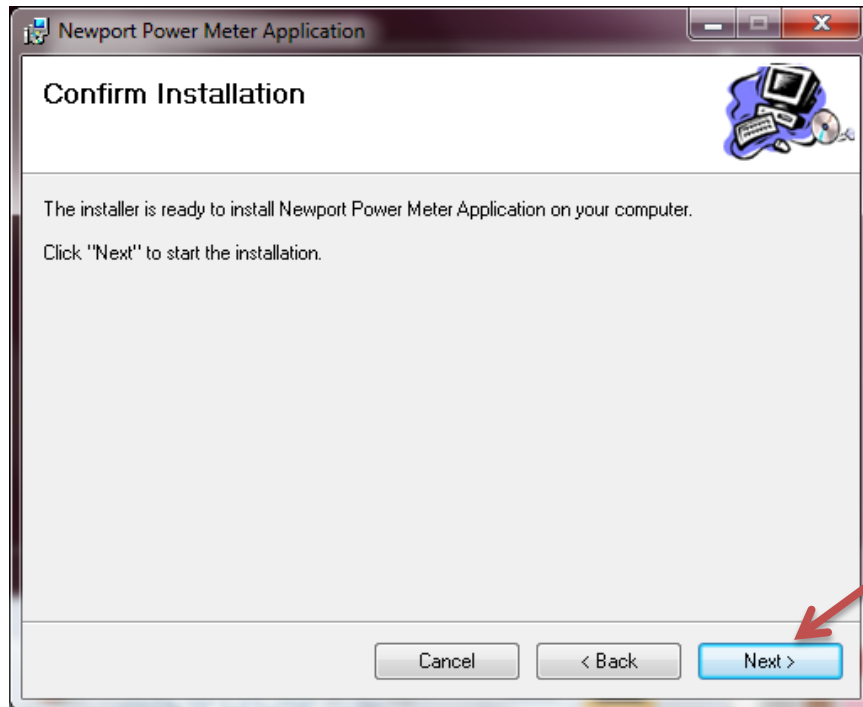
**Figure 16: Power Meter Setup Wizard**

Select “Everyone” to allow all users to access this application. Browse to an alternate installation folder directory, if desired. Click “Next” to proceed.



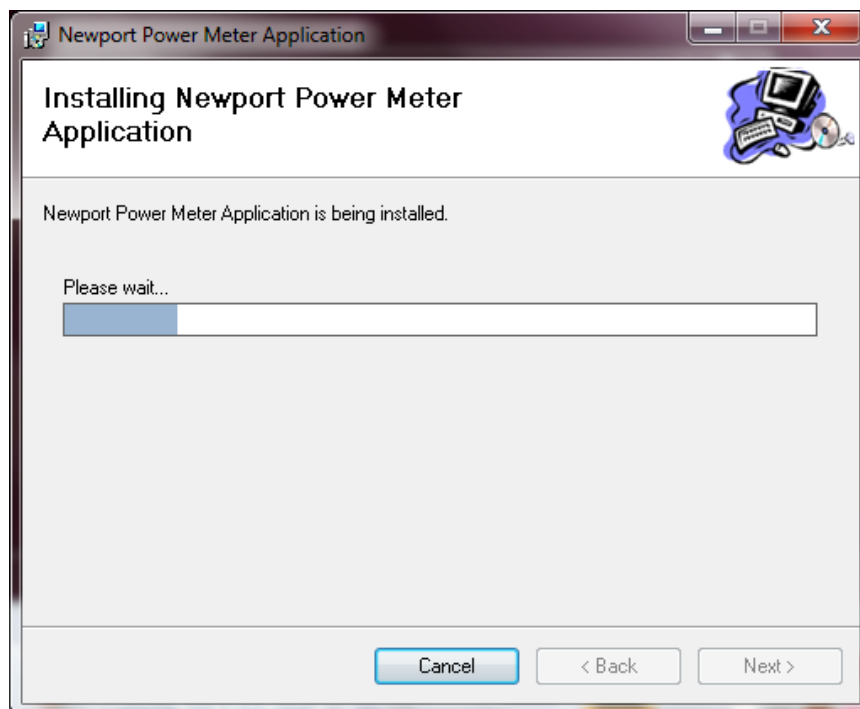
**Figure 17: Select Installation Folder**

Click "Next" to continue the process.



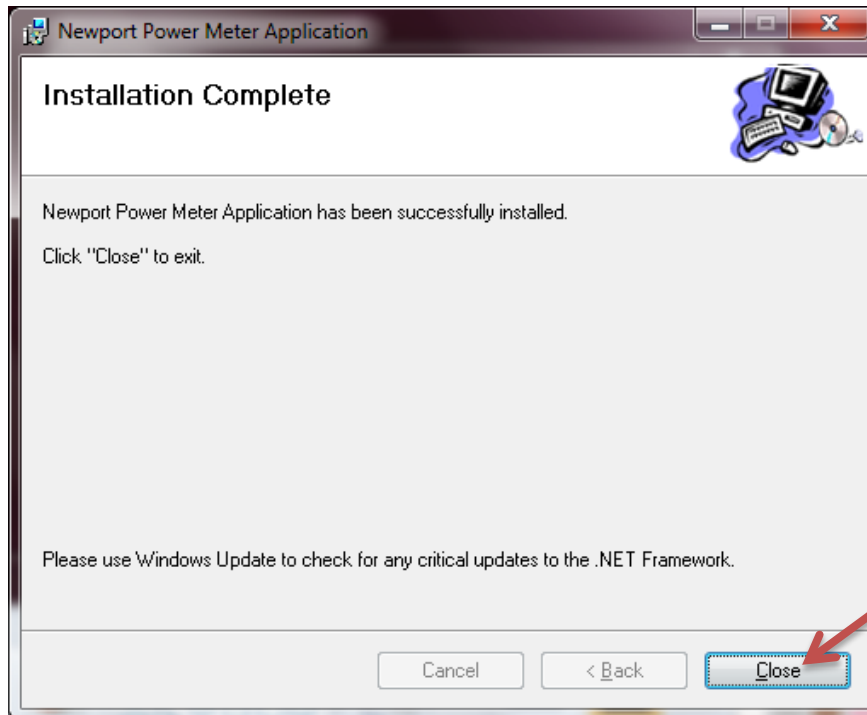
**Figure 18: Confirm Installation**

Click "Cancel" at any time to stop the installation process.



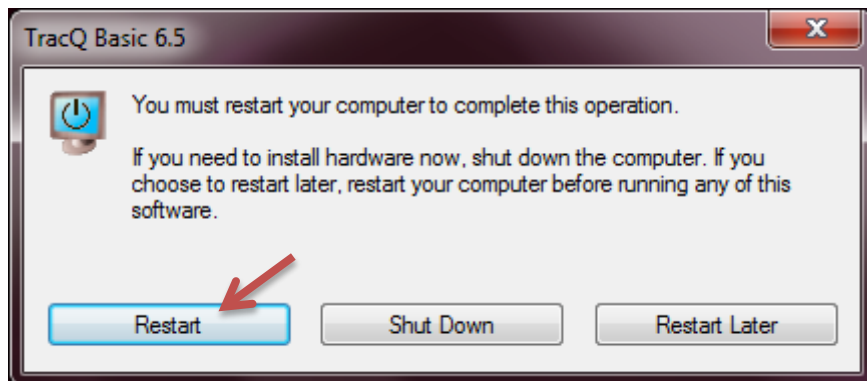
**Figure 19: Power Meter Installation in Progress**

Click "Close".



**Figure 20: Power Meter Installation Complete**

Click "Restart" to complete the installation process. Restarting the computer is required prior to using TracQ Basic.



**Figure 21: Restart Prompt**

Right click once on the TracQ Basic icon and click “Properties”. In the Compatibility tab of the Properties window, click on “Change settings for all users”.

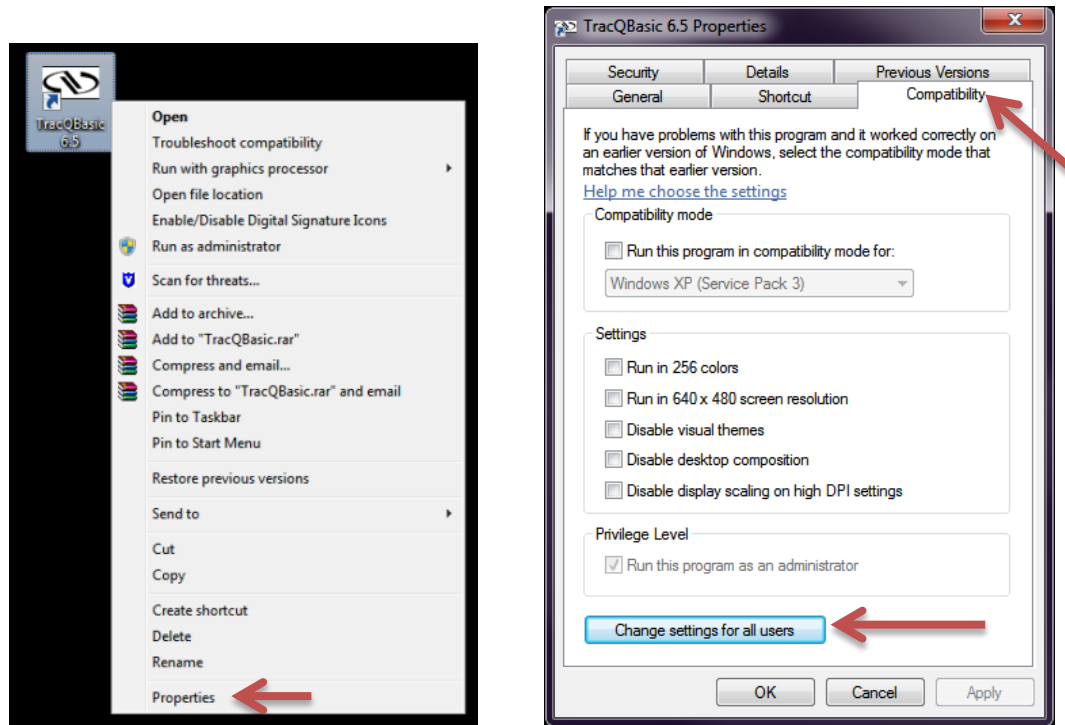


Figure 22: TracQ Basic Properties

Check the box “Run this program as administrator”, then click “OK”.

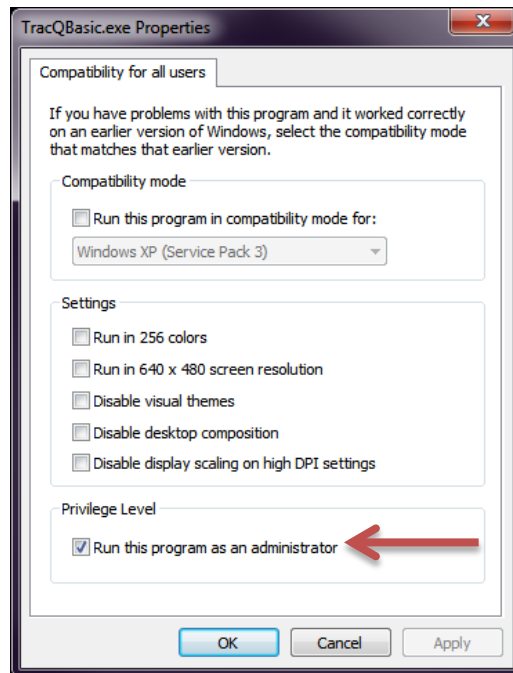


Figure 23: Run as Administrator for All Users



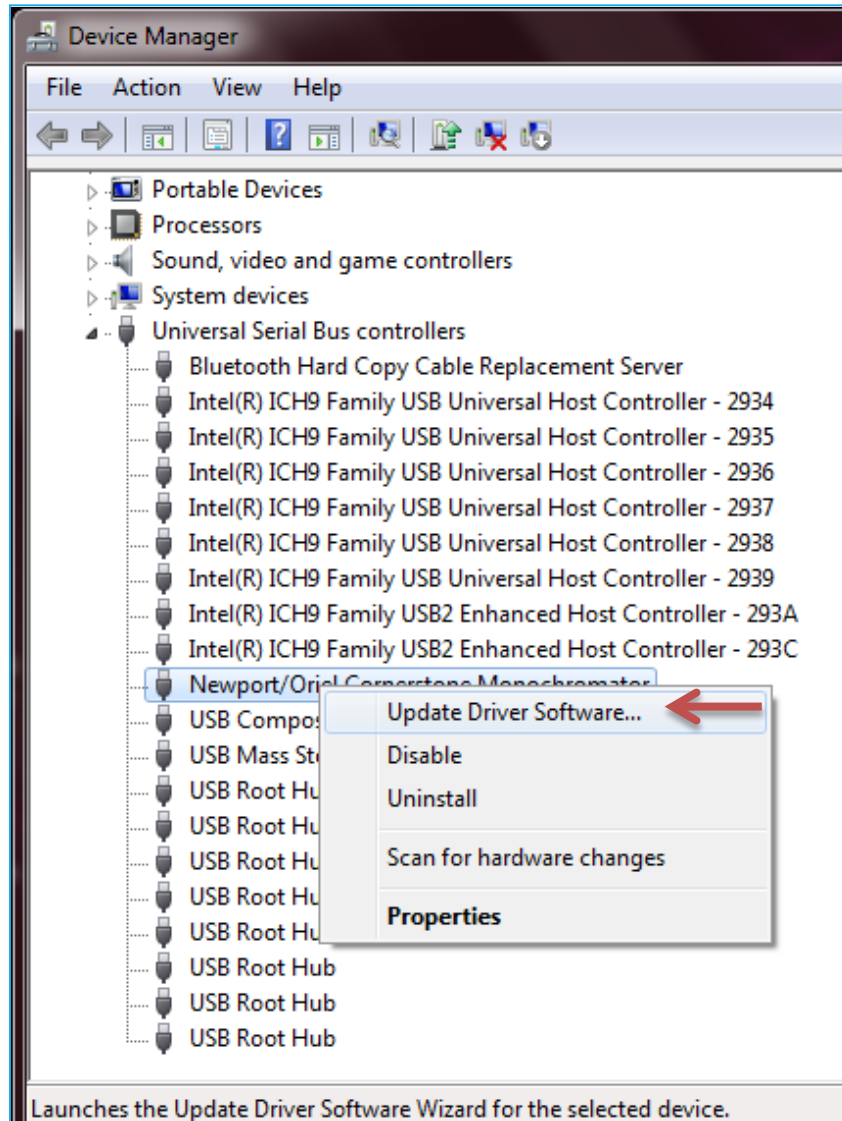
### 3.4 USB MONOCHROMATOR DRIVER UPDATE

The USB models for each type of monochromator or spectrograph require a driver update in order to allow TracQ Basic to recognize the instrument. Connect the instrument to the computer using the USB cable provided and turn the instrument on. When the instrument is started, it makes various sounds when positioning the gratings, filters and shutter. Once the sounds have stopped, the driver may be updated.

DRIVER MONOCHROMATORS, SPECTROGRAPHS AND TUNABLE LIGHT SOURCES			
Model	Series	Driver Folder	Operating System
74004	Cornerstone 130 Monochromators	CS Drivers	Windows XP and Windows 7 (32- and 64-bit)
CS130-USB-x-xx		CS Drivers	Windows XP and Windows 7 (32- and 64-bit)
74125	Cornerstone 260 Monochromators	CS Drivers	Windows XP and Windows 7 (32- and 64-bit)
CS260-USB-x-xx-x		CS Drivers	Windows XP and Windows 7 (32- and 64-bit)
74085	MS260i Spectrographs	CS Drivers	Windows XP and Windows 7 (32- and 64-bit)
74086		CS Drivers	Windows XP and Windows 7 (32- and 64-bit)
MS260i-USB-x-xx-x		CS Drivers	Windows XP and Windows 7 (32- and 64-bit)
77778	MS257 Monochromators	MS257 USB Drivers (x86)	Windows XP and Windows 7 (32-bit)
		MS257 USB Drivers (x64)	Windows 7 (64-bit)
77781		MS257 USB Drivers (x86)	Windows XP and Windows 7 (32-bit)
		MS257 USB Drivers (x64)	Windows 7 (64-bit)
77780	MS257 Spectrographs	MS257 USB Drivers (x86)	Windows XP and Windows 7 (32-bit)
		MS257 USB Drivers (x64)	Windows 7 (64-bit)
77782		MS257 USB Drivers (x86)	Windows XP and Windows 7 (32-bit)
		MS257 USB Drivers (x64)	Windows 7 (64-bit)
TLS-xxxx	Tunable Light Sources	CS Drivers	Windows XP and Windows 7 (32- and 64-bit)

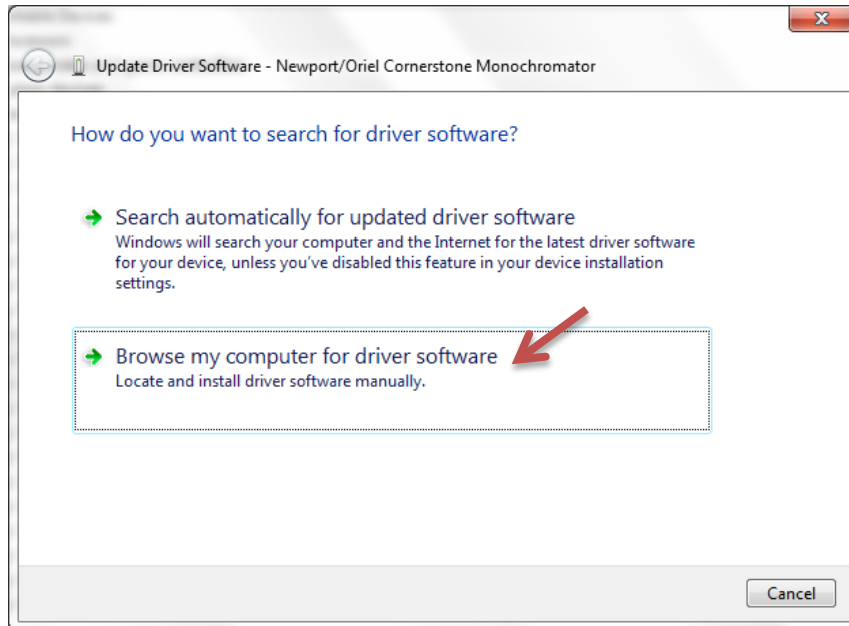
Figure 24: Monochromator, Spectrograph and Tunable Light Source Drivers

Open the Windows Device Manager and locate the instrument. Depending on the model, it may be listed as an Unknown Device. Right click on the instrument listing and select “Update Driver Software...”.



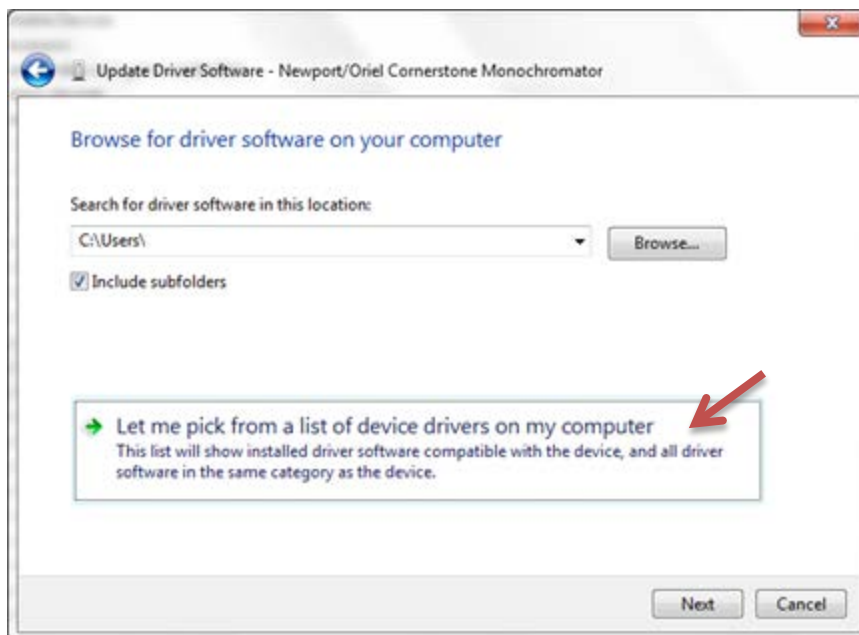
**Figure 25: Locating Instrument in Device Manager**

Click on "Browse my computer for driver software".



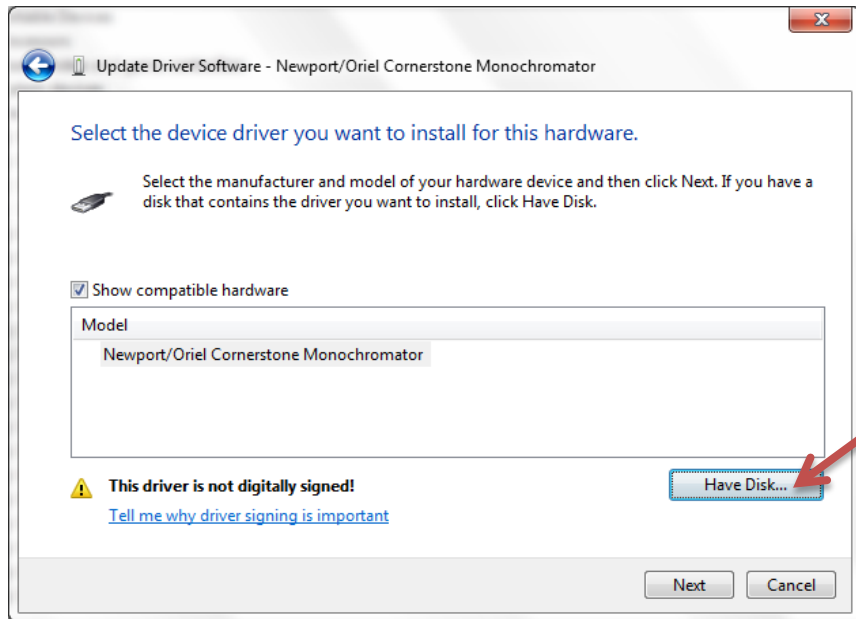
**Figure 26: Browse Computer for Driver Software**

Click on "Let me pick from a list of device drivers on my computer".



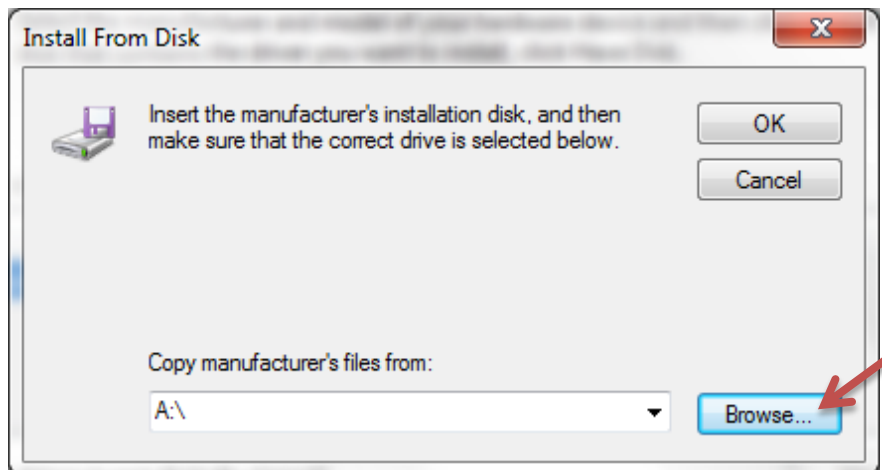
**Figure 27: Pick From a List of Drivers**

Click on “Have Disk...”.



**Figure 28: Select Device Driver**

Click on “Browse...”.



**Figure 29: Browse to Driver Location**

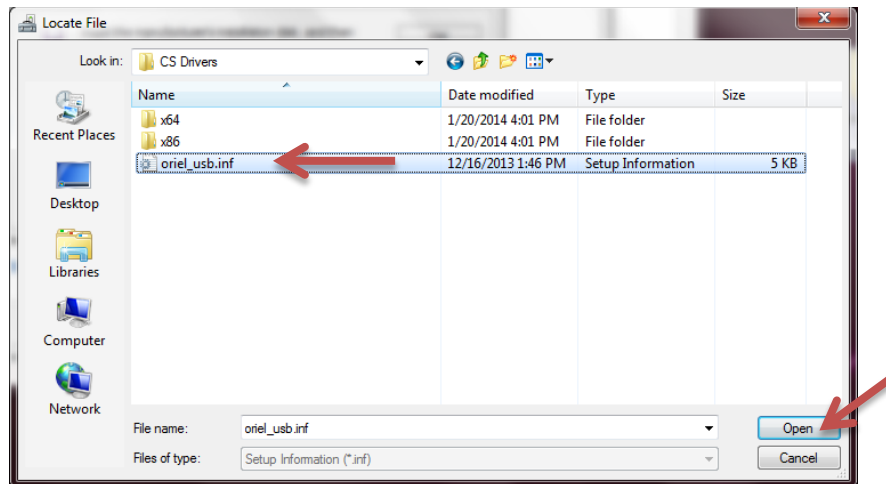
Navigate to the location of the USB driver on the computer based upon the type of monochromator. Select the .inf file as listed and click “Open”. The file path to each type of driver is listed below. This is based upon the default directory location for TracQ Basic as selected during the software installation process.

Cornerstone monochromators and MS260i spectrographs:  
C:\Program Files\Newport - Oriel Instruments\TracQ Basic\CS Drivers\oriel\_usb.inf

MS257 on 64-bit operating system:  
C:\Program Files\Newport - Oriel Instruments\TracQ Basic\MS257 USB Driver (x64)\MS257x64.inf

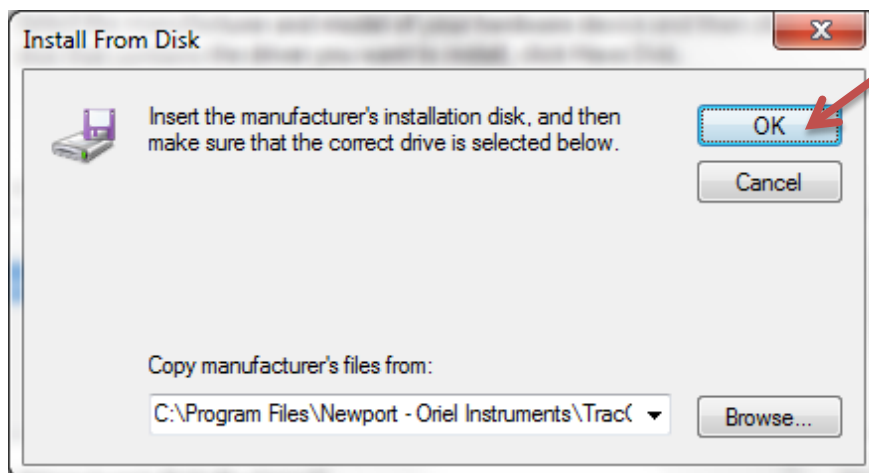
MS257 on 32-bit operating system:  
C:\Program Files\Newport - Oriel Instruments\TracQ Basic\MS257 USB Drivers (x86)\USBBulk.inf

**Figure 30: List of Driver Software File Locations**



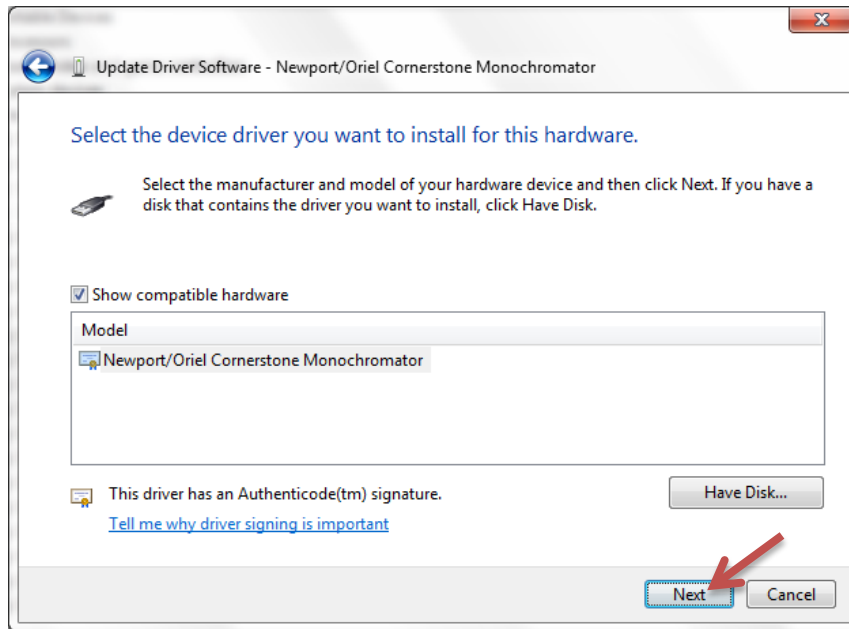
**Figure 31: Select Driver File**

Click “OK” to continue, after verifying file path chosen.



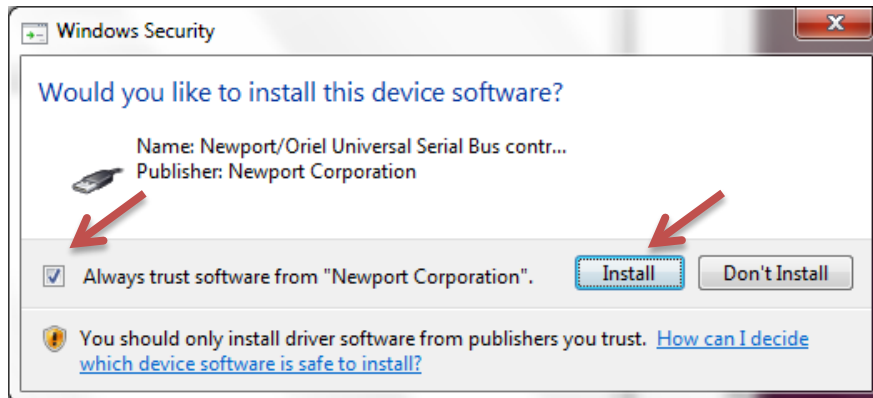
**Figure 32: Check Driver Selection**

Click “Next” to proceed with the driver software installation.



**Figure 33: Proceed with Driver Installation**

Check the box marked “Always trust software from ‘Newport Corporation’”. Then click “Install”.



**Figure 34: Confirm Driver Installation**

### 3.5 DETERMINING RS232 COM PORT NUMBER OR GPIB ADDRESS

When selecting an instrument in TracQ Basic, each RS232 or GPIB instrument will have a default Com Port or GPIB Address. Depending on whether additional equipment is also connected and other factors, the defaults setup in the software may not be valid for the monochromator or detection instrument. The Com Port or Address is easily updated in TracQ. It is necessary to determine the actual Com Port or Address of the specific instrument prior to updating it in TracQ Basic.

A Com Port number may be determined using in the Windows Device Manager. If multiple devices are listed, turning the instrument off and back on will help to determine which Com Port applies to which instrument. When the instrument is turned off, it will no longer be listed in the Device Manager. It will reappear when the instrument is turned back on.

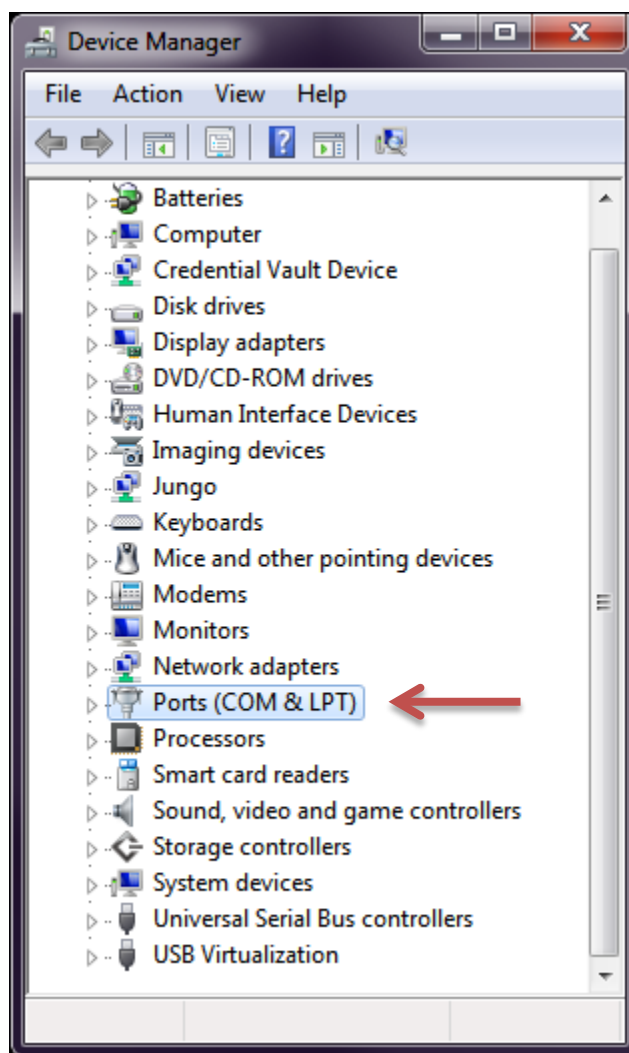
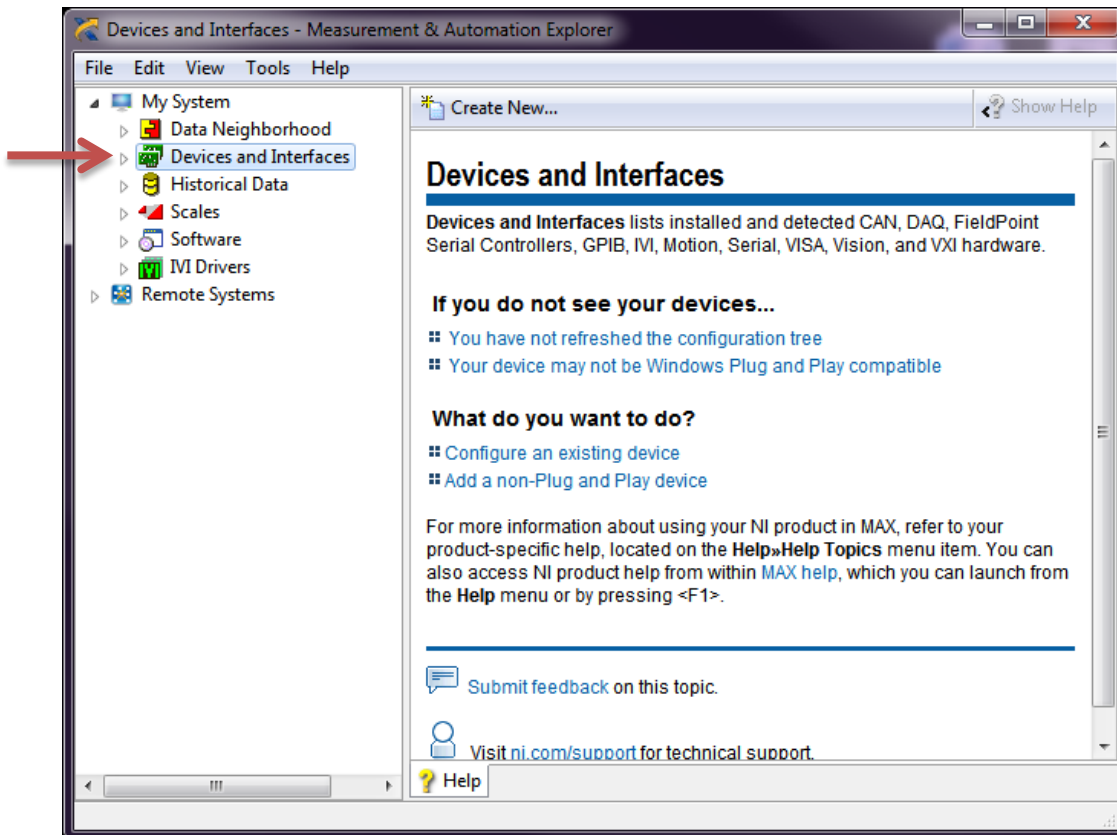


Figure 35: Run as Administrator for All Users

When TracQ Basic is installed, it also installs the National Instruments Measurement & Automation Explorer. This appears on the desktop with an icon named “NI Max”. When using this software, it is easy to determine the GPIB Address scheme and update it if needed. This information may be found under Devices and Interfaces. Refer to the online help files from National Instruments for more information.



**Figure 36: Measurement & Automation Explorer**

When using a GPIB/USB or RS232/USB converter cable, the instrument will appear with a GPIB Address or Com Port just as if they were connected using a standard cable. The Address or Com Port of these cables may differ from the defaults for the instruments when they are connected using standard cables. In these cases, it is essential to know how the cables are configured in order to establish communication in TracQ Basic.



**Figure 37: USB Converter Cables**



<b>DEFAULT COMMUNICATION PARAMETERS FOR DETECTION INSTRUMENTS</b>			
<b>Model</b>	<b>Series</b>	<b>GPIB Address</b>	<b>Com Port</b>
70100	Oriel Merlin Lock-In Digital Amplifiers		1
70103		1	
70104			1
70105		1	
LIDA-SRS-KIT	Oriel Lock-In Digital Amplifier Kit	2	
SR810	Stanford Research Systems Lock-In Digital Amplifier	2	

<b>DEFAULT COMMUNICATION PARAMETERS FOR MONOCHROMATORS, SPECTROGRAPHS AND TUNABLE LIGHT SOURCES</b>			
<b>Model</b>	<b>Series</b>	<b>GPIB Address</b>	<b>Com Port</b>
74000	Cornerstone 130 Monochromators	4	1
CS130-RG-x-xx			
74100	Cornerstone 260 Monochromators	4	1
CS260-RG-x-xx-x			
74050	MS260i Imaging Spectrographs	4	1
74055			
MS260i-RG-x-xx-x			
77700	MS257 Monochromators	1	6
77781		1	
77702	MS257 Imaging Spectrographs	1	6
77782		1	
TLS-xxxx	Tunable Light Sources		1

**Figure 38: RS232 and GPIB Default Settings**

## 4 STARTING THE SOFTWARE FOR FIRST TIME

A detection instrument is required when taking data using TracQ Basic. A monochromator is optional, as other light sources (laser, etc.) may be used. Before launching TracQ Basic, the instruments to be used must be connected to the computer, their drivers updated (if USB) and the instruments switched on.

TracQ displays the instrument status as indicators on the main window of the software, as seen in Figure 39. When the correct instruments are selected and TracQ is successfully able to establish communication, the indicators are green. If instruments cannot be found, the indicators are red.

When starting the software for the first time, prompts will appear to select the instrument libraries. When the window shown in Figure 40 appears, click on the instrument library folder corresponding to the instrument, then click “Select Folder”.

These libraries appear by default in C:/Program Files/Newport – Oriel Instruments/TracQ Basic.

If it is decided to not select instrument libraries, click “Cancel”. TracQ Basic provides the opportunity to select or change instruments at any time.

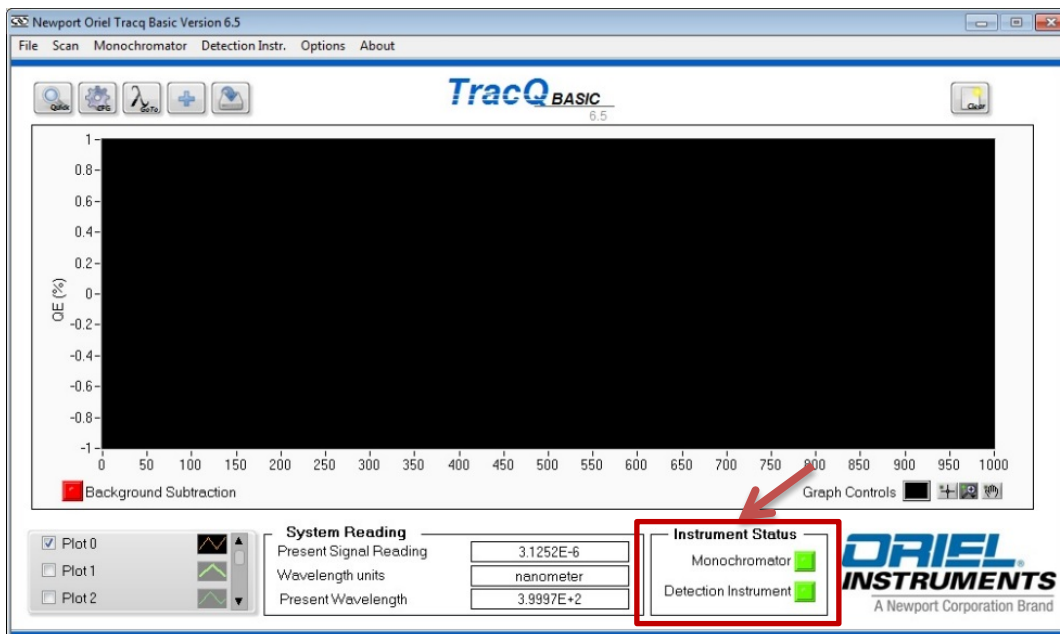


Figure 39: Instrument Status Indicators

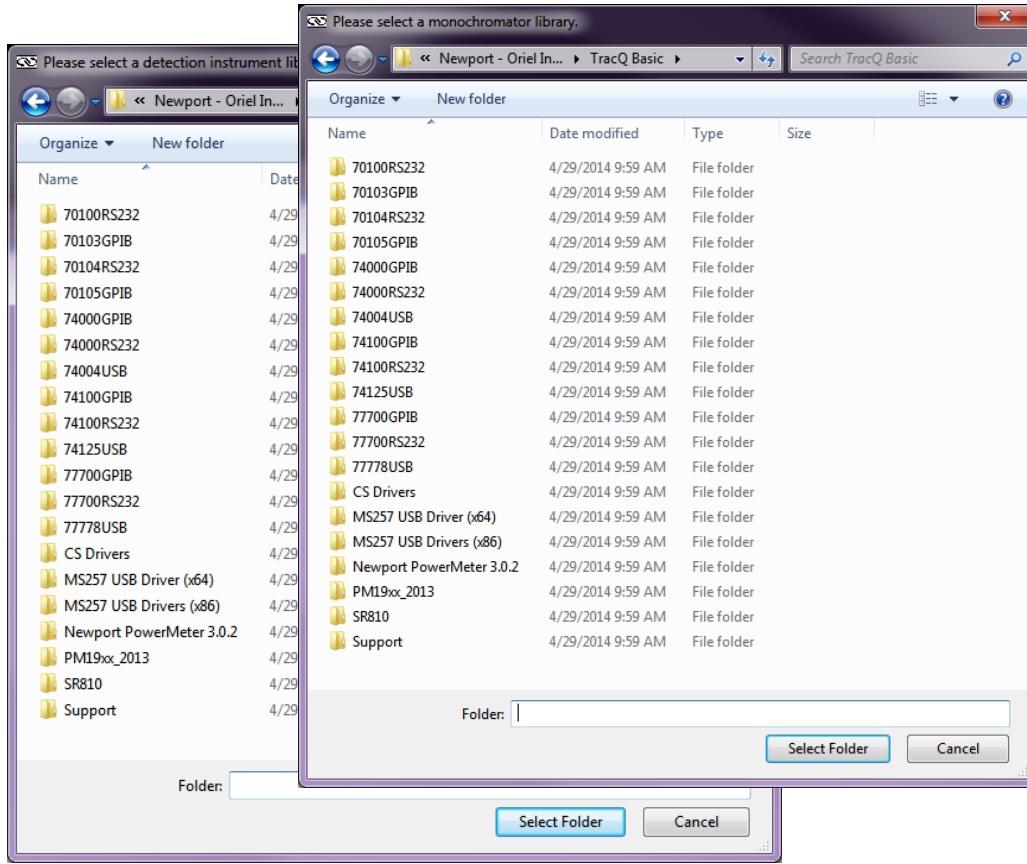


Figure 40: Selecting a Detection Instrument or Monochromator Library

DETECTION INSTRUMENT LIBRARIES			
Model	Interface	Library Folder	Series
70100	RS232	70100RS232	Oriel Merlin Lock-In Digital Amplifiers
70103	GPIB (IEEE-488)	70103GPIB	
70104	RS232	70104RS232	
70105	GPIB (IEEE-488)	70105GPIB	
1918-C	USB	PM19xx_2013	Newport Power Meters
1918-R	USB		
1936-C	USB		
1936-R	USB		
2936-C	USB		
2936-R	USB		
LIDA-SRS-KIT	GPIB (IEEE-488)	SR810	Oriel Lock-In Digital Amplifier Kit
SR810	GPIB (IEEE-488)	SR810	Stanford Research Systems Lock-In Digital Amplifier

Figure 41: Detection Instrument Libraries

MONOCHROMATOR AND SPECTROGRAPH LIBRARIES			
Model	Interface	Library Folder	Series
74000	RS232	74000RS232	Cornerstone 130 Monochromators
	GPIB (IEEE-488)	74000GPIB	
74004	USB 2.0	74004USB	
CS130-RG-x-xx	RS232	74000RS232	
	GPIB (IEEE-488)	74000GPIB	
CS130-USB-x-xx	USB 2.0	74004USB	
74100	RS232	74100RS232	Cornerstone 260 Monochromators
	GPIB (IEEE-488)	74100GPIB	
74125	USB 2.0	74125USB	
CS260-RG-x-xx-x	RS232	74100RS232	
	GPIB (IEEE-488)	74100GPIB	
CS260-USB-x-xx-x	USB 2.0	74125USB	
74050	RS232	74100RS232	MS260i Spectrographs
	GPIB (IEEE-488)	74100GPIB	
74055	RS232	74100RS232	
	GPIB (IEEE-488)	74100GPIB	
74085	USB 2.0	74125USB	
74086	USB 2.0	74125USB	
MS260i-RG-x-xx-x	RS232	74100RS232	
	GPIB (IEEE-488)	74100GPIB	
MS260i-USB-x-xx-x	USB 2.0	74125USB	
77700	RS232	77700RS232	MS257 Monochromators
	GPIB (IEEE-488)	77700GPIB	
77778	USB 2.0	77778USB	
77781	USB 2.0	77778USB	
	RS232	77700RS232	
77702	RS232	77700RS232	MS257 Spectrographs
	GPIB (IEEE-488)	77700GPIB	
77780	USB 2.0	77778USB	
77782	USB 2.0	77778USB	
	RS232	77700RS232	
TLS-xxxx	USB 2.0	74004USB	Tunable Light Sources
	RS232	74000RS232	

**Figure 42: Monochromator, Spectrograph and Tunable Light Source Libraries**

## 5 QUICK START GUIDE

Ensure all instruments are connected to the computer, powered on and visible in the Device Manager or National Instruments Measurement & Automation Explorer (accessible from NI Max icon on desktop).

A detection instrument is required for taking measurements, while monochromator is optional. However, scans can be loaded for viewing without any instruments connected. The following instructions assume that both a detection instrument and monochromator are being utilized. It also assumes the light source is turned on and warmed up.

Double click the TracQ Basic icon to open the application, ensure the instrument status indicator is green for the detection instrument and green for the monochromator, if used. If they are red, proceed to Section 5.1 to establish communication. If the indicators are green, skip to Sections 5.2 and 5.3 to set up the instrument parameters.

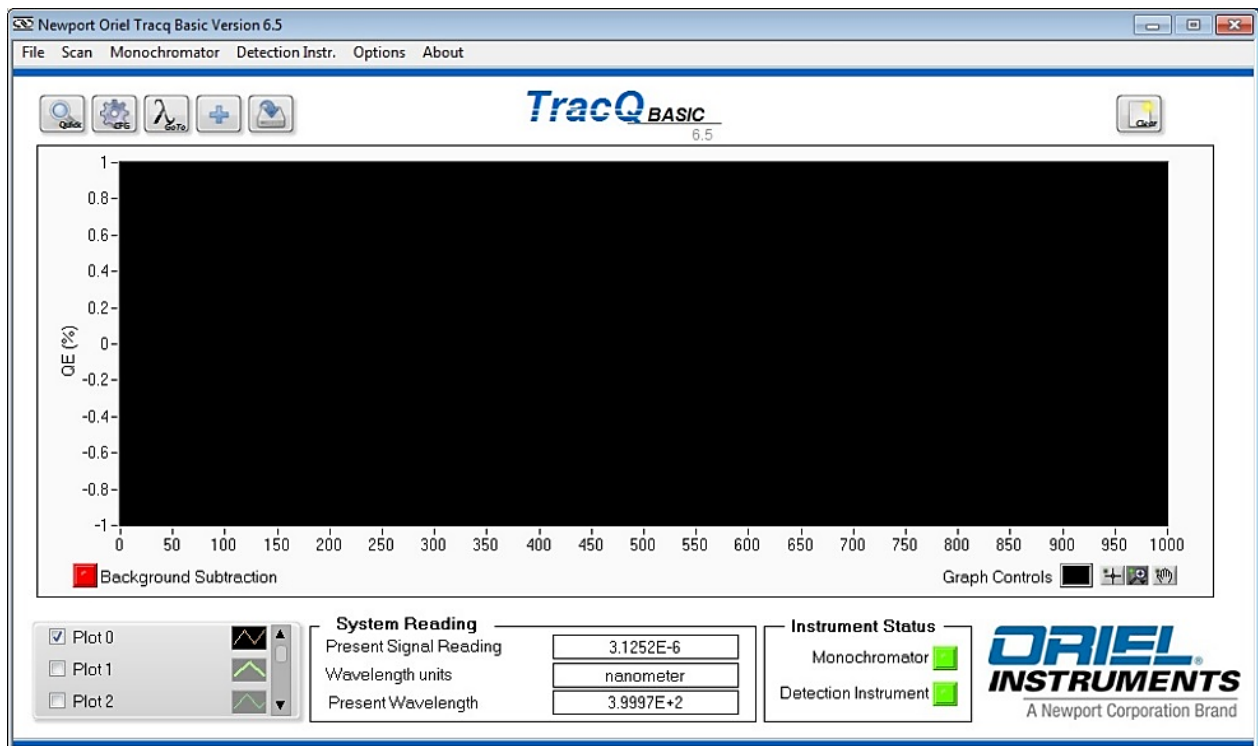


Figure 43: Main Application Window

## 5.1 SELECTING INSTRUMENTS AND ESTABLISHING COMMUNICATION

A detection instrument is selected by going to the following pulldown menu:  
Detection Instr. → Select Detector Library Path

Navigate to C:/Program Files/Newport – Oriel Instruments/TracQ Basic or the location in which the software has been installed.

Click on the folder of the instrument library corresponding to the instrument being used. A list of libraries is shown in Figure 41.

If the instrument indicator remains red and the instrument is GPIB or USB, update the com port or address by going to Detection Instr. → Setup Communications.

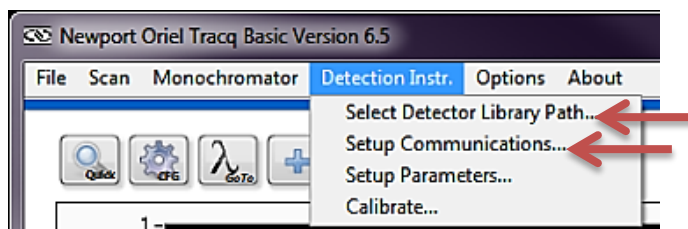


Figure 44: Detection Instrument Library and Communication Selection

A monochromator is selected by going to the following pulldown menu:  
Monochromator → Select Monochromator Library Path

Navigate to C:/Program Files/Newport – Oriel Instruments/TracQ Basic or the location in which the software has been installed.

Click on the folder of the instrument library corresponding to the instrument being used. A list of libraries is shown in Figure 42.

If the instrument indicator remains red and the instrument is GPIB or USB, update the com port or address by going to Monochromator → Setup Communications.

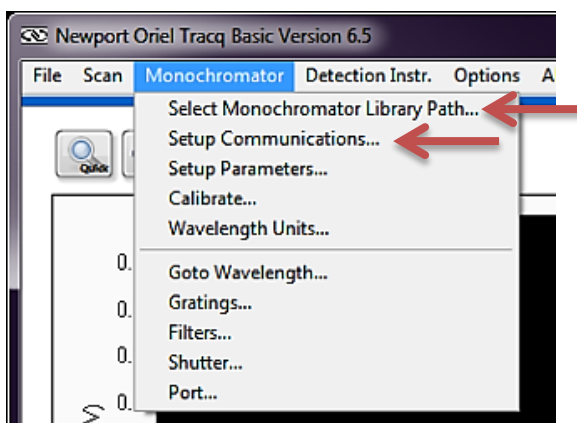


Figure 45: Monochromator Library and Communication Selection

## 5.2 SETTING UP MONOCHROMATOR AND FILTERS

Navigate to the menu options shown in Figure 46 and select the grating, filter and output port to be used for the scan. An individual filter or grating may be selected. To automatically change the grating, filter and output port at specific wavelengths, select the “Auto” feature and fill out the wavelength changeover tables. More details on the available settings are shown in Sections 19 and 20. Tunable light sources settings are discussed in Section 21. Please note that not all instruments are available with dual output ports.

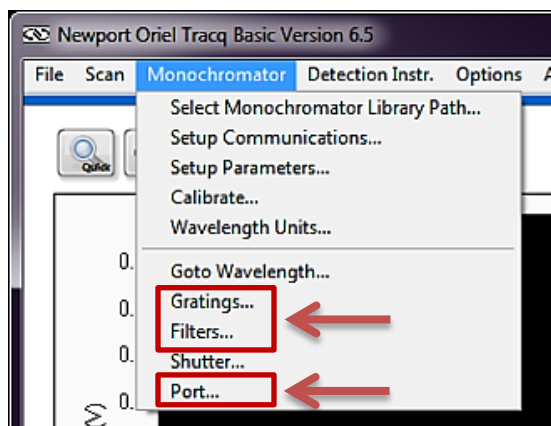


Figure 46: Monochromator and Filter Setup

## 5.3 SETTING UP DETECTION INSTRUMENT

Navigate to the menu shown in Figure 47 and configure the instrument parameters as appropriate for the application. More details on the available settings are shown in Sections 22 and 23.

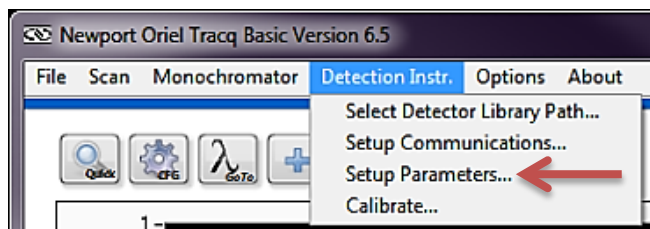


Figure 47: Detection Instrument Setup

## 5.4 SELECTING WAVELENGTH AND UNITS

Scans may be performed using nanometers (nm), micrometers (um) or wavenumber (cm<sup>-1</sup>). The default units are nanometers. To change the units, go to the menu shown in Figure 48. To assist with aligning the detector or sample, go to a wavelength which the detector is sensitive to or an easily visible wavelength such as 555 nm. The Go to Wavelength icon is shown in Figure 49.

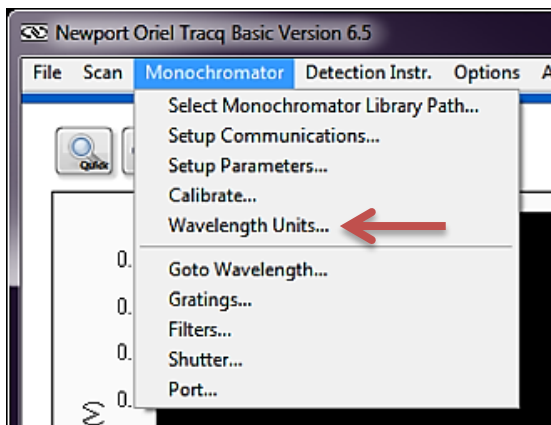


Figure 48: Wavelength Units Selection

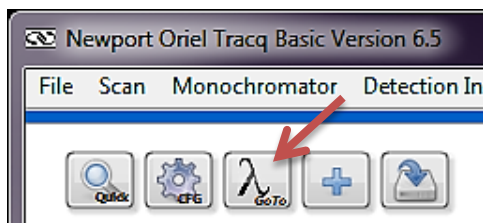


Figure 49: Set Monochromator to a Specific Wavelength

## 5.5 CONTROLLING THE SHUTTER

Open the shutter that is built into the monochromator, allowing light to illuminate the detector or sample by using the menu command shown in Figure 50. Make any final adjustments to the detector or sample position as required.

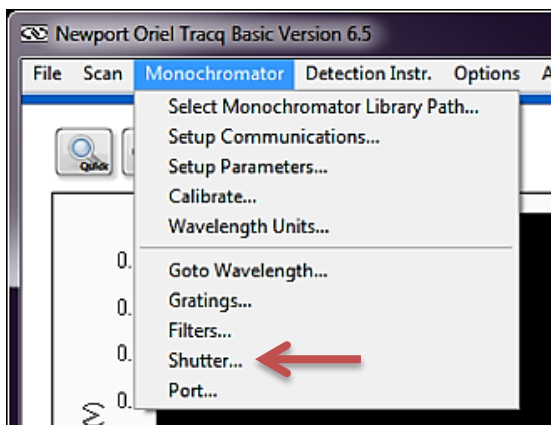


Figure 50: Opening the Monochromator Shutter



## 5.6 CHOOSING SCAN PARAMETERS

Click the CFG icon shown in Figure 51. Enter the starting and ending wavelengths, wavelength interval (step size) and delay time between wavelengths.

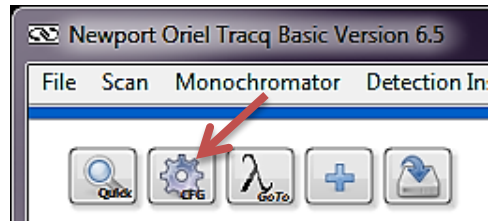


Figure 51: Scan Parameters Configuration Icon

## 5.7 PERFORMING A WAVELENGTH SCAN

Click the Quick Scan icon shown in Figure 52.

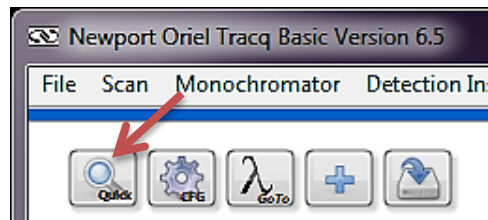


Figure 52: Start Scan Icon

## 5.8 ABORTING A SCAN

While the scan is underway, an Abort icon will appear in the main application window, as show in Figure 53. Click this icon to cancel the scan at any time. Cancelled scans will not be saved.



Figure 53: Abort Icon

## 5.9 SAVING A FILE

To save a file, click the icon shown in Figure 54. Files are saved in text tab delimited format. When multiple scans are run, a window opens up to allow the user to select which scan to save.



Figure 54: Save Scan File Icon

## 5.10 CLEARING GRAPH WINDOW

To clear the plotting window of completed graphs, click the Clear icon in Figure 55. Always ensure scans are saved before clearing them.



Figure 55: Clear Graph Icon

## 5.11 LOADING A PREVIOUSLY SAVED FILE

To load a previously saved scan or other data, click the Load Scan icon shown in Figure 56. In addition to being able to open data saved in TracQ Basic, any text tab delimited data set matching the TracQ format may be loaded. One example of non-TracQ data would be an Oriol detector calibration file.

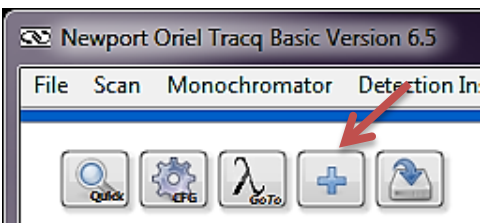


Figure 56: Load File Icon

## 5.12 EXITING TRACQ BASIC

Exit TracQ Basic using either the red X in the upper right corner of the application, or the pulldown menu selection shown in Figure 57. A prompt will appear asking to save settings as shown in Figure 58. In order to save the instrument selections and their basic setup information, select “Yes”.

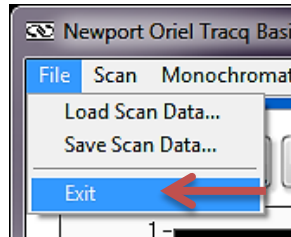


Figure 57: Exiting TracQ Basic

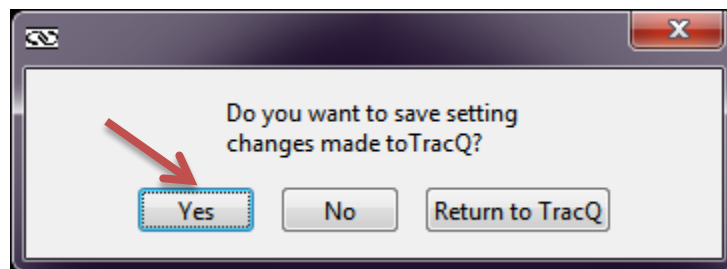


Figure 58: Saving Software Settings

## 6 GRAPH CONTROLS

### 6.1 PAN AND ZOOM CONTROLS

Graph controls are located below the plot window, as illustrated in Figure 59. Panning is accomplished by using the hand icon. The magnifying glass icon is used to bring up six additional icons used for zoom control, which are illustrated in Figure 60.

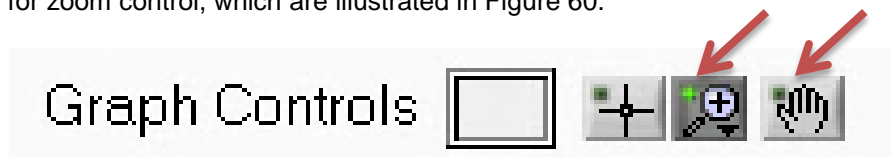


Figure 59: Graph Controls – Pan and Zoom

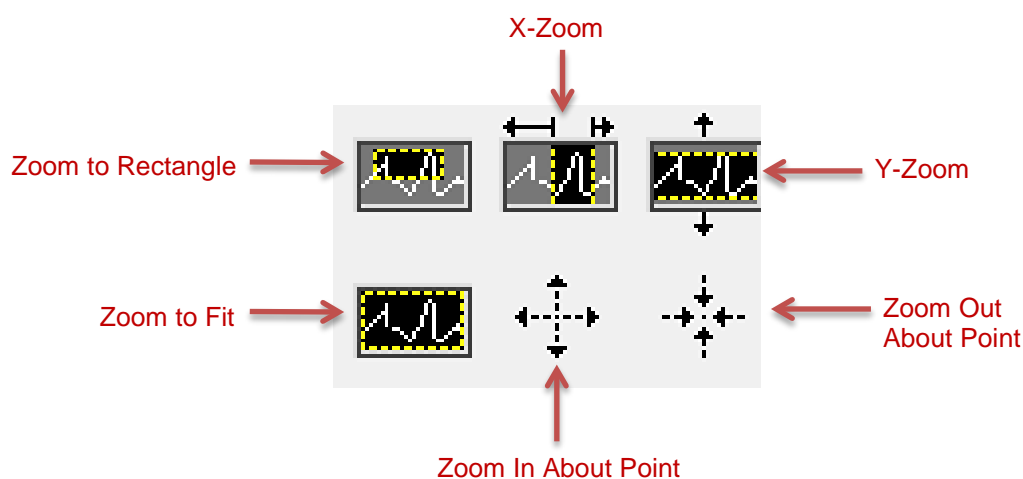


Figure 60: Pan and Zoom Icons

**Zoom to Rectangle:** changes the viewing window. Click in one corner of the desired viewing window, and then drag the mouse to form a rectangular viewing area.

**X-Zoom:** zooms in on a specific range on the x-axis.

**Y-Zoom:** zooms in on a specific range on the y-axis.

**Zoom to Fit:** automatically fits entire plot to window.

**Zoom In About Point:** zooms in on a specific point. Hold down the Shift on the keyboard to zoom out.

**Zoom Out About Point:** zooms out from a specific point. Hold down the Shift on the keyboard to zoom in.

Alternatively, X-Zoom and Y-Zoom may be accomplished by highlighting and retyping the starting and ending values of the plot in x and y-axes, respectively. This is a useful feature when it is desired to zoom in to a very specific range. An example is shown in in Figure 61. The scan shows a Xenon lamp output as captured by a silicon detector. The lowest wavelength of 100 nm was retyped to be 700 nm. The highest wavelength of 1200 nm was retyped to be 1100 nm.

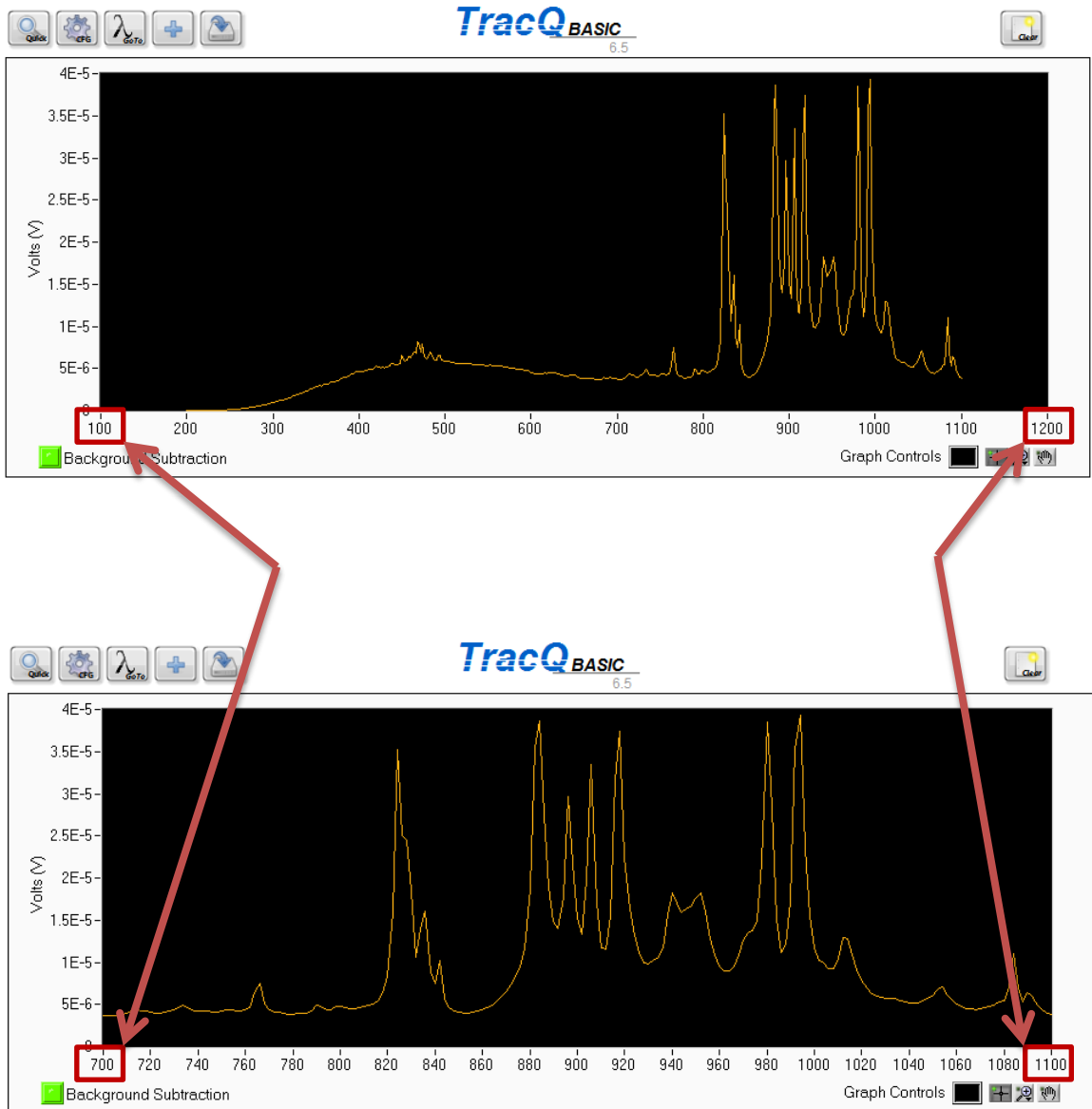


Figure 61: Graph Scale Customization

## 6.2 PLOT APPEARANCE CUSTOMIZATION

Graph controls are located below the plot window, as illustrated in Figure 62. Changing the background color is accomplished by clicking on the square icon. A color control selector appears, as shown in Figure 63. Click on the desired color, and the background color of the plot window shall be updated immediately. Using an alternative color to the default black allows the grid lines of the plot (always in black) to become visible.

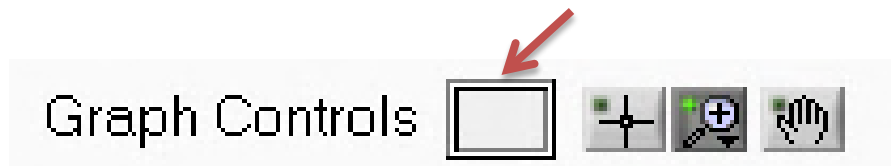


Figure 62: Graph Control – Background Color

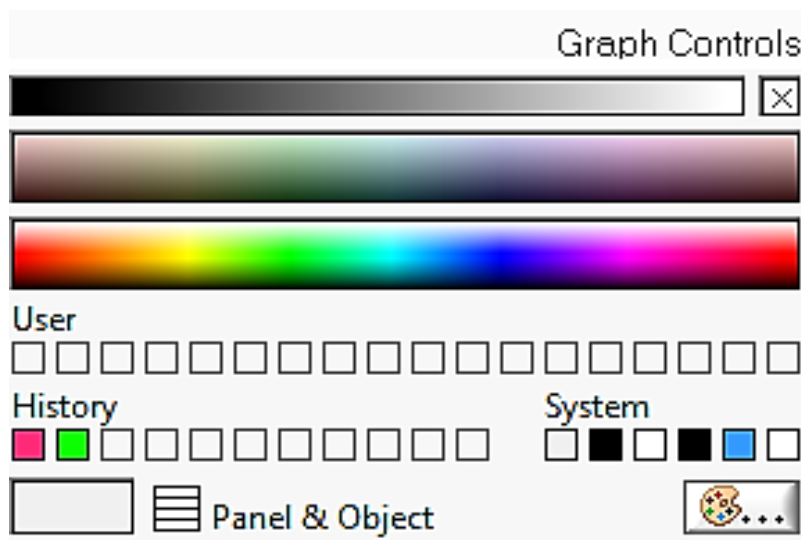


Figure 63: Background Color Control Selector

The color, line style and line width of the graph may be changed if desired, to improve visibility when displaying multiple plots. It may also be used when the default color selected by TracQ Basic does not provide enough contrast when using a customized background color. Data points may also be added to differentiate actual data taken and interpolation between the data points.

To update the graph color, right click once on the graph color shown next to the plot name. Then left click to bring up choices for adjusting the line appearance or data point style.

An example of customization is shown in Figure 65 and Figure 66. The plot in Figure 65 was taken of an Oriel Tunable Light Source (model TLS-300X). The data shows the Xenon lamp spectrum as recorded by a germanium detector. The monochromator input and output slits were set to .05  $\mu\text{m}$  width. In Figure 66, the starting and ending wavelengths were manually entered as noted in Section 6.1, the background was changed to light grey, data points were added and the graph color and line thickness were customized.

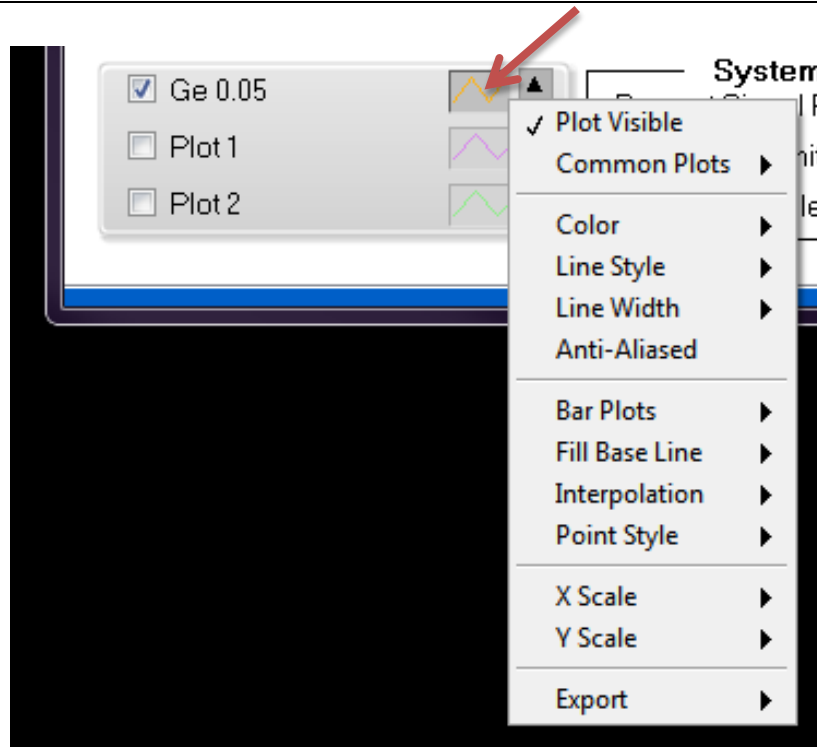


Figure 64: Plot Appearance Customization Menu

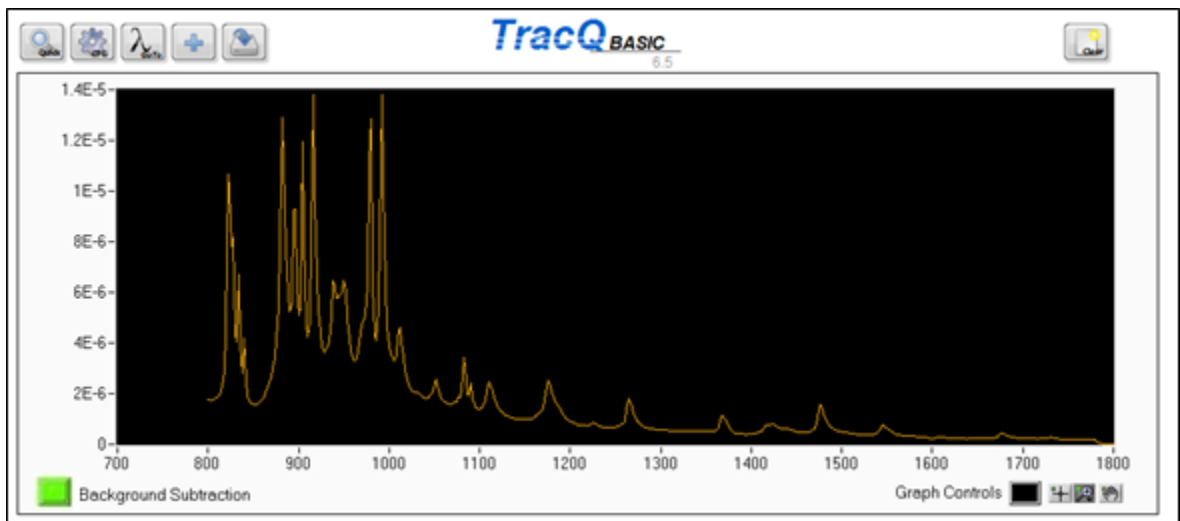


Figure 65: Standard Plot Scale and Appearance

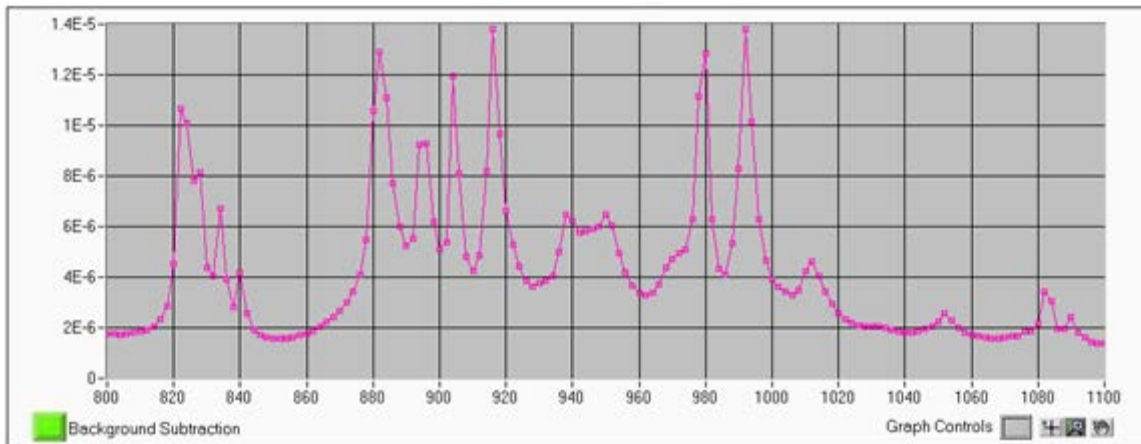


Figure 66: Customized Plot Scale and Appearance

### 6.3 CLEARING GRAPH WINDOW

To clear the plotting window of completed graphs, click the Clear icon in Figure 67. If it is desired to keep the data for future reference, always ensure scans are saved before clearing them. Clearing the screen is useful to avoid displaying too many plots and cluttering the screen.

Clearing the plotting window is suggested when loading scans with different Y-axis parameters and very different scales. For example, if the output power of a monochromator is measured using the same light source with very wide slits followed by then repeated using narrow slits, the plot for the narrow slits will appear nearly flat. This is because throughput decreases with the use of narrow slits.



Figure 67: Clear Graph Icon

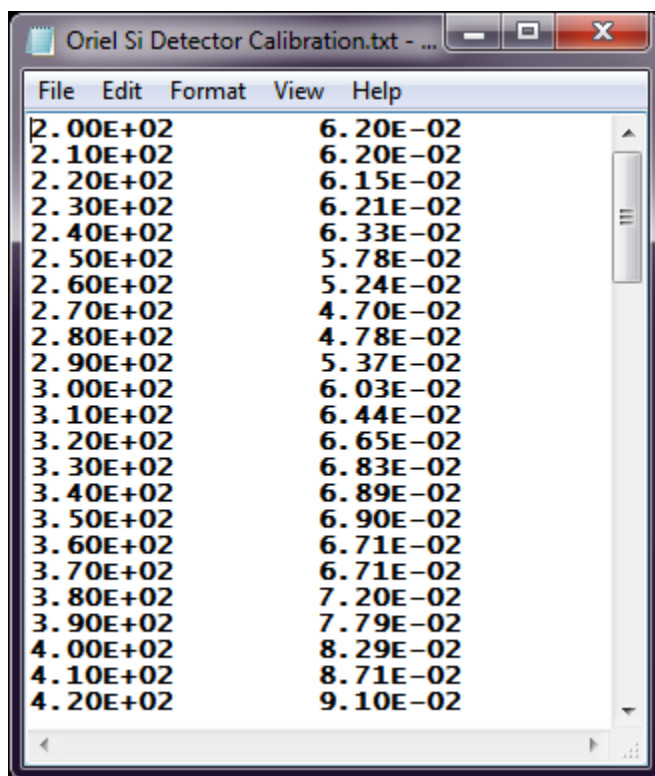


## 7 DATA FILES

### 7.1 REFERENCE FILES

Depending on the type of scan to be performed, it may be necessary to load reference data files. Examples could be a detector calibration or lamp calibration file. All files read by TracQ Basic must be text files saved in tab-delimited format. The left column lists the wavelengths in numerical order. The wavelengths must be in nanometers. The right column lists the lamp irradiance, detector spectral responsivity or other values.

Please note that blank lines cannot exist in any part of the file, including the last lines. Any blank line must be deleted.



File	Edit	Format	View	Help
2.00E+02				6.20E-02
2.10E+02				6.20E-02
2.20E+02				6.15E-02
2.30E+02				6.21E-02
2.40E+02				6.33E-02
2.50E+02				5.78E-02
2.60E+02				5.24E-02
2.70E+02				4.70E-02
2.80E+02				4.78E-02
2.90E+02				5.37E-02
3.00E+02				6.03E-02
3.10E+02				6.44E-02
3.20E+02				6.65E-02
3.30E+02				6.83E-02
3.40E+02				6.89E-02
3.50E+02				6.90E-02
3.60E+02				6.71E-02
3.70E+02				6.71E-02
3.80E+02				7.20E-02
3.90E+02				7.79E-02
4.00E+02				8.29E-02
4.10E+02				8.71E-02
4.20E+02				9.10E-02

Figure 68: Detector Calibration File Example

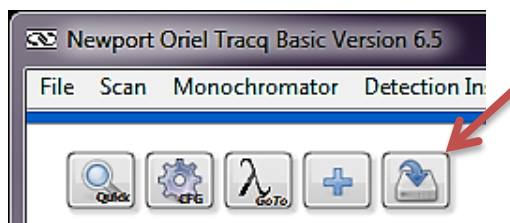
## 7.2 SAVING SCAN DATA

All scans that have been allowed to run to completion (not aborted) and are visible in the TracQ Basic plotting window (not cleared) may be saved. To save a file, click the icon shown in Figure 69. Files are saved in text tab delimited format. When multiple scans are available, a window opens up to allow the user to select the scan to save.

Figure 70 illustrates a Tunable Light Source (model TLS-300X) with its output power recorded by a calibrated silicon detector. Plots were taken using different monochromator slit width settings. These plots illustrate the relationship of resolution and throughput with respect to the slit widths chosen (narrow slits reduce throughput, but increase resolution).

To save these files or to rename the files, click the Save icon. Another window appears allowing the user to pick which scan should be saved. Previously unsaved scans are listed as Plot1, Plot2, etc. Clicking once on the scan name allows the scan to be previewed, so that the correct one is selected. After clicking "OK", navigate to the desired file location and enter the file name.

Please note that any scan that was aborted before completion will display in the plotting window until it is cleared. However, it cannot be saved.



**Figure 69: Save Scan File Icon**

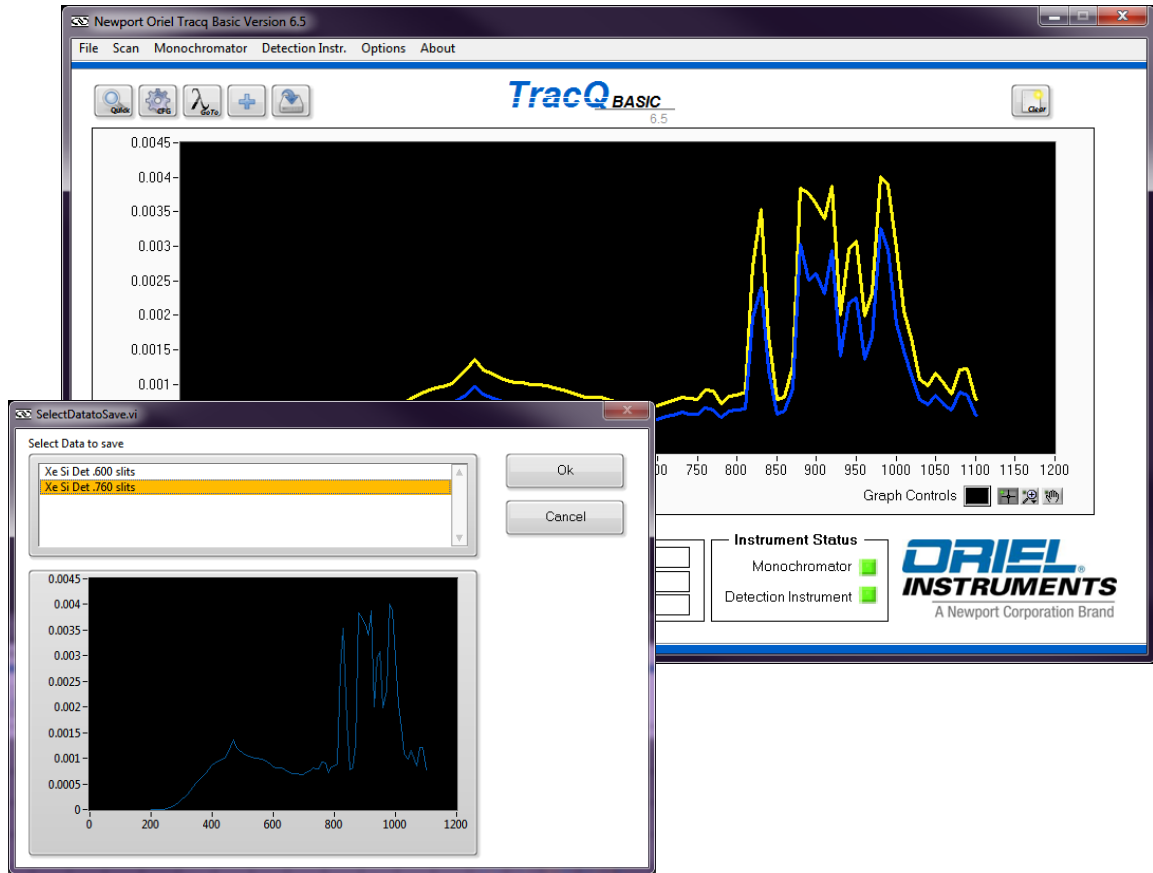


Figure 70: Selecting Scan to Save

### 7.3 OPENING DATA FILES

To load a previously saved scan or other data so that it is visible in the plotting window, click the Load Scan icon shown in Figure 71. In addition to being able to open data saved in TracQ, any text tab delimited data set matching the TracQ format may be loaded. One example of non-TracQ data could be opened is an Oriel detector calibration file.

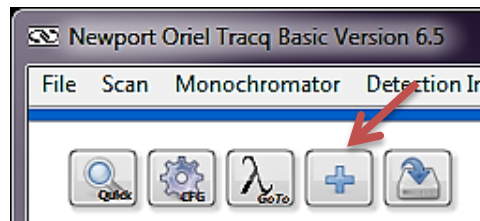


Figure 71: Load File Icon

## 8 BASIC WAVELENGTH SCAN

A basic wavelength scan is used as a reference scan when performing many different types of measurements. It is also used to create a scan for background subtraction. A basic wavelength scan is a plot of the detector's reading over a series of wavelengths. Depending on the setup, the detector readings may be in volts, watts or amps.

Volts are frequently used, as this is the output generated by a detector coupled to a transimpedance amplifier. If a lock-in digital amplifier is used as the detection instrument, the type of signal to be read is dependent on the model. The legacy Merlin models require a voltage. The LIDA-SRS-KIT and SR810 can read either voltage or current. However, voltage readings provide an advantage due to the greater dynamic range of the detection instrument when reading this type of signal. Newport's 19xx series power meters may read voltage, current or power. Power readings require a Newport detector with a calibrated PROM connected to the meter.

TracQ Basic graphs the wavelength scan with the y-axis labeled as volts by default, as this is the most common type of reading. The equations listed in Appendix 1 also list voltages as the unit of measure for reference and data scans. In the equations where the units cancel out, voltage may be replaced by current or power measurements.

When taking data, it is important to allow the light source enough warmup time to ensure stable performance. If the optical signal is being chopped (a requirement for a lock-in digital amplifier), ensure the chopper is locked into the desired frequency prior to taking data. If a monochromator is being used, ensure its built-in shutter is open, all other parameters are set up to ensure the correct grating, filter, and output ports are used. Ensure the detection instrument parameters are also set up.

### 8.1 SETTING UP SCAN PARAMETERS

Click the CFG icon shown in Figure 72 or go to the pulldown menu Scan → Setup Scan Wavelength Parameters. A window shall appear as shown in Figure 73. Enter the starting and ending wavelengths, wavelength interval (step size) and delay time between wavelengths. A delay time is typically suggested, to allow the reading to stabilize at each subsequent wavelength.

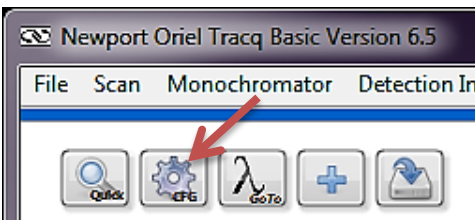


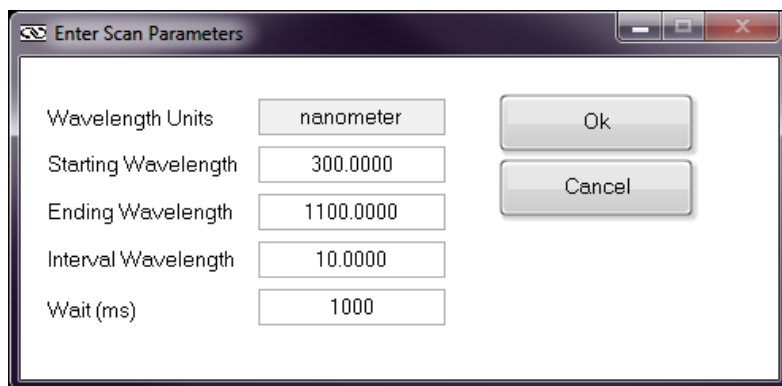
Figure 72: Scan Parameters Configuration Icon

The reference scan is typically followed by a data scan, such as Quantum Efficiency, Transmittance, etc. The parameters entered should be the same for both scans. The starting and ending wavelengths must be within the operating range of the detector. When data scans require calibration files, the wavelength range of this information must include the wavelengths covered by the scan. For example, if a scan is performed from 200 to 400 nm and the detector calibration file has spectral responsivity data from 300 to 1100 nm, this will result in an error.

The interval wavelength determines how often to take data. As an example, a scan from 800 to 850 nm with an interval wavelength of 10 nm will take data at 800, 810, 820, 830, 840 and 850 nm.

Deciding upon an appropriate interval wavelength is dictated by the needs of the application as well as the resolution of the system. Without taking the resolution of the system into account, a scan performed with many data points may not add to the accuracy of the data and will increase the time required for completion.

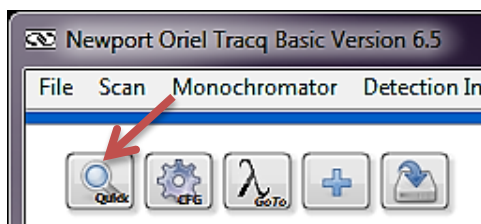
When using a monochromator, the resolution at the grating's blaze wavelength may be calculated as the slit width multiplied by the reciprocal dispersion, as provided with each Oriel grating. This does not take into account aberrations when using very narrow slits, but it is a good approximation in general. If the resolution of the monochromator is 10 nm, for example, performing a scan every 1 nm does not add any value to the data.



**Figure 73: Scan Parameters Configuration Icon**

## 8.2 PERFORMING A WAVELENGTH SCAN

To assist with aligning the detector or sample, go to a wavelength which the detector is sensitive to or an easily visible wavelength such as 555 nm. Once it is positioned, click the Quick Scan icon shown in Figure 52 to begin the scan. The scan shall begin immediately.



**Figure 74: Start Scan Icon**

If it is necessary to abort the scan, click the Abort icon as noted in Section 5.8. When the scan is finished, save the scan as noted in Section 7.2. Because the y-axis scale and unit type may be different for the data scan, it is suggested to clear the reference scan once it has been saved.

## 9 BACKGROUND SUBTRACTION

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Background light in the environment or light leakage in a system may result in data inaccuracy. For example, a dark box must be constructed to perform quantum efficiency measurements on a dye-sensitized solar cell. If the dark box is not completely light tight, the light leakage will introduce an offset into the measurements. In this situation, measurements should be taken for the background light and saved. When background subtraction is enabled, these background measurements are subtracted from the reference or data scan.

Background scans take time to perform and must be periodically retaken as light levels may vary over time. To save time, it is suggested to check the background light levels by running a basic wavelength scan with the light source turned off. If the light levels in the background scan will have a measurable effect on the final data, then enabling background subtraction is strongly suggested. Otherwise, it is not necessary.

Please note that in the case of very high background light levels, the detector will saturate. This may happen with unchopped light, or even with a lock-in digital amplifier, where chopped light must be utilized. Any unchopped background light, if intense enough, will essentially overwhelm the detector's sensor and negatively affect its ability to take readings. In cases such as this, enabling background subtraction will not resolve the situation. Excessively high background light levels must be eliminated by either using a closed optical path or making changes to the testing environment.

### 9.1 PERFORMING A BACKGROUND SCAN

The first step in performing a background scan is to prevent the signal from the light source used in the data taking process to reach the detector. If a monochromator is utilized, the built-in shutter must be closed. If a laser is used, it should not be on. If a broadband source is used, the source must be off and completely cool. It should be noted that the filament or electrodes in a lamp continue to glow for some time until it is completely cooled off.

Set up the basic wavelength scan parameters to be the same as the reference and data scans that shall be performed afterwards. Then run the scan and save the data. To locate this scan easily, it is suggested to include the word "background" in the file name.

## 9.2 ENABLING BACKGROUND SUBTRACTION

To load the background scan data, go to the pulldown menu Options → Background File → Load. The menu is shown in Figure 75. This will automatically enable background subtraction, which is shown by the green indicator light in TracQ Basic per Figure 76.

Once the scan has been loaded, it may be toggled on or off as shown in the pulldown menu. This is convenient when making comparisons to determine whether background subtraction makes a measurable difference in scan data.

When the software is exited and settings are saved, the background file remains loaded. Upon restarting TracQ Basic, background subtraction is toggled off. To continue using the loaded background scan, toggle on the background subtraction.

When the background subtraction file is no longer valid, it should be cleared. Reasons for invalidation include changes to the application setup (i.e. different monochromator slit widths) or changes in the background environment, such as switching on additional room lights. If it is desired to continue using background subtraction after conditions have changed, the background scan should be re-taken and the new background scan data loaded into TracQ Basic.

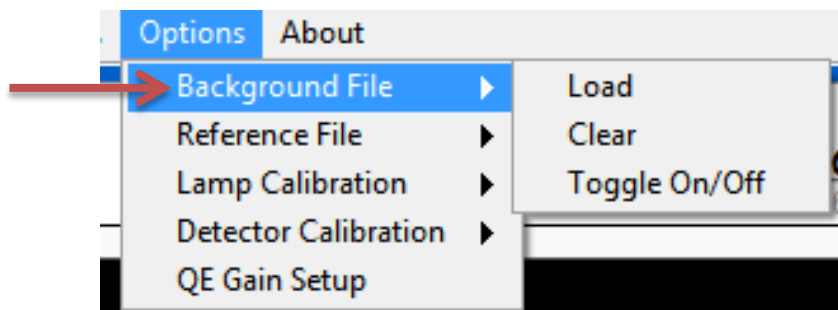


Figure 75: Background Subtraction Menu Choices

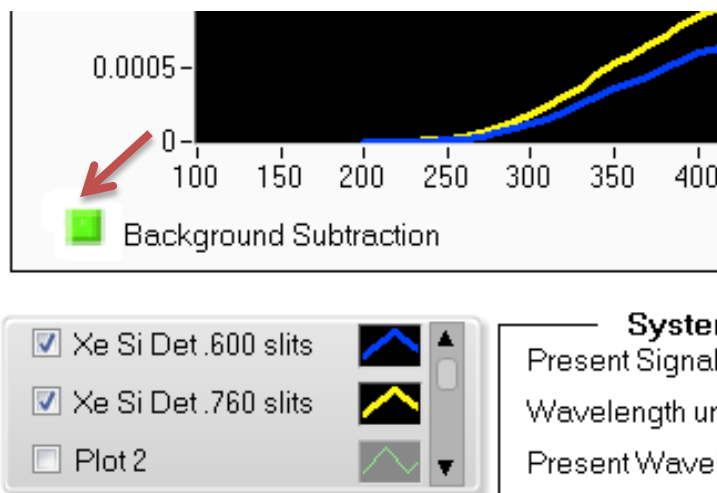


Figure 76: Background Subtraction Enabled

## 10 TIME INTERVAL SCAN

A time interval scan records the signal produced when a light source is read by a detector. The signal is read over a specified time range, with the user able to select how many times the signal is sampled within this time.

A time interval scan requires the use of a detection instrument to read the signal. The scan may be performed on the output of a monochromator or other light source. This type of scan may be used to determine the stability of a source. In the case of a pulsed source, a time interval scan can be used for characterization. Unlike other types of data scans, a reference scan is not needed. When a monochromator is used, the scan is performed at a single wavelength.

### 10.1 SETTING UP SCAN PARAMETERS

Go to the pulldown menu Scan → Setup Time Interval Scan as shown in Figure 77. Enter the length of time to perform the scan and the number of data points to take during the scan, as shown in Figure 78. As an example, set the timed interval to 1,000 ms and the number of data points to 20. TracQ Basic will wait take a reading once every second until 20 readings have been taken. With the first data point taken at time = 0, the scan is complete after 19 seconds have elapsed.

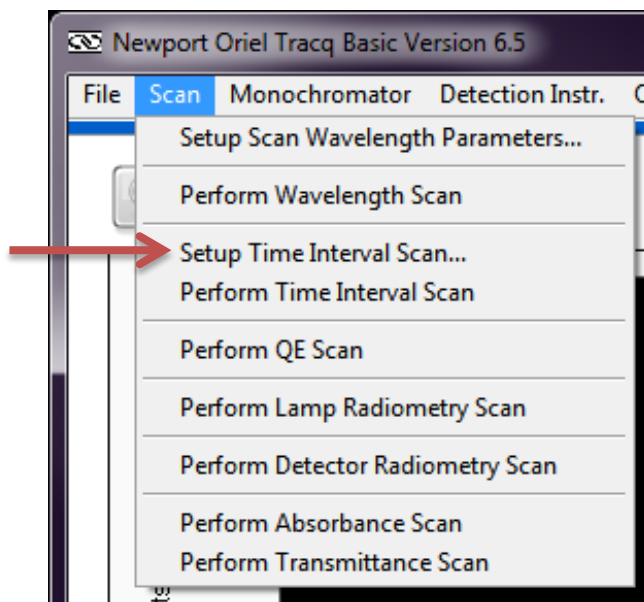


Figure 77: Setting Up a Timed Interval Scan

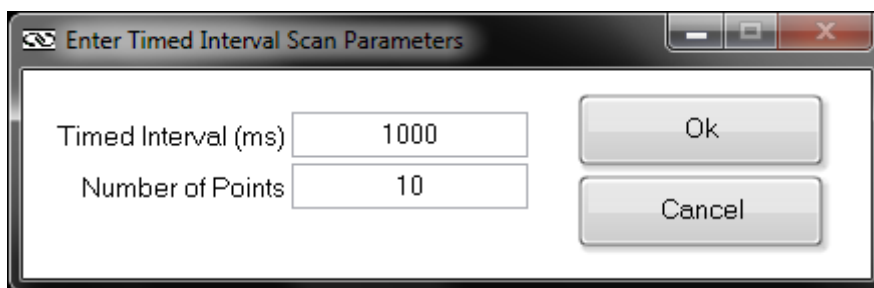


Figure 78: Timed Interval Scan Parameters



## 10.2 PERFORMING A TIME INTERVAL SCAN

When the source and detector are set up and aligned, begin the scan by going to the pulldown menu Scan → Perform Time Interval Scan as shown in Figure 79.

An example of a scan is shown in Figure 80. In this scan, a Xenon lamp was used at the input to a Cornerstone 130 monochromator and allowed to warm up for one hour. The monochromator's grating and order sorting filter were set for 840 nm, the location of a Xenon line. Data was taken using an amplified Oriel silicon detector and SR810 lock-in digital amplifier. The scan indicates the output signal level variation at this wavelength. Knowing the spectral responsivity of the detector at this wavelength would allow the user to easily convert this reading to power by using Equation 3.

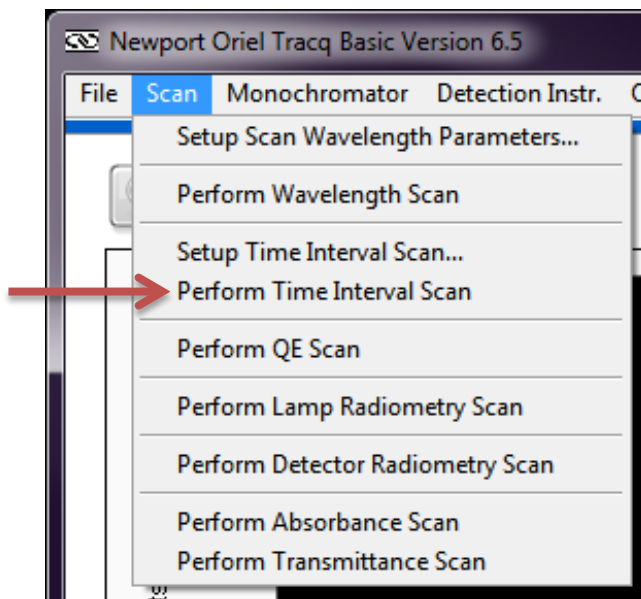


Figure 79: Performing Timed Interval Scan

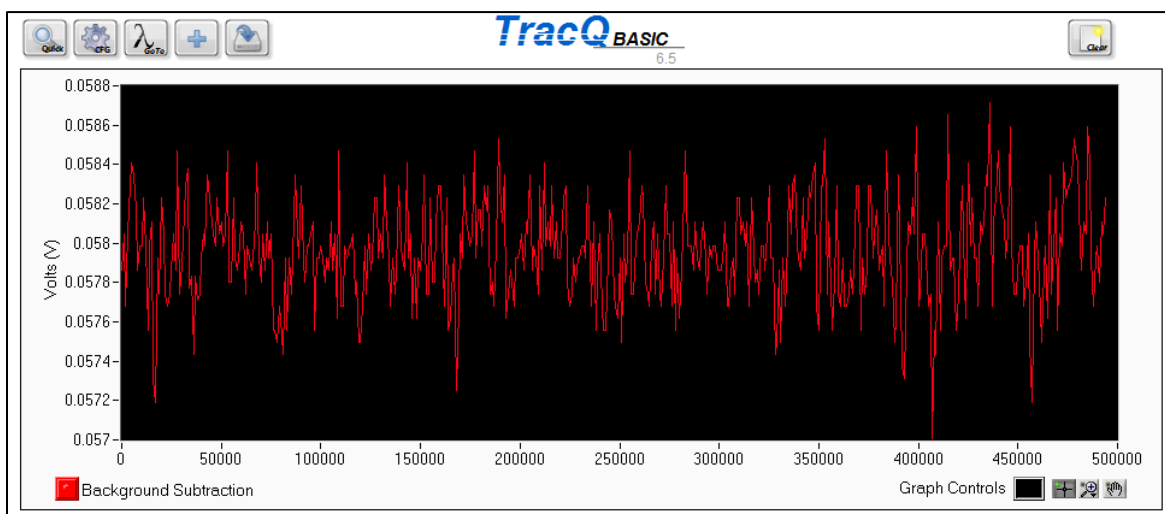


Figure 80: Example of Timed Interval Scan

## 11 QUANTUM EFFICIENCY (QE) SCAN

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There are two types of optoelectronic devices: one that creates photons by converting electrons and one that creates electrons by converting photon energy. Examples of the latter include a photodiode or a diode array, an imaging device such as a CCD or a CMOS camera, and a solar cell. Due to the band gap structure of these devices, light measurement is an essential to characterize the materials used to fabricate the device and the device themselves. The result is typically expressed as a plot of quantum efficiency (QE) or incident photon to charge carrier conversion efficiency (IPCE) as a function of wavelength.

The band gap structure in a semiconductor device introduces wavelength dependent absorptivity. A photon with energy larger than the band gap is typically absorbed by the material, while a photon with energy smaller than the band gap is transparent. The absorbed photon energy creates an electron-hole pair charge, which leads to creation of electricity.

The terms QE and IPCE indicate the ratio of the number of photons to the number of generated charge carriers. More specifically, QE can be divided into internal QE (IQE) or external QE (EQE). In the photovoltaics field IPCE and EQE are considered identical. Since the number of quanta (photons and charge carriers) are compared in QE measurements, percentage is used as the unit of measure. Typically, the result is recorded as a function of wavelength. When selecting a QE scan, TracQ Basic measures EQE.

Requirements:

Performing a QE scan requires the use of a detector that has been calibrated over the wavelength range to be examined. This data must be available in a text tab delimited file, with the wavelengths in nanometers. Calibrated detectors are available from Newport at [www.Newport.com](http://www.Newport.com).

Below is a summary of steps required to complete a QE scan:

1. Set up the scan wavelength parameters
2. Load reference detector calibration file
3. Place reference detector in light path
4. Take a basic wavelength scan
5. Save as a reference file
6. Place sample to be tested in light path
7. Load reference file
8. Select menu choice "Take QE Scan"
9. Enter preamplifier gain for sample
10. Select AC or DC measurement
11. Save completed QE scan data.

Prior to taking QE data, it is important to read Section 8 in order to perform a reference scan, as well as Section 9 in regards to background subtraction.

It is important that the reference detector and sample be placed so that their active areas are the same distance from the output of the monochromator. The light cannot overfill either the reference detector or the sample, as the mathematics assumes that both are receiving the same amount of light.

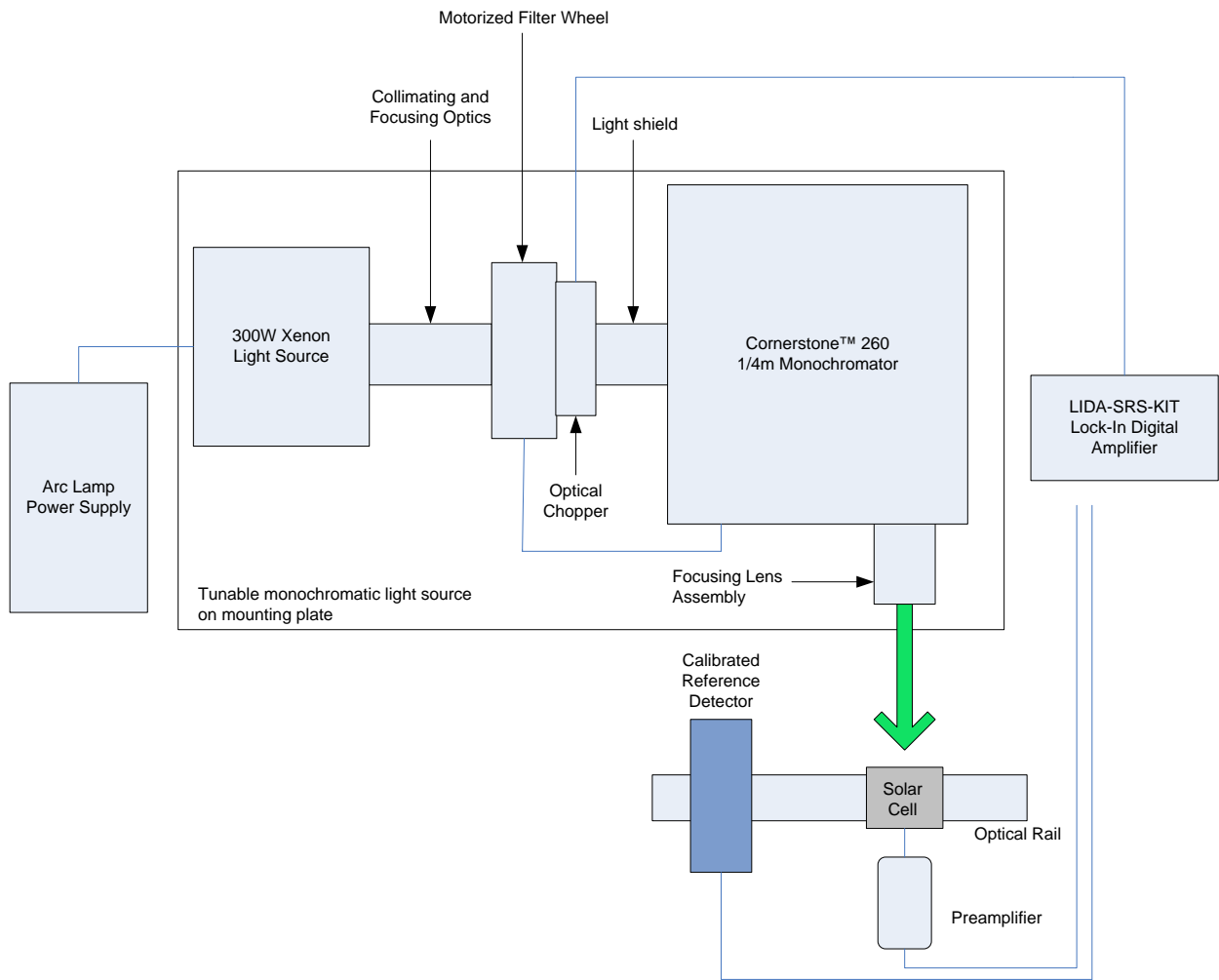


Figure 81: Example of QE Measurement System

## 11.1 CREATING A REFERENCE SCAN

Set up the scan wavelength parameters as described in Section 8 with wavelength units in nanometers. Load the reference detector calibration file into TracQ Basic, as shown in Figure 82. Position this detector in the path of light, and then perform a basic wavelength scan. A reference scan for a Xenon lamp is shown in Figure 83. If a quartz tungsten halogen (QTH) lamp is used as a light source, the reference scan will appear to be a smooth curve, as it does not have Xenon lines.

The file must be saved before proceeding with taking QE measurements. Once the reference scan is saved, clear the plotting window.

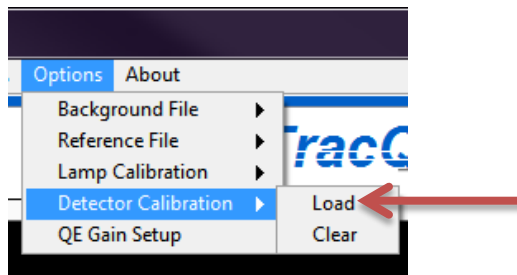


Figure 82: Loading a Detector Calibration File

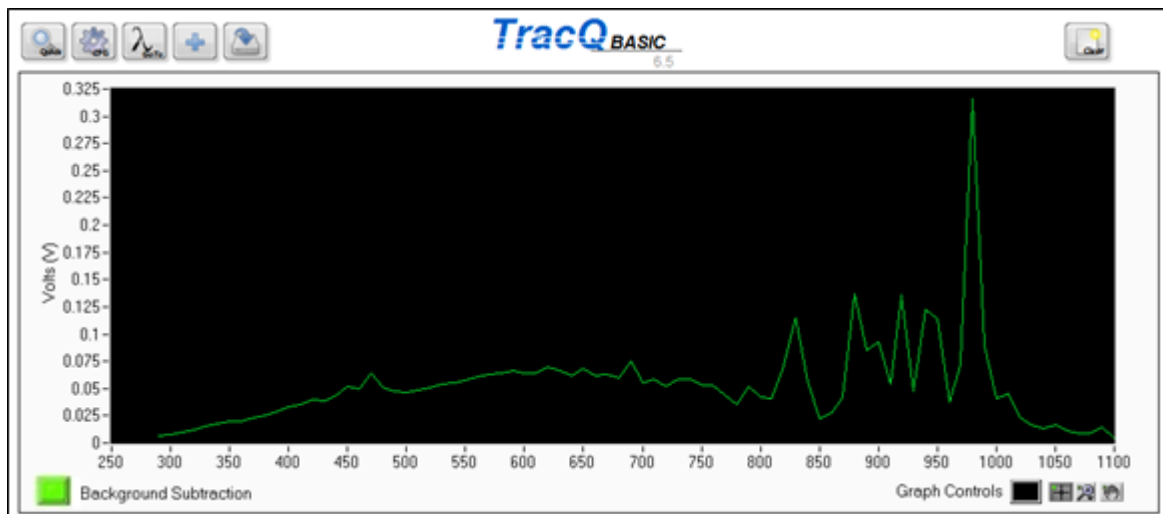


Figure 83: Reference Scan for Xenon Lamp

## 11.2 PERFORMING A QE SCAN

Load the reference scan file into TracQ Basic, as shown in Figure 84. Remove the calibrated reference detector from the light path and install the sample to be tested in its place. It is helpful to set the monochromator to a visible wavelength, such as 555 nm, to assist with locating the sample.

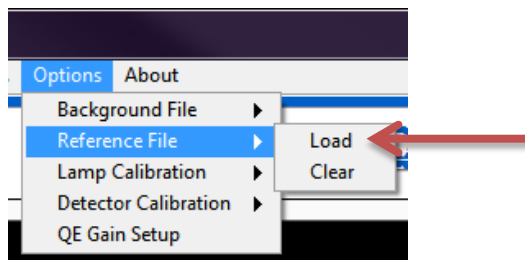


Figure 84: Loading a Reference File

All scan parameters, including grating and filter selection should remain the same as what were utilized during the reference scan. When ready, go to the pulldown menu Scan → Perform QE Scan to initiate the scanning process. Prior to starting the scan, the software will request information to be entered regarding the gains used and the type of QE scan desired.

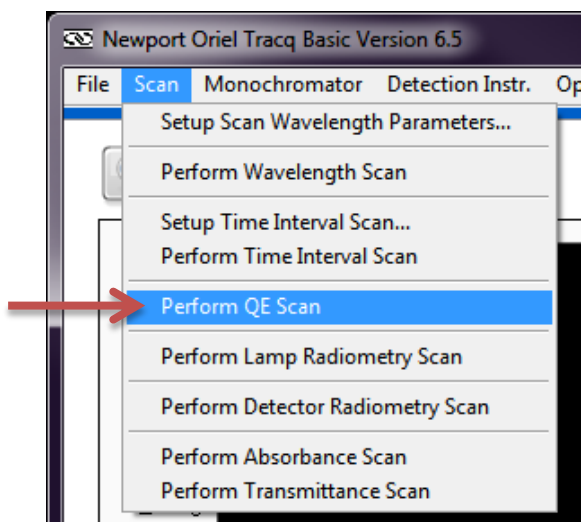
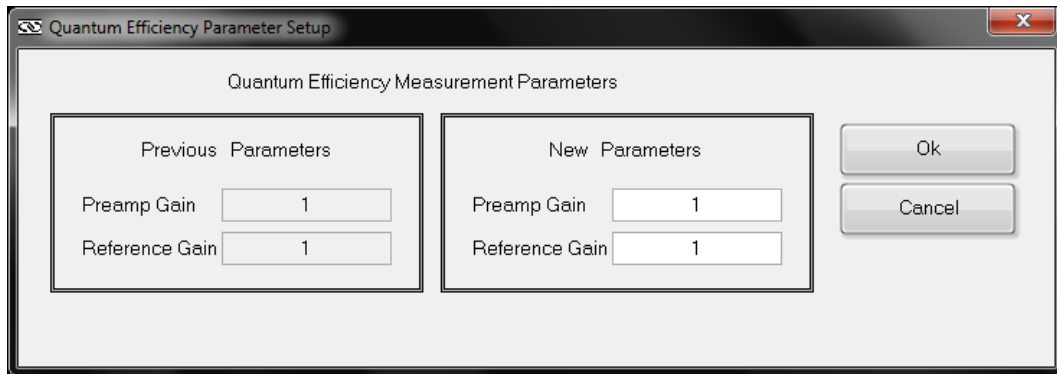


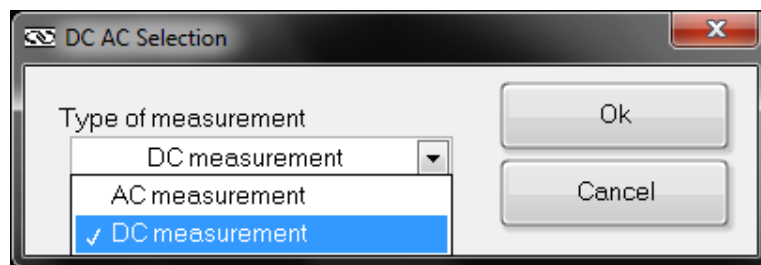
Figure 85: Initiating a QE Scan

Enter the gain values for the reference detector (labeled Reference Gain) and the sample (labeled Preamp Gain). If they are the same, the two values can be left as 1.

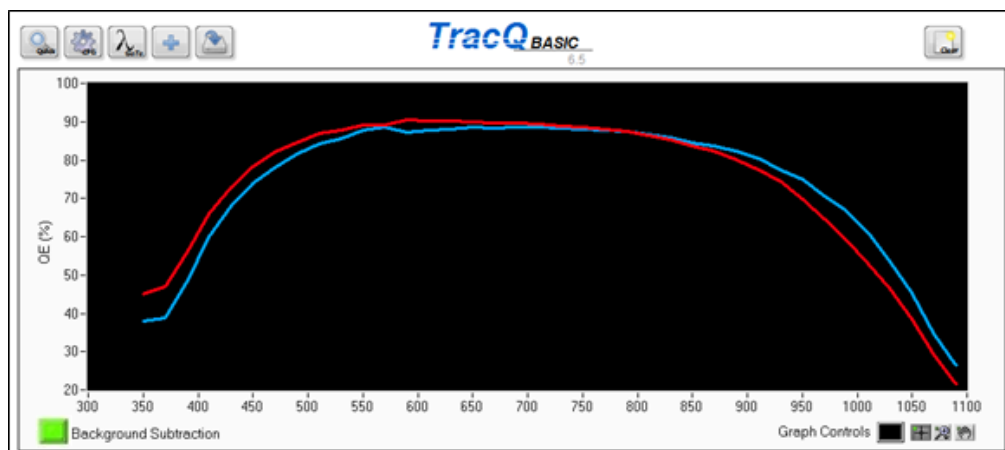


**Figure 86: QE Measurement Gain Settings**

When prompted, select the type of QE measurement to be performed. The choices are either AC or DC. AC indicates chopped light and DC is continuous light. Click "OK" to begin the quantum efficiency scan.



**Figure 87: QE Measurement Type Selection**



**Figure 88: Quantum Efficiency Scans for Two Silicon Solar Cells**

## 12 LAMP RADIOMETRY SCAN

A calibrated lamp is provided with irradiance values over a specified wavelength range. This type of lamp may be used to characterize the irradiance of an unknown light source. Lamps have limited lifespans, so a secondary standard may be created from the calibrated lamp. The secondary standard can then be used for everyday purposes, while the calibrated lamp would be used only when creating a new secondary standard.

Requirements:

Performing a lamp radiometry scan requires the use of a lamp that has been calibrated over the wavelength range to be examined. This data must be available in a text tab delimited file, with the irradiance values listed with respect to wavelength in nanometers. A number of calibrated Quartz Tungsten Halogen (QTH) lamps are available at [www.Newport.com](http://www.Newport.com).

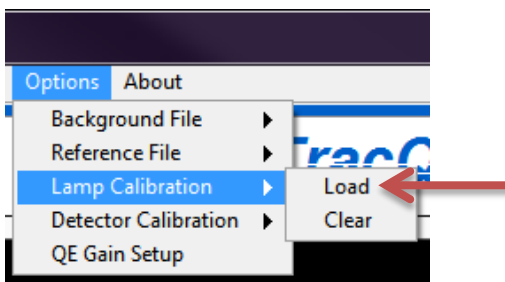
Below is a summary of steps required to complete a lamp radiometry scan:

1. Set up the scan wavelength parameters
2. Load reference lamp calibration file
3. Place reference lamp in light path
4. Take a basic wavelength scan
5. Save as a reference file
6. Place the lamp to be tested in light path
7. Load reference file
8. Select menu choice "Take Lamp Radiometry Scan"
9. Save completed scan data.

Prior to taking data, it is important to read Section 8 in order to perform a reference scan.

### 12.1 CREATING A REFERENCE SCAN

Set up the scan wavelength parameters as described in Section 8. Load the reference lamp calibration file into TracQ Basic, as shown in Figure 89. Position this lamp in the path of the monochromator, and then perform a basic wavelength scan.



**Figure 89: Loading a Lamp Calibration File**

The completed scan must be saved before proceeding with taking lamp radiometry measurements. Once the reference scan is saved, clear the plotting window.

## 12.2 PERFORMING A LAMP RADIOMETRY SCAN

Load the reference file into TracQ Basic, as shown in Figure 90. Remove the calibrated lamp from the light path and install the lamp to be tested in its place. The lamp under test should be in the same location as the reference lamp, such that the radiating area is the same distance from test setup. An example of a test setup is shown in Figure 92 that utilizes a dual output Oriel MS257™ monochromator enabling extended range scans without needing to break down the setup to change detectors.

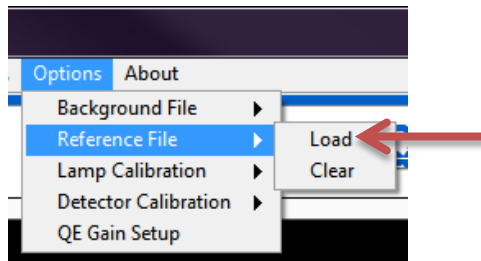


Figure 90: Loading a Reference File

All scan parameters, including grating and filter selection should remain the same as what were utilized during the reference scan. When ready, go to the pulldown menu Scan → Perform Lamp Radiometry Scan to initiate the scanning process. Figure 93 shows irradiance plots of Newport's 45 watt and 200 watt calibrated quartz tungsten halogen (QTH) lamps

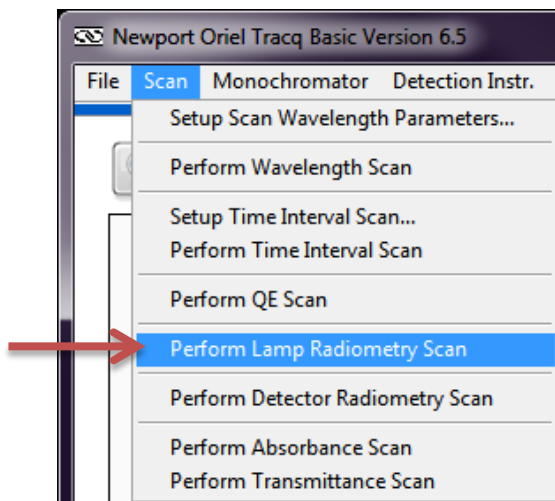


Figure 91: Initiating a Lamp Radiometry Scan



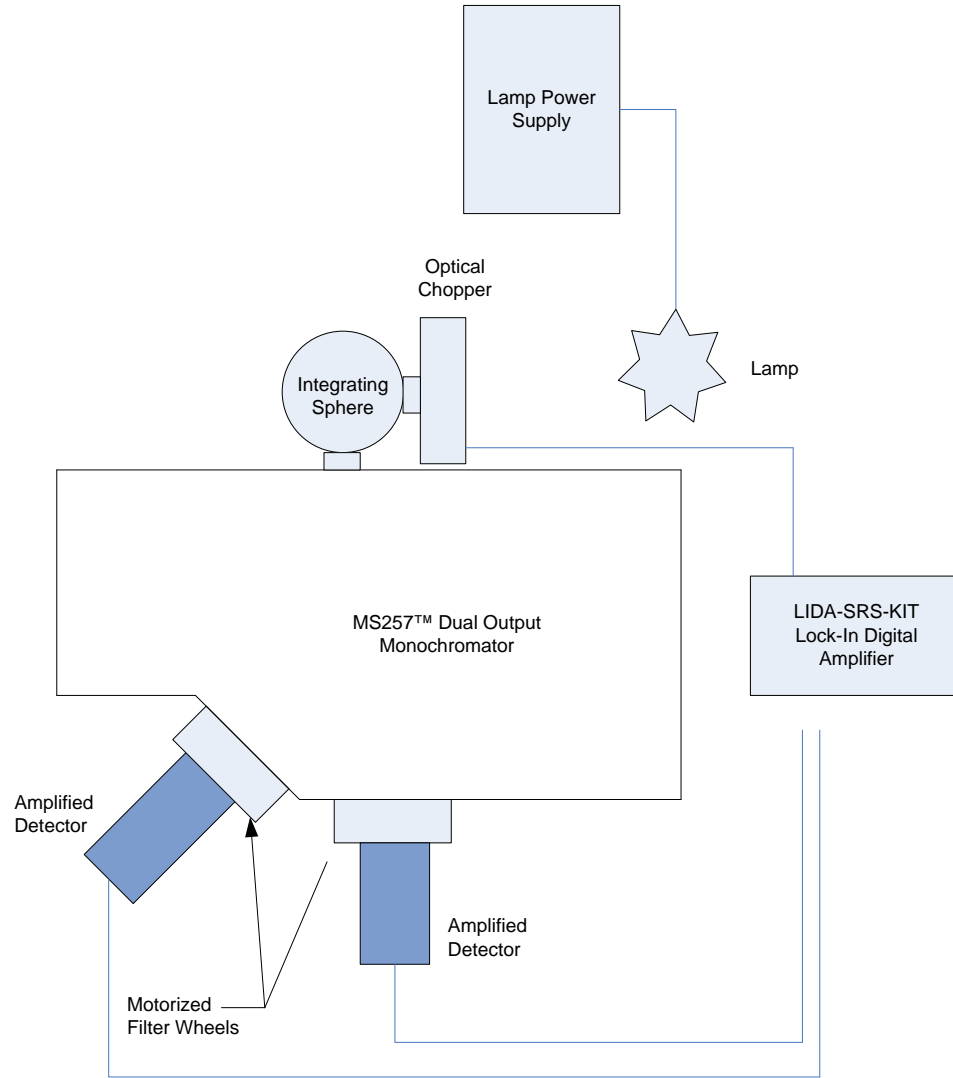


Figure 92: Example of Lamp Irradiance Measurement System

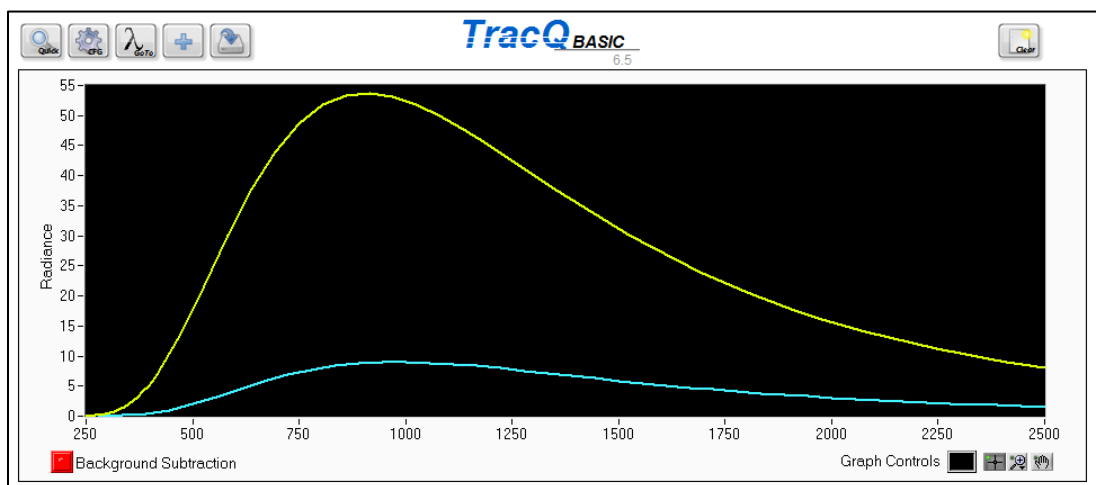


Figure 93: Irradiance of 45W and 200W QTH Lamps

## 13 DETECTOR RADIOMETRY SCAN

A detector radiometry scan measures optical power using an optical detector with a known electrical response to specific wavelengths.

An unamplified detector produces a current output. Models with a built-in preamplifier or a separate preamplifier connected to the detector output produce a voltage output. In order to measure power, it is necessary to know the detector's spectral responsivity over the wavelength(s) being measured. Detectors that have been characterized in terms of their spectral responsivity are referred to as "calibrated" detectors.

Requirements:

Performing a detector radiometry scan requires the use of a detector that has been calibrated over the wavelength range to be examined. This data must be available in a text tab delimited file, with the spectral responsivities listed with respect to wavelength in nanometers. Calibrated detectors are available from Newport at [www.Newport.com](http://www.Newport.com).

Below is a summary of steps required to complete a detector radiometry scan:

1. Set up the scan wavelength parameters
2. Load reference detector calibration file
3. Place reference detector in light path
4. Take a basic wavelength scan
5. Save the scan

Prior to taking detector radiometry data, it is important to read Section 8 in order to perform a reference scan, as well as Section 9 in regards to background subtraction.

### 13.1 SETTING UP SCAN PARAMETERS

Set up the scan wavelength parameters as described in Section 8. Load the reference detector calibration file into TracQ Basic, as shown in Figure 94. Position this detector in the path of light.

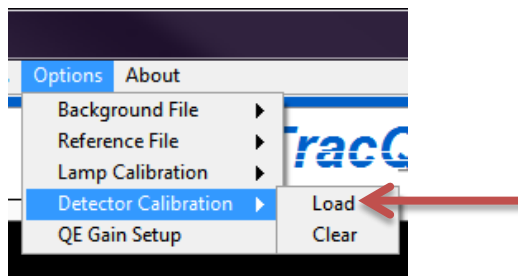
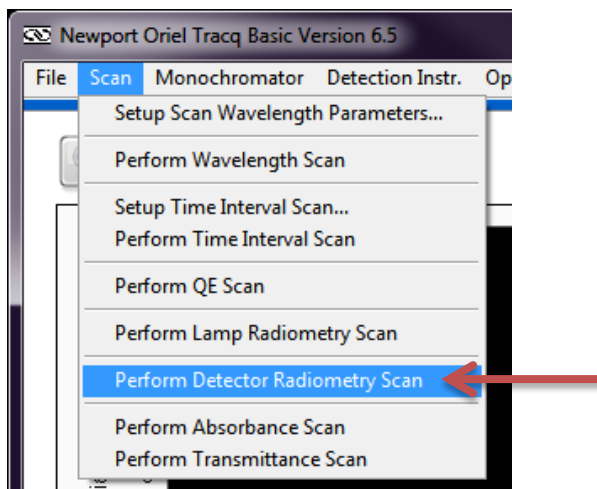


Figure 94: Loading a Detector Calibration File

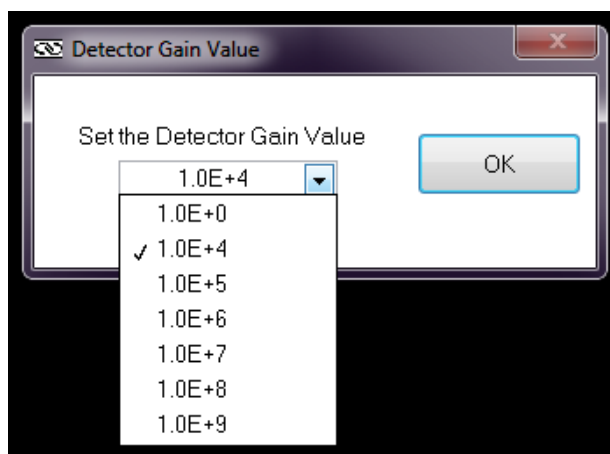
## 13.2 PERFORMING A DETECTOR RADIOMETRY SCAN

When ready, go to the pulldown menu Scan → Perform Detector Radiometry Scan to initiate the scanning process per Figure 95.



**Figure 95: Initiating a Detector Radiometry Scan**

Prior to starting the scan, the software will request information to be entered regarding the gain setting for the calibrated detector. Available gain value selections are shown in Figure 96. These values correspond to unamplified detectors, Oriol amplified calibrated detectors and unamplified detectors coupled to the Oriol model 70710 Current Preamplifier. These gain switches are shown in Figure 97.



**Figure 96: Setting Calibrated Detector Gain**



Figure 97: Gain Settings on Oriel Detector and Preamplifier

Figure 98 shows the spectrum obtained from an Oriel calibration line lamp. This data was obtained using a Cornerstone 260 monochromator, power meter model 2936-R and calibrated detector model 918D-UV-OD3.

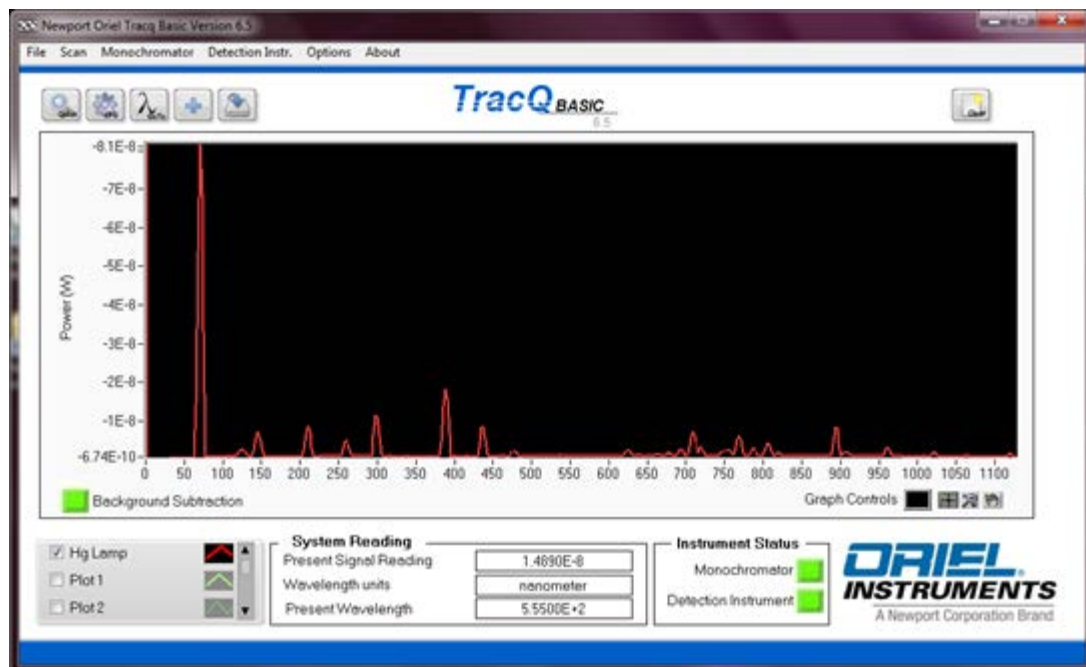
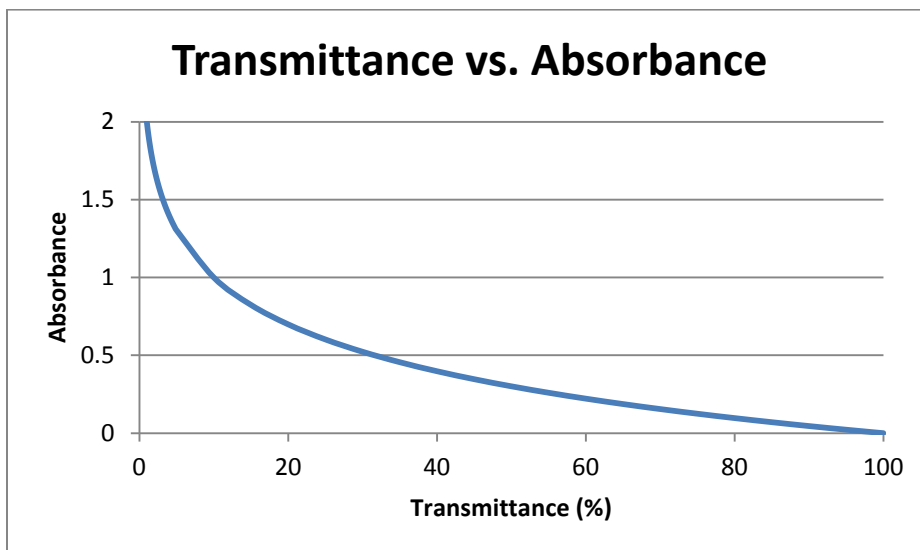


Figure 98: Power Measurement of an Oriel Calibration Line Lamp

## 14 ABSORBANCE SCAN

Absorbance measurements are performed to quantify the amount light is absorbed by a sample at various wavelengths. Light is shone through a sample, after which is placed an optical detector. Absorbance (A) is related to transmittance (T) as  $A=2-\log_{10}\%T$ . Absorbance scans are frequently performed to quantify the concentration of a substance in a solvent, although absorbance measurements may be performed on any number of materials permeable to light.



Absorbance is related not only to the concentration of a solution, but also to the cell path length, per Beer's Law. When measuring absorbance of a solution vs. the solvent, it is important to use cuvettes or other vessels with the same path length.

Below is a summary of steps required to complete an absorbance scan:

1. Set up the scan wavelength parameters
2. Place the reference solvent in light path
3. Take a basic wavelength scan
4. Save the reference scan
5. Clear the graph from the plotting window
6. Load reference file into TracQ Basic
7. Place sample in the light path
8. Take an absorbance scan
9. Save completed absorbance scan data.

Prior to taking absorbance data, it is important to read Section 8 in order to perform a reference scan, as well as Section 9 in regards to background subtraction.

## 14.1 GENERATING REFERENCE SCAN DATA

A solution is created by dissolving a substance into an appropriate solvent. The baseline, or reference, measurement is obtained by placing a cuvette or other vessel into the output path of a monochromator, followed by a detector sensitive to the wavelength range of interest. The reference measurement is performed on the solvent alone.

Set up the scan wavelength parameters as described in Section 8. Once the scan is completed, it must be saved before proceeding with taking absorbance measurements. Once the reference scan is saved, clear the plotting window.

## 14.2 PERFORMING AN ABSORBANCE SCAN

Load the reference scan file into TracQ Basic, as shown in Figure 99. Remove the vessel containing the plain solvent from the light path and install the sample to be tested in its place.

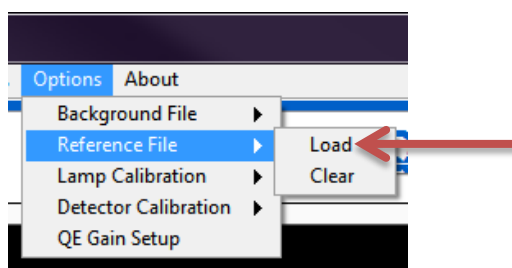


Figure 99: Loading a Reference File

All scan parameters, including grating and filter selection should remain the same as what were utilized during the reference scan. Ensure the path length is the same for the solution as was used for the reference scan. When ready, go to the pulldown menu Scan → Perform Absorbance Scan to initiate the scanning process.

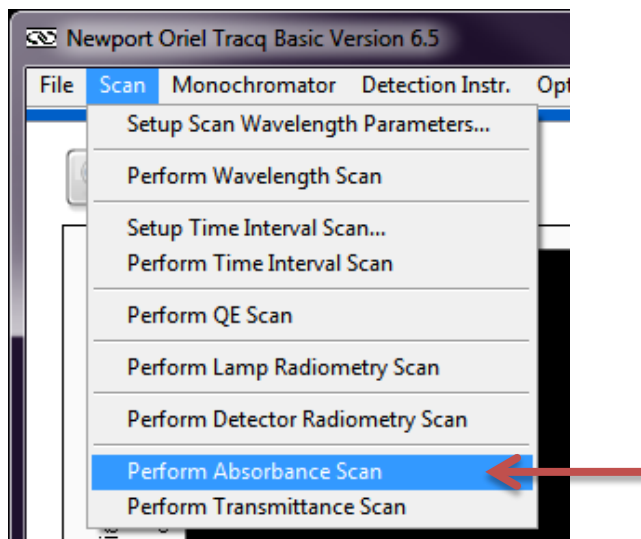
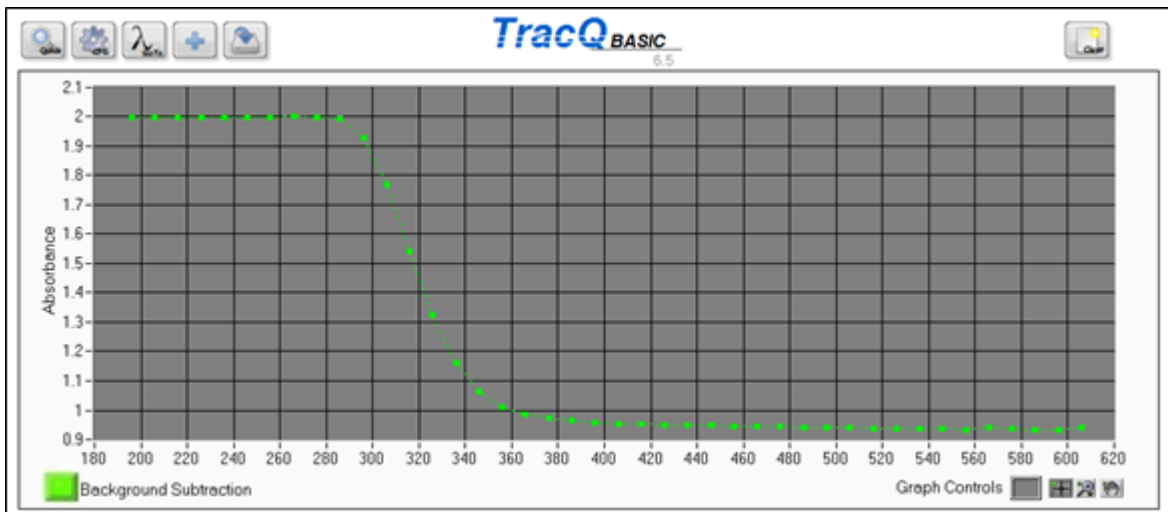


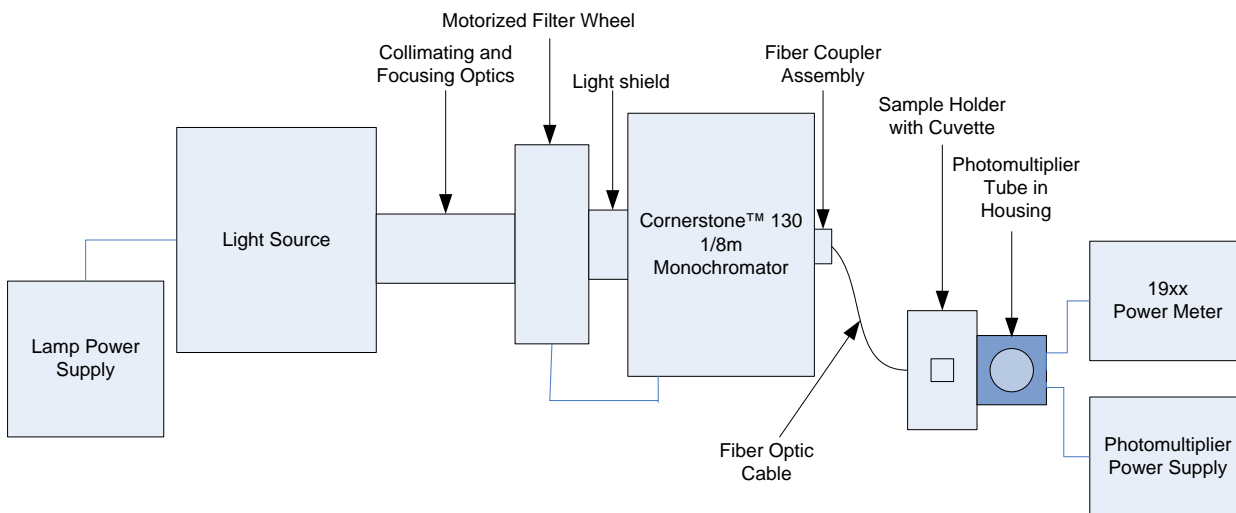
Figure 100: Initiating an Absorbance Scan

Figure 101 illustrates an absorbance scan of the Oriel model 6057 safety filter. Although it is a solid and not a liquid solution filter, this example is shown to compare the measurements obtained against the transmittance scan of the same filter shown in Figure 105.



**Figure 101: Absorbance Scan of 6057 Safety Filter**

Figure 102 is a diagram of a common absorbance scan measurement setup. In this system, a fiber is coupled from the output of a monochromator to the Oriel mode 30750 sample compartment. A solution contained in a cuvette, which is placed in the sample holder. A photomultiplier tube is located after the solution, and its signal is read by a Newport model 19xx power meter.



**Figure 102: Example of Absorbance Measurement System**

## 15 TRANSMITTANCE SCAN

Transmittance measurements are performed to quantify the amount light capable of passing through a sample at various wavelengths. Light is shone through a sample, after which is placed an optical detector. Transmittance is expressed as a percentage, with 100% indicating that all light passes through a sample. Prior to performing the transmittance scan, a reference scan is performed with no sample in the light path as a baseline measurement.

It is important to note that the light must reach the detector when the sample is in place. Leaving the detector in the same location as the reference scan assumes the index of refraction equals 1, so that the light is not bent (which would miss the active area of the detector). It should also be noted that with samples that diffuse light, both the reference and sample scans should be performed by collecting the light with an integrating sphere.

### 15.1 SETTING UP SCAN PARAMETERS

Set up the scan wavelength parameters as described in Section 8. Position this detector in the path of light. Once the scan is completed, it must be saved before proceeding with taking transmittance measurements. Once the reference scan is saved, clear the plotting window.

### 15.2 PERFORMING A TRANSMITTANCE SCAN

Load the reference scan file into TracQ Basic, as shown in Figure 103. Place the sample to be tested between the light source and the detector. All scan parameters, including grating and filter selection should remain the same as what were utilized during the reference scan. When ready, go to the pulldown menu Scan → Perform Transmittance Scan to initiate the scanning process.

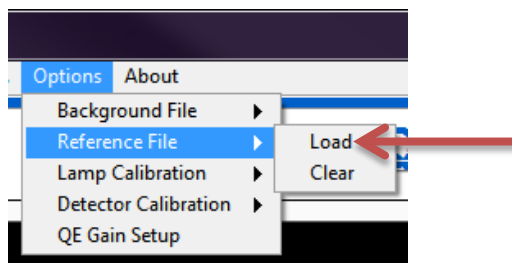


Figure 103: Loading a Reference File

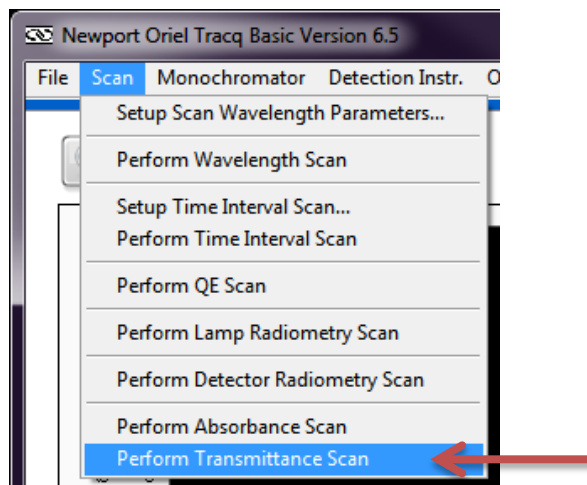
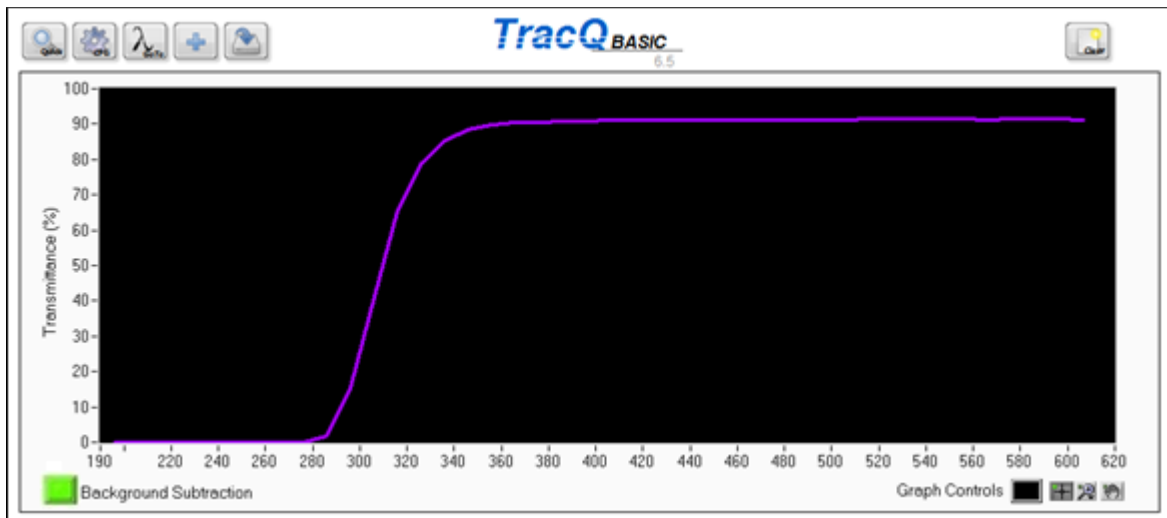


Figure 104: Initiating a Transmittance Scan

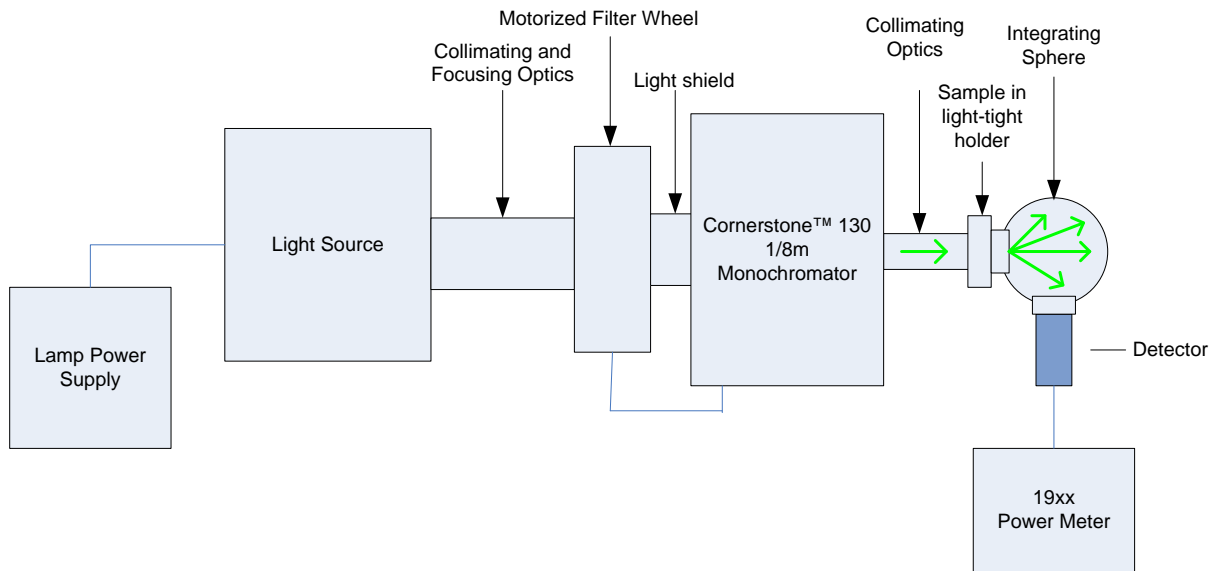


Figure 105 illustrates the transmittance of the Oriel model 6057 safety filter used with calibration line lamps.



**Figure 105: Transmittance Scan of 6057 Safety Filter**

Figure 106 shows a transmittance measurement system where the sample diffuses light. The light is captured using an integrating sphere. Note that the illustration does not show the interior baffle arrangement of the integrating sphere. The baffle must be located between the light input port and the detector port, so that the light must bounce off at least two surfaces before striking the detector. Light directly hitting the active area of the detector will result in measurement errors.



**Figure 106: Example of Transmittance Measurement System**

## 16 TROUBLESHOOTING

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The following troubleshoot section details potential sources of error with respect to using TracQ Basic. Please refer to the user manuals for each instrument being utilized for information on hardware troubleshooting. If the documentation provided does not resolve the issue, please contact Newport Corporation or the representative through whom the equipment was purchased for assistance.

### 16.1 SOFTWARE INSTALLATION DIFFICULTIES

- Ensure the user installing the software has administrator privileges. Check with the facility's IT department if unsure.
- Plug the USB memory stick containing the TracQ Basic installation software into a different USB port.
- Install the software on another computer

### 16.2 INSTRUMENT COMMUNICATION ERRORS

- Ensure all instruments are plugged in and turned on before starting TracQ Basic.
- If a USB cable is used to convert from GPIB or RS232, ensure its driver is installed and is compatible with National Instruments software.
- For RS232 and GPIB instrument, or when using a USB converter cable, check the Windows Device Manager and/or NI Max to check the port or addresses used by the instruments.
- Install Newport power meter application as part of the TracQ Basic setup. Do not install this application separately, either before or after TracQ is installed. If necessary, uninstall the power meter application and TracQ, and then reinstall TracQ.
- Ensure the correct operating system was selected during installation of TracQ Basic. If unsure, uninstall TracQ and reinstall it.
- If utilizing a monochromator hand controller, press the Local key to resume computer control. If communication is lost, re-select the instrument libraries or restart both TracQ and the instrument.
- Do not use front panel display controls in the legacy Merlin lock-in digital amplifier while simultaneously controlling the instrument through TracQ. If the instrument stops responding, reset the Merlin and then restart the software.

### 16.3 FILE MESSAGE ERRORS

- Any file utilized by TracQ Basic must be in text tab delimited format. Open the file in Windows Notepad to check the file type.
- Certain types of scans require a calibration or reference file to be loaded prior to initiating the scan. The requirement for each scan type is detailed in this user manual.
- A scan reported as being out of range has a wavelength range that does not match the calibration or reference file that is loaded. Recheck the scan parameters or load the correct file(s).

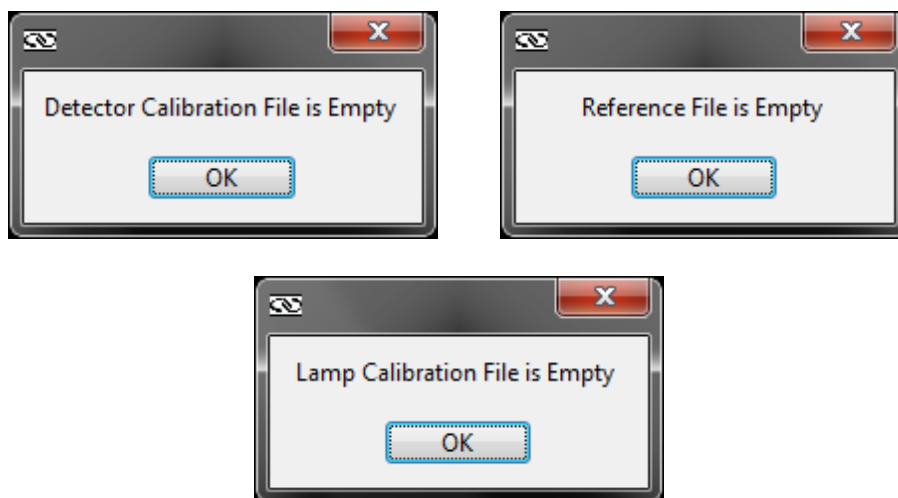


Figure 107: Empty File Error Messages

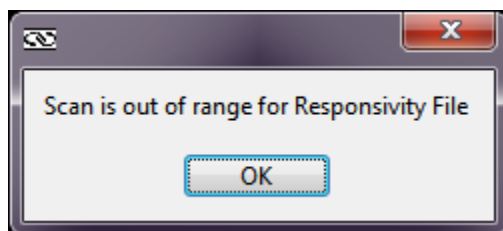


Figure 108: Out of Range Error Message

## 16.4 GRAPH DISPLAY ERRORS

- Data displaying incorrectly may be due to extra empty lines at the bottom of the file. Clear the graph, open the file in Notepad and delete any blank lines at the bottom of the file. Then re-load the scan.

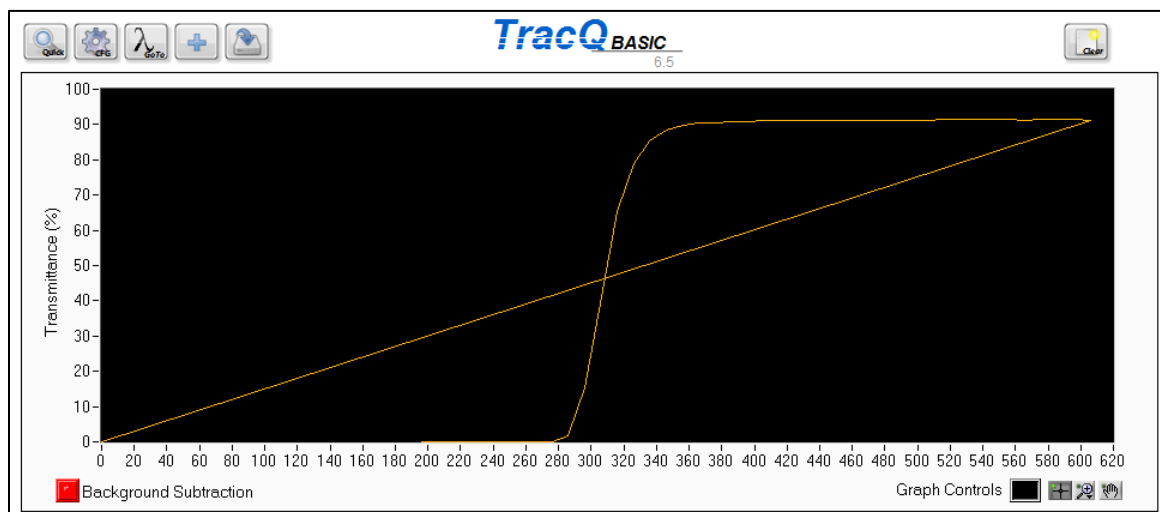


Figure 109: Graph Display Error

## 16.5 SETTINGS NOT SAVED

- Upon exiting TracQ Basic, a prompt appears asking if the software settings should be saved. Select “Yes”.
- Ensure the user’s computer privileges allow saving settings to the .ini files used by TracQ Basic.

## 16.6 NO LIGHT OR INCORRECT WAVELENGTH OUTPUT

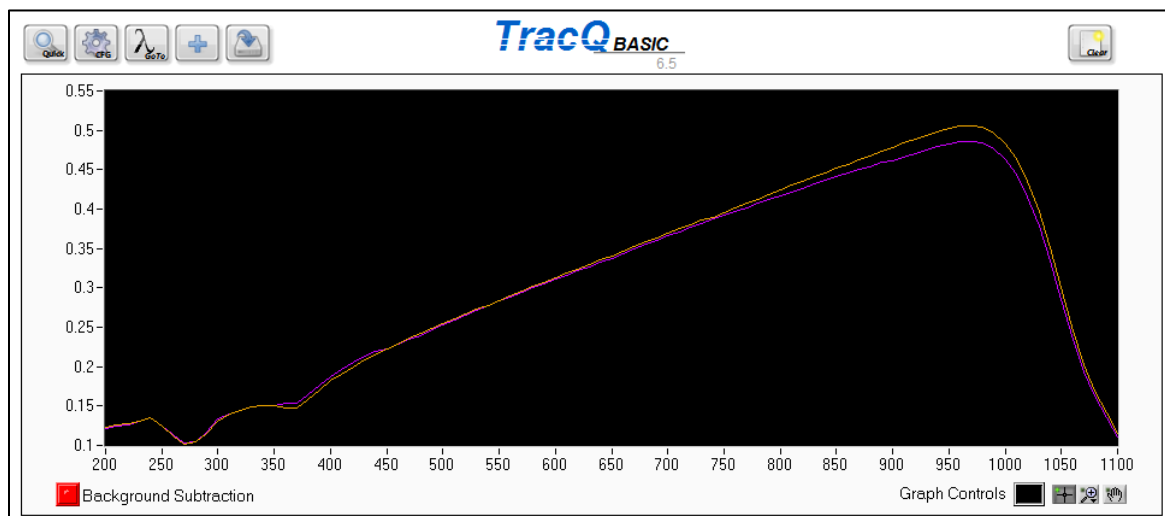
- Ensure the light source has been turned on.
- Check that the monochromator shutter is open.
- Ensure the monochromator is set to a visible wavelength in TracQ Basic.
- If wavelength output is not correct, when automatic filter and grating tables are utilized, ensure the tables are filled out correctly and “Auto” is select for both the grating and the filter.
- If wavelength output is not correct and the MS257 is utilized, ensure the correct filter wheel is selected.
- Ensure filters are correctly selected, installed into the filter wheel(s) and in the expected positions.

## 16.7 SCANNED DATA ERRORS

- Ensure calibration, reference or background files were not inadvertently overwritten. Any text tab delimited file may be loaded in TracQ Basic and viewed directly.
- Check if the correct files are loaded for the type of scan being performed.
- Check if background subtraction is enabled.
- An open system with high levels of unchopped background light may saturate the detector.
- Ensure detector and sample are not overfilled when performing QE scans.

## 16.8 INCONSISTENT DATA

- Ensure the light source was given enough time to warm up and stabilize. If the light source is not needed for short amounts of time, close the shutter rather than turn off the lamp. This allows the lamp to remain warmed up and extends lamp life.
- Determine if the calibrated detector requires recalibration. Spectral responsivity changes over time, particularly when the detector is subjected to UV light. The spectral responsivity plot in Figure 110 is of the exact same detector, with calibration data taken five years apart. Newport suggests annual recalibration of detectors.
- Determine if the monochromator or spectrograph is due for recalibration. Newport suggests annually recalibrating the instrument.
- Ensure the lamp is aligned correctly, particularly if the lamp was replaced prior to the data inconsistencies appearing.
- Lamp output may change as it ages, particularly at UV wavelengths. Replace the lamp when it is at the end of its life and consider using the light intensity control feature provided with the Newport OPS series power supplies.



**Figure 110: Detector Spectral Responsivity Changes**

## 17 APPENDIX 1: EQUATIONS

Depending on the setup, the detector readings may be in volts, watts or amps. Volts are frequently used, as this is the output generated by a detector coupled to a transimpedance amplifier. If a lock-in digital amplifier is used as the detection instrument, the type of signal to be read is dependent on the model. The legacy Merlin models require a voltage. The LIDA-SRS-KIT and SR810 can read either voltage or current. However, voltage readings provide an advantage due to the greater dynamic range of the detection instrument when reading this type of signal. Newport's 19xx series power meters may read voltage, current or power. Power readings require a Newport detector with a calibrated PROM connected to the meter.

TracQ Basic graphs the wavelength scan with the y-axis labeled as volts by default, as this is the most common type of reading. The equations listed in Appendix 1 also list voltages as the unit of measure for reference and data scans. In the cases where the units cancel out, voltage may be replaced by current or power measurements. Both the reference and QE scans are conducted in nanometers as the chosen wavelength unit.

### 17.1 QUANTUM EFFICIENCY

$$QE = \left[ \frac{(V)(CR)(1240)}{\lambda} \right] \left[ \frac{SR_{det}}{V_{ref}} \right] \left[ \frac{G_{ref}}{G_{preamp}} \right]$$

Equation 1: Quantum Efficiency

$V$	Background subtracted voltage as read from the device under test
$CR$	Correction multiplier for DC or AC measurement AC correction factor = 2.2 DC correction factor = 1
$\lambda$	Wavelength in nanometers
$SR_{det}$	Wavelength interpolated spectral responsivity value for a calibrated detector in nanometers
$V_{ref}$	Voltage loaded from a reference scan performed with a calibrated detector
$G_{ref}$	Gain set for the calibrated detector when performing the reference measurement
$G_{preamp}$	Preamp gain set for the sample detector cell

## 17.2 LAMP RADIOMETRY

$$Irr = L_{lamp} \left[ \frac{V}{V_{ref}} \right]$$

**Equation 2: Lamp Radiometry**

$L_{lamp}$	Irradiance exitance of calibrated lamp
$V$	Background subtracted voltage as read from the lamp under test
$V_{ref}$	Reference voltage scan performed using calibrated lamp

## 17.3 DETECTOR RADIOMETRY

$$E = \left[ \frac{V}{G} \right] \left[ \frac{1}{SR_{det}} \right]$$

**Equation 3: Detector Radiometry**

$V$	Background subtracted voltage as read from the detector
$G$	Gain of the detector
$SR_{det}$	Spectral responsivity of the detector

## 17.4 ABSORBANCE

$$ABS = \log_{10} \left[ \frac{V}{V_{ref}} \right]$$

**Equation 4: Absorbance**

$V$	Background subtracted voltage
$V_{ref}$	Measured voltage from a reference scan

## 17.5 TRANSMITTANCE

$$T = 100 \times \left[ \frac{V}{V_{ref}} \right]$$

**Equation 5: Transmittance**

$V$	Background subtracted voltage
$V_{ref}$	Measured voltage from a reference scan



## 18 APPENDIX 2: PULLDOWN MENU STRUCTURE

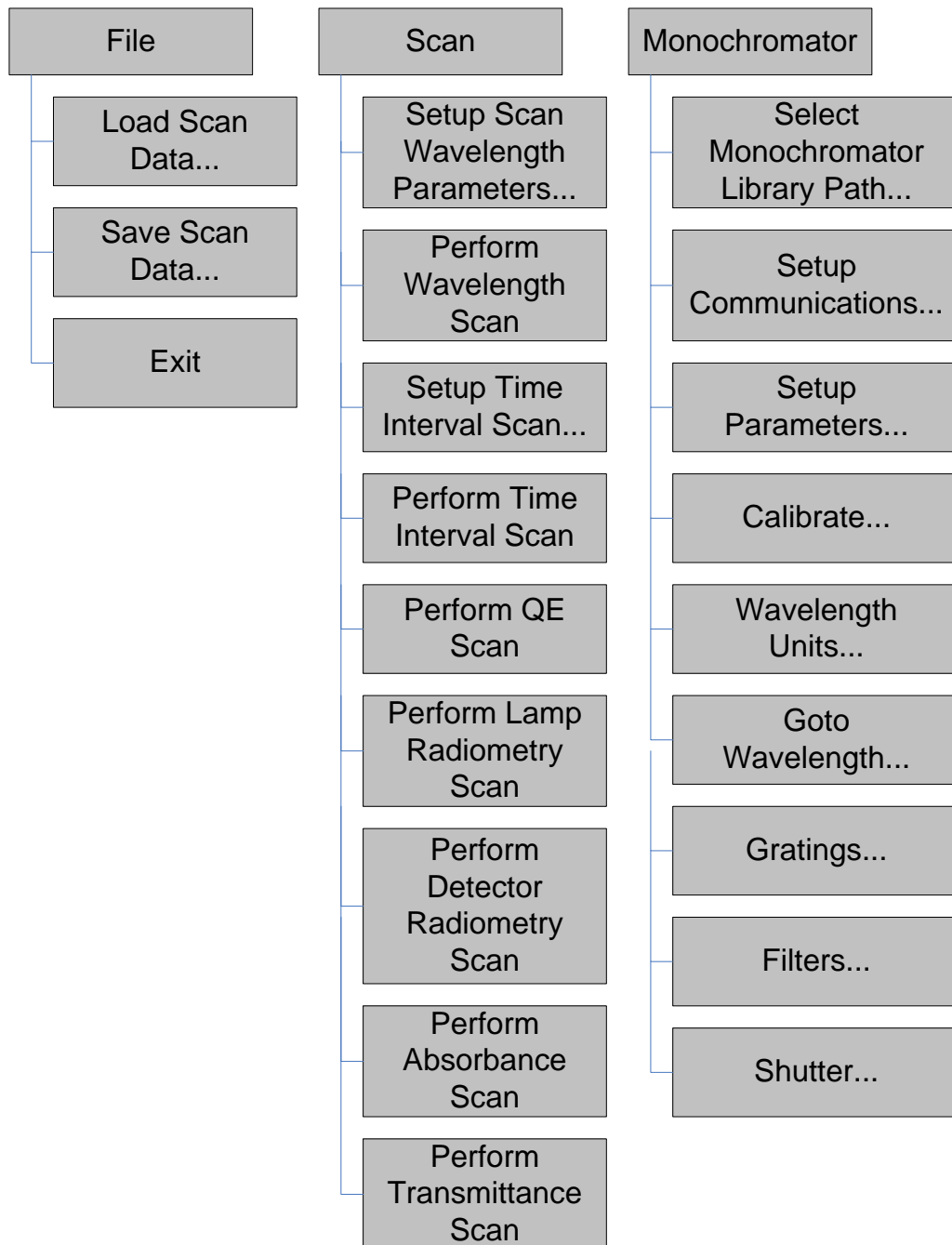


Figure 111: File, Scan and Monochromator Menus

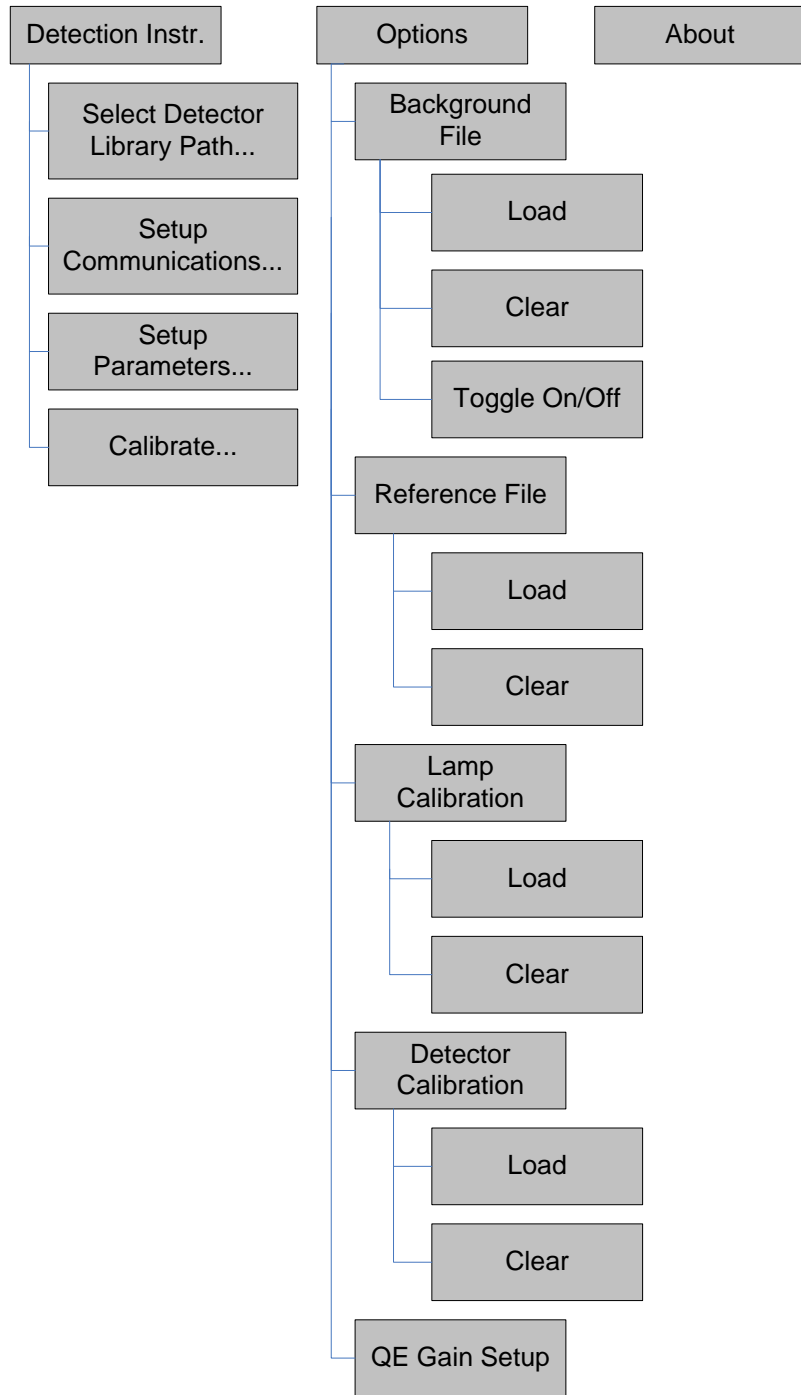
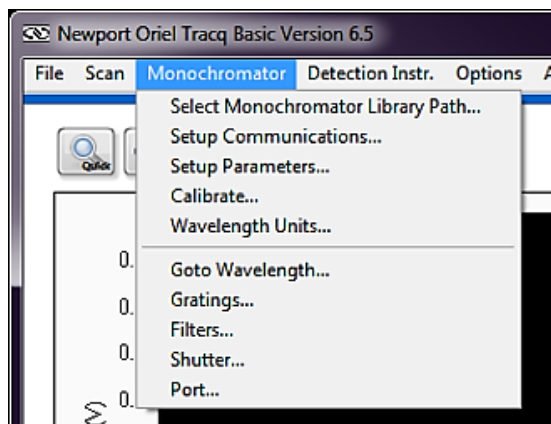


Figure 112: Detection Instrument, Options and About Menus

## 19 APPENDIX 3: CORNERSTONE 130 & 260, MS260i SETUP

This section details all settings that may be configured in TracQ Basic for the Cornerstone 130 monochromator, Cornerstone 260 monochromator or MS260i Imaging Spectrograph. For simplicity, all instruments in this section shall be referred to as monochromators.

Please read all documents provided with the instrument to understand its operation. To set up the instrument, go to the pulldown menu named “Monochromator”, shown in Figure 113.



**Figure 113: Monochromator Configuration Menu**

Note that not all features available with TracQ Basic are supported with all types of instruments. For example, the Cornerstone 260 and MS260i may utilize motorized slits. The Cornerstone 130 does not support motorized slits.

Dual output ports are available with instruments configured as such when the instrument was built. The Cornerstone 260 and MS260i may be reworked to support dual output ports. However, the Cornerstone 130 cannot support dual output ports.

## 19.1 COMMUNICATION SETUP

These instruments are available with two communication options for interfacing with a computer: RS232/GPIB or USB. To change the default communication setup, go to the pulldown menu Monochromator → Communication. Enter the Com Port number or the GPIB Board Index and Address, then click “OK”. This menu choice is not available with USB instruments.



Figure 114: RS232 Communication Setup

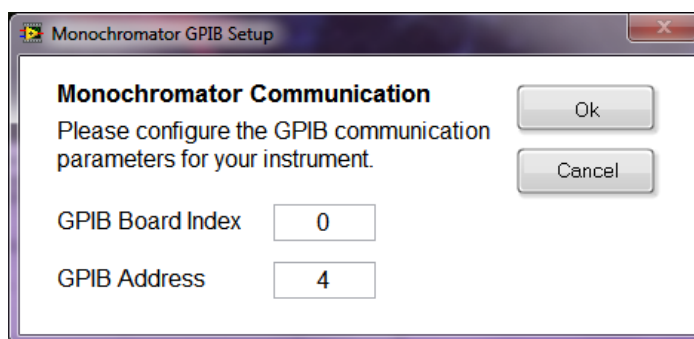


Figure 115: GPIB Communication Setup

## 19.2 SHUTTER CONTROL

An electronic shutter is integrated into the all Oriel monochromators and spectrographs. It is mounted inside the housing at the input port. This shutter is normally closed. To access the shutter control setting, go to the pulldown menu Monochromator → Shutter, choose “Open” or “Closed” and click “OK”.

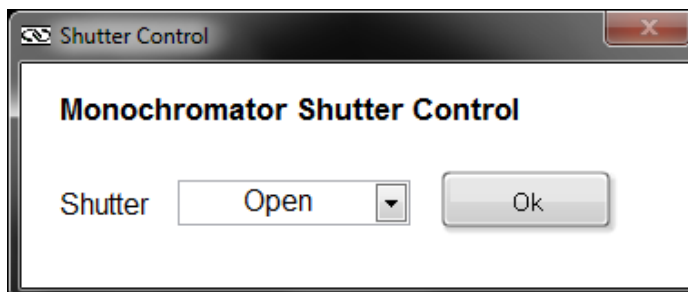


Figure 116: Shutter Control

### 19.3 FILTER SELECTION

To select filters, go to the pulldown menu Monochromator → Filters. To select an individual filter, choose the filter position number corresponding to its installation location in the motorized filter wheel. To automatically change filters during a scan, select “Auto” instead of a specific filter number. Then fill out the automatic changeover wavelengths.

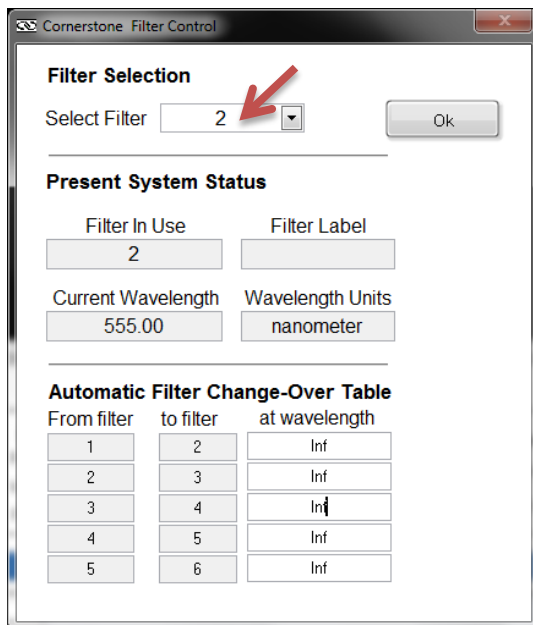


Figure 117: Selecting a Specific Filter

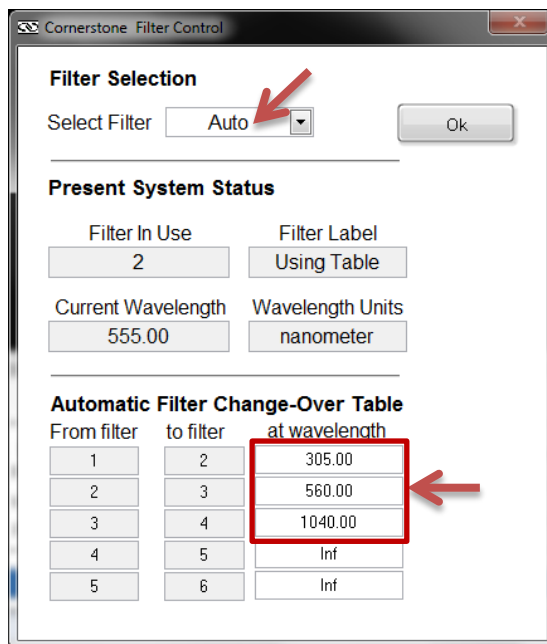


Figure 118: Automatic Filter Selection

## 19.4 GRATING SELECTION

To select gratings, go to the pulldown menu Monochromator → Gratings. To select an individual grating, choose the grating position number corresponding to its installation location in the monochromator. Generally, the gratings are positioned such that the one with the lowest blaze (i.e. peak efficiency) wavelength is in the first position. The locations are noted in the calibration parameters document provided with the instrument. To automatically change gratings during a scan, select “Auto” instead of a specific grating number. Then fill out the automatic changeover wavelengths. The Cornerstone 130 may hold up to two gratings, allowing one automatic changeover wavelength to switch between them. The other instruments may hold up to three gratings.

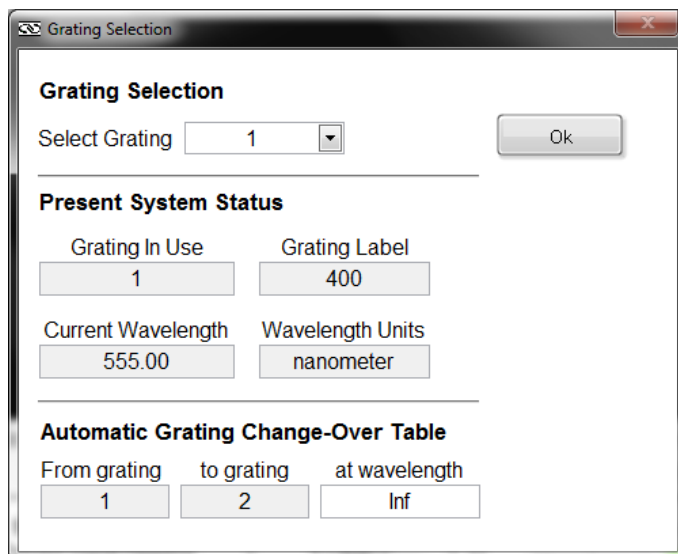


Figure 119: Selecting an Individual Grating

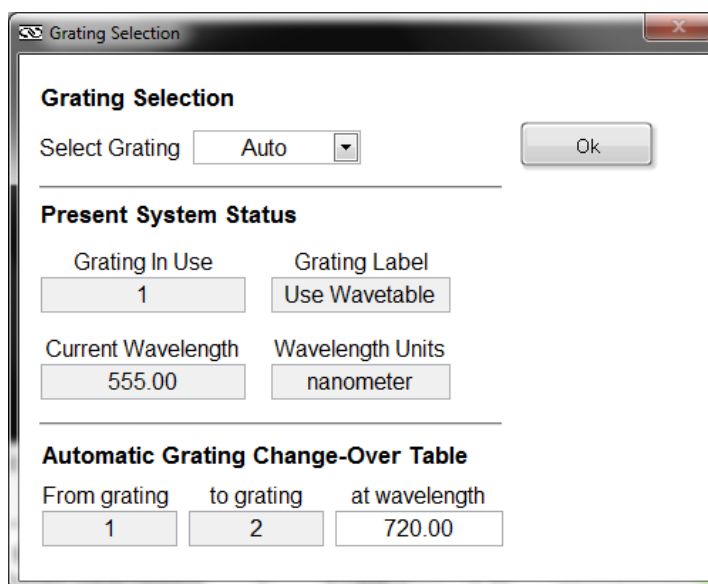


Figure 120: Automatic Grating Selection

## 19.5 SELECTING WAVELENGTH UNITS

TracQ Basic scans may be taken and data displayed in nanometers, micrometers or wavenumber. The default value is nanometers. To select the wavelength units, go to the pulldown menu Monochromator → Wavelength Units.

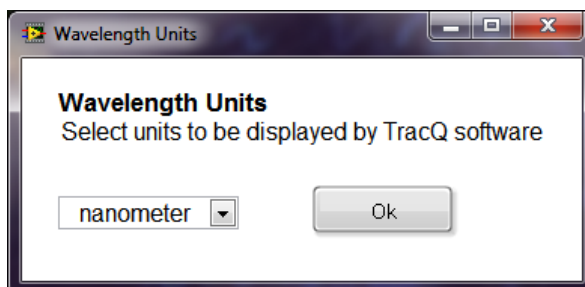


Figure 121: Selecting Wavelength Units

## 19.6 SETTING MONOCHROMATOR WAVELENGTH OUTPUT

Selecting a specific wavelength for the monochromator to output is useful when positioning a detector or sample. The default wavelength is 555 nm, as it is very easily seen by the human eye. Go to the pulldown menu Monochromator → Goto Wavelength. Click on the “555 nm” icon or type in another wavelength if desired. Note that this may also be accessed from the Lambda icon in the main application window.

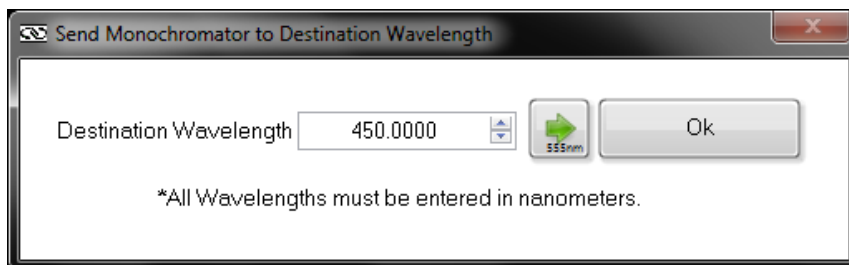


Figure 122: Selecting a Monochromator Output Wavelength

## 19.7 MONOCHROMATOR OFFSET

An offset may be introduced to the monochromator's wavelength, if required. A light source with a known spectral peak must be utilized. Go the wavelength of the peak. If the actual wavelength differs from the wavelength displayed by the monochromator in TracQ Basic, go to the pulldown menu Monochromator → Calibrate. Enter the actual wavelength of the peak and click "OK".

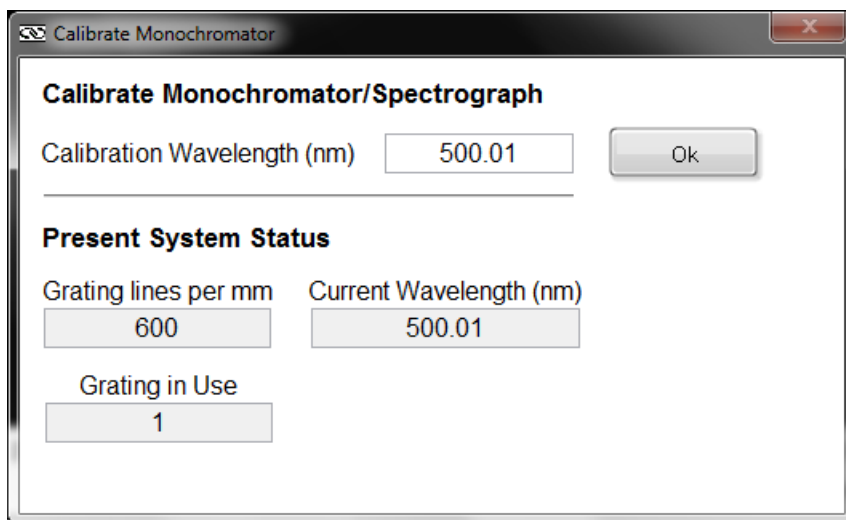


Figure 123: Monochromator Wavelength Offset

## 19.8 MONOCHROMATOR CALIBRATION PARAMETERS

Each instrument comes with calibration parameters for all gratings installed. The maximum number of gratings that may be installed is depended on the type of instrument. To view this information, go to the pulldown menu Monochromator → Setup Parameters. Unless a field calibration was performed or an offset introduced, these values should match the values contained in the calibration data supplied with the instrument.

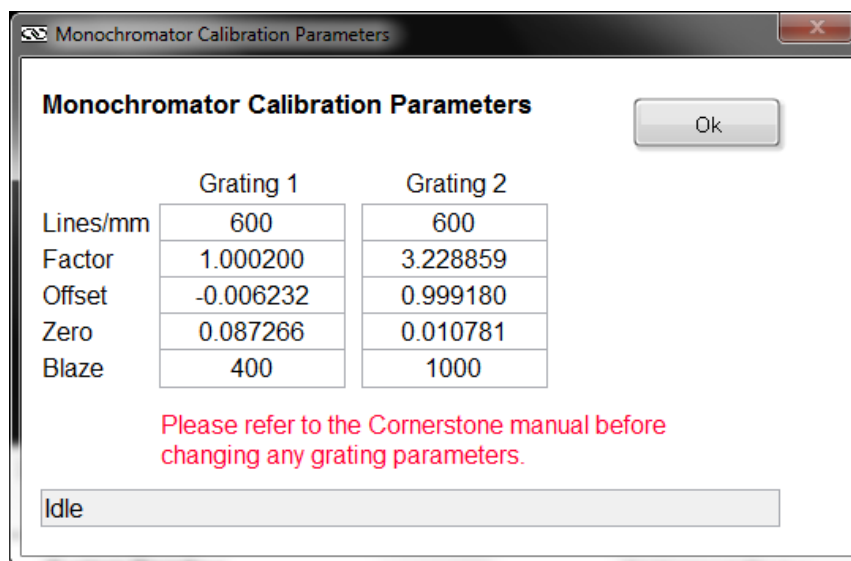


Figure 124: Monochromator Calibration Parameters



## 19.9 MOTORIZED SLIT CONTROL

Motorized slits may be set to a specific width either by manually entering the desired widths in microns or by enabling automatic bandpass control. To access the slit control feature, go to the pulldown menu Monochromator → Setup Parameters. Click on “Motorized Slits”. Please note that this feature is not available with the Cornerstone 130 monochromator.

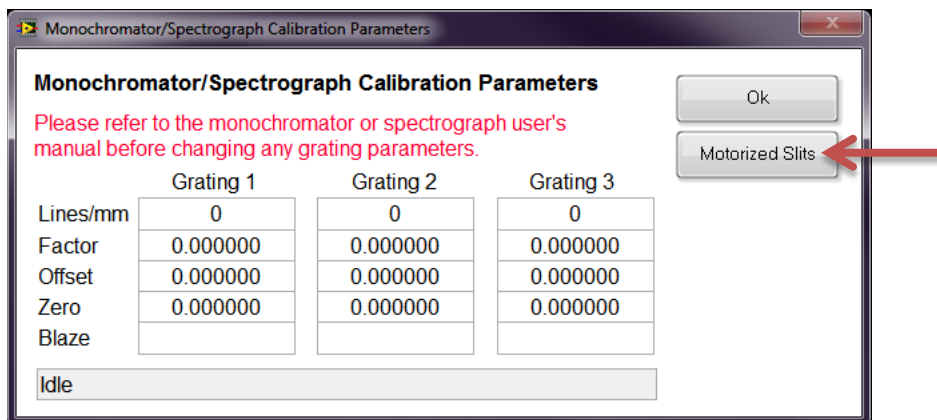


Figure 125: Motorized Slit Control Icon

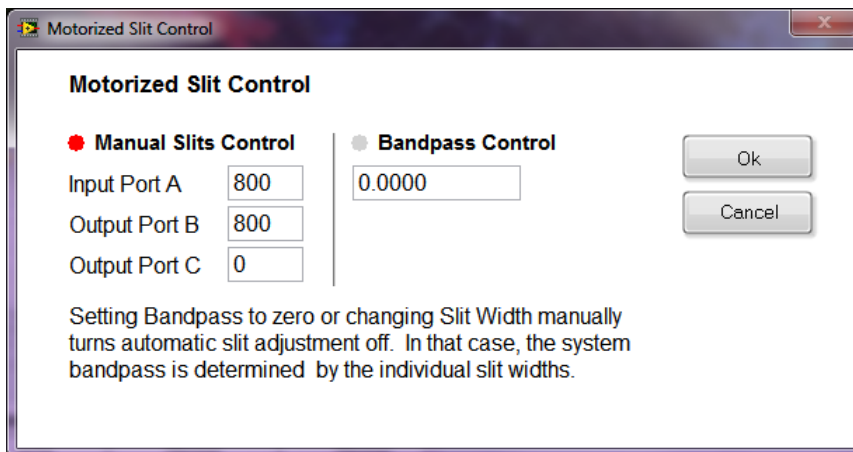


Figure 126: Motorized Slit Control Settings

## 19.10 OUTPUT PORT SELECTION

Dual output port selection is an optional feature for the Cornerstone 260 monochromator and MS260i spectrograph. To access this control feature, go to the pulldown menu Monochromator → Port. To select a specific port, choose either Axial or Lateral. If the Cornerstone 260 or MS260i is not equipped with a built-in motorized flip mirror to allow port selection to take place, using this feature in TracQ Basic will have no effect. To automatically change ports during a scan, select “Auto” instead of a specific port. Then fill out the automatic changeover wavelength.

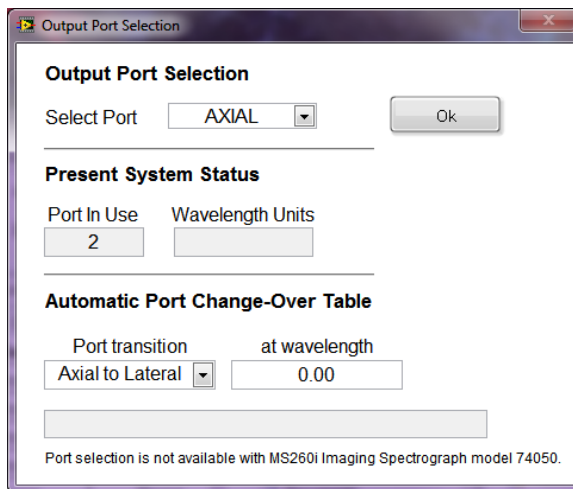


Figure 127: Selecting a Specific Output Port

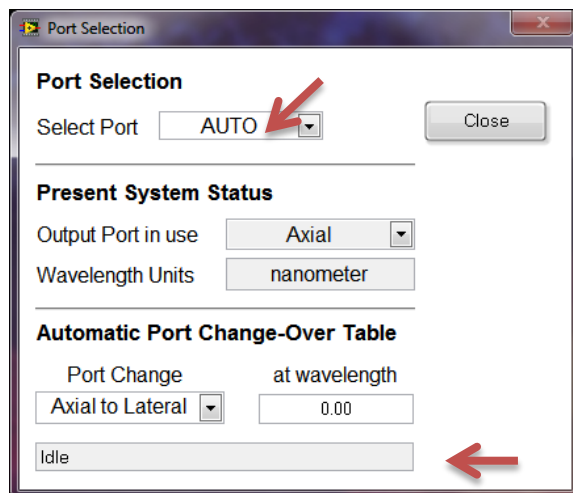


Figure 128: Automatic Port Selection

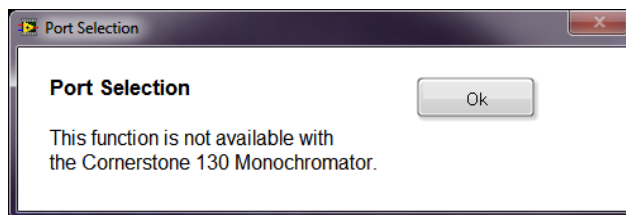
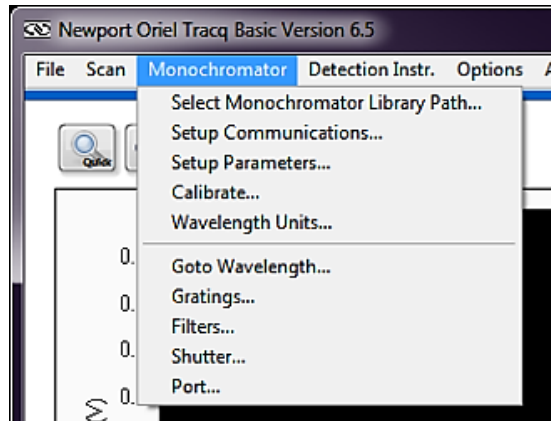


Figure 129: Cornerstone 130 Port Selection Disabled

## 20 APPENDIX 4: MS257 SETUP

This section details all settings that may be configured in TracQ Basic for the MS257 Monochromators and Imaging Spectrographs. For simplicity, all instruments in this section shall be referred to as monochromators.

Please read all documents provided with the instrument to understand its operation. To set up the instrument, go to the pulldown menu named “Monochromator”, shown in Figure 130.



**Figure 130: MS257 Monochromator Configuration Menu**

Note that not all features available with TracQ Basic are supported with all types of instruments. For example, if a motorized output turning mirror is not installed inside the instrument, changing the output port selection will have no effect.

## 20.1 COMMUNICATION SETUP

Depending on the exact model of instrument, communication may be established using USB, RS232 or GPIB. To change the default communication setup, go to the pulldown menu Monochromator → Communication. Enter the Com Port number or the GPIB Board Index and Address, then click “OK”. This menu choice for USB instruments is to select the first available instrument found by the software.



Figure 131: MS257 USB Communication Setup



Figure 132: MS257 RS232 Communication Setup

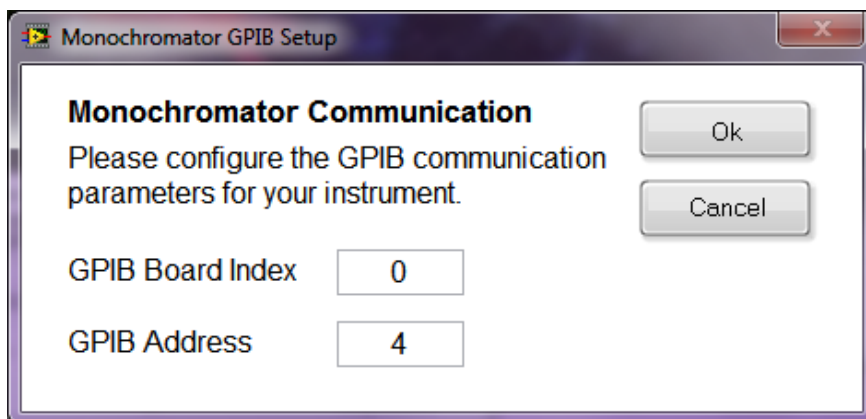


Figure 133: MS257 GPIB Communication Setup

## 20.2 SHUTTER CONTROL

An electronic shutter is integrated into the all Oriol monochromators and spectrographs. It is mounted inside the housing at the input port. This shutter is normally closed. To access the shutter control setting, go to the pulldown menu Monochromator → Shutter, choose “Open” or “Closed” and click “OK”.

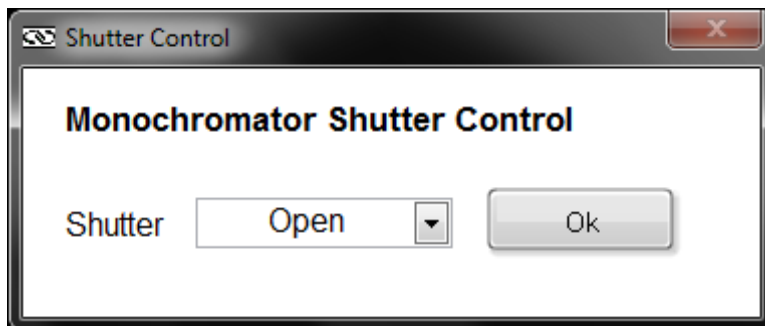


Figure 134: MS257 Shutter Control

## 20.3 FILTER SELECTION

The MS257 is able to control up to two filter wheels. To select filters, go to the pulldown menu Monochromator → Filters. Begin by choosing the appropriate filter wheel. To select an individual filter, choose the filter position number corresponding to its installation location in the motorized filter wheel. To automatically change filters during a scan, select “Auto” instead of a specific filter number. Then fill out the automatic changeover wavelengths.

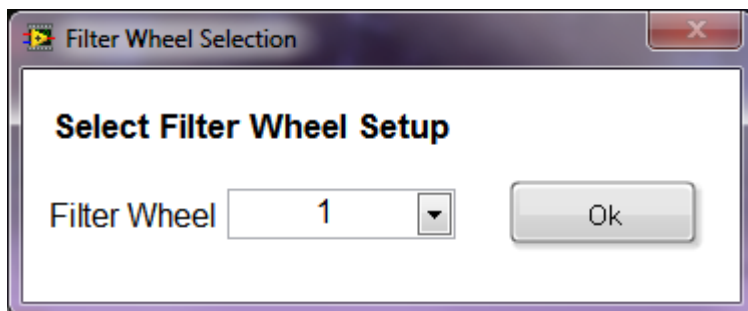


Figure 135: MS257 Filter Wheel Selection

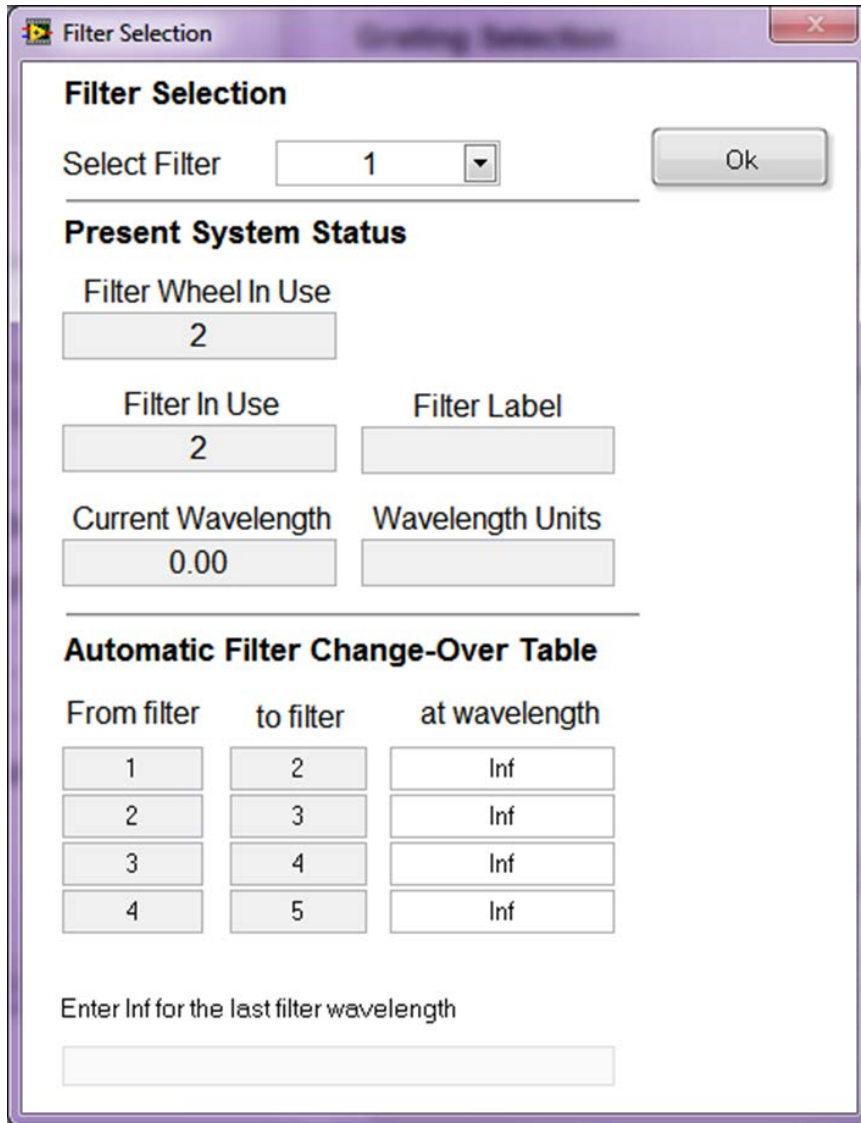


Figure 136: MS257 Selecting a Specific Filter

## 20.4 GRATING SELECTION

To select gratings, go to the pulldown menu Monochromator → Gratings. To select an individual grating, choose the grating position number corresponding to its installation location in the monochromator. Generally, the gratings are positioned such that the one with the lowest blaze (i.e. peak efficiency) wavelength is in the first position. The grating positions are noted in the calibration parameters documentation provided with the instrument.

To automatically change gratings during a scan, select “Auto” instead of a specific grating number. Then fill out the automatic changeover wavelengths. The MS257 may hold up to four gratings. The automatic grating changeover table lists four gratings, so it important to know the exact configuration of the instrument in order to set it up appropriately.

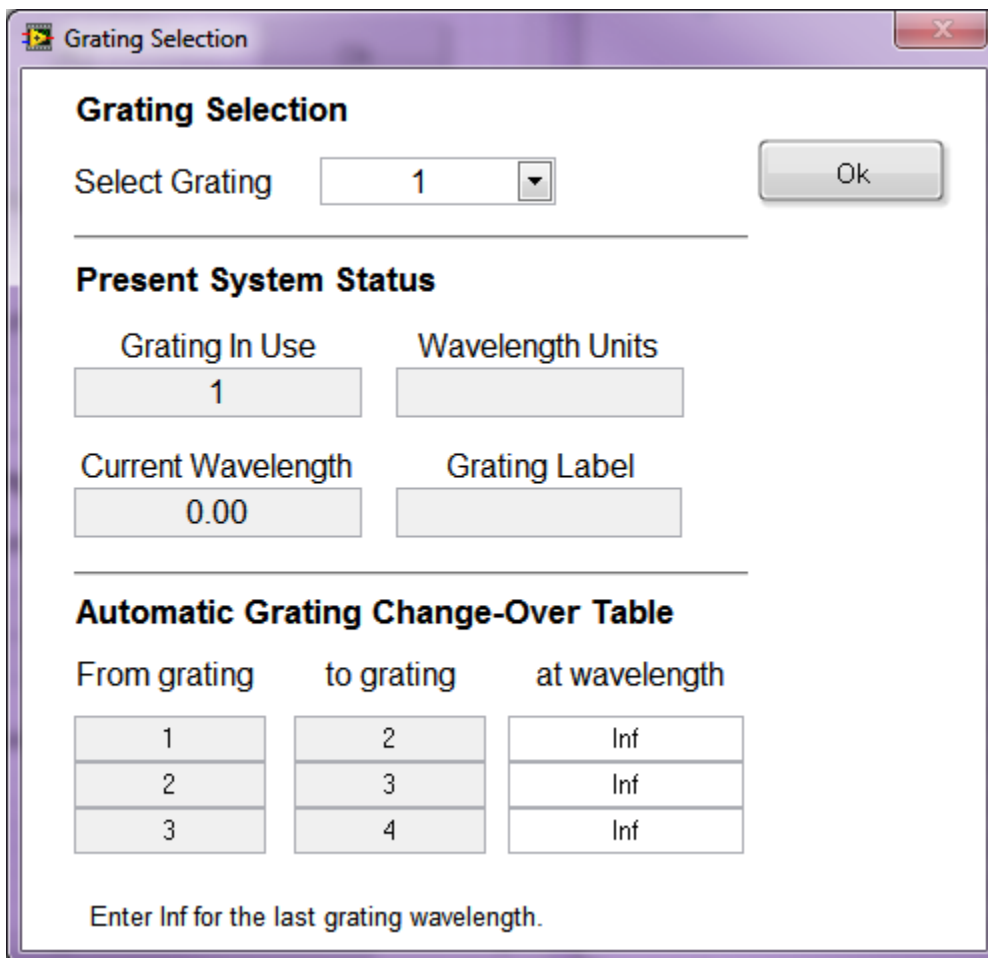


Figure 137: MS257 Automatic Grating Selection

## 20.5 SELECTING WAVELENGTH UNITS

TracQ Basic scans may be taken and data displayed in nanometers, micrometers or wavenumber. The default value is nanometers. To select the wavelength units, go to the pulldown menu Monochromator → Wavelength Units.

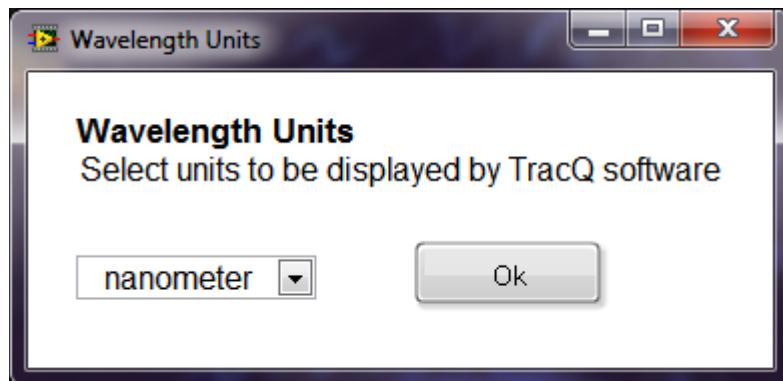


Figure 138: MS257 Selecting Wavelength Units

## 20.6 SETTING MONOCHROMATOR WAVELENGTH OUTPUT

Selecting a specific wavelength for the monochromator to output is useful when positioning a detector or sample. The default wavelength is 555 nm, as it is very easily seen by the human eye. Go to the pulldown menu Monochromator → Goto Wavelength. Click on the “555 nm” icon or type in another wavelength if desired. Note that this may also be accessed from the Lambda icon in the main application window.

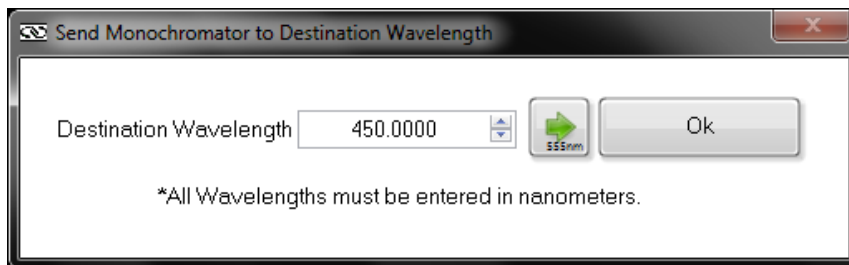


Figure 139: MS257 Selecting a Monochromator Output Wavelength



## 20.7 MONOCHROMATOR OFFSET

An offset may be introduced to the monochromator's wavelength, if required. A light source with a known spectral peak must be utilized. Go to the wavelength of the peak. If the actual wavelength differs from the wavelength displayed by the monochromator in TracQ Basic, enter go to the pulldown menu Monochromator → Calibrate. Enter the actual wavelength of the peak and click "OK".

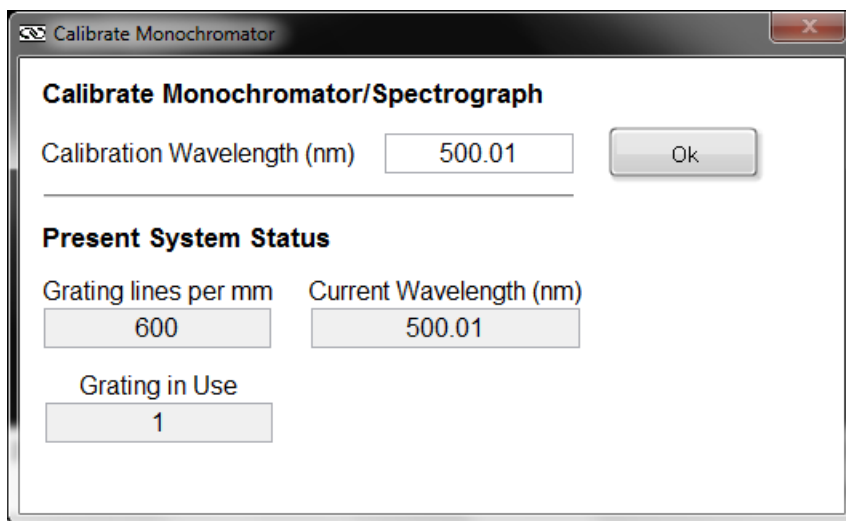


Figure 140: MS257 Monochromator Wavelength Offset

## 20.8 MONOCHROMATOR CALIBRATION PARAMETERS

Each instrument comes with calibration parameters for all gratings installed. The total quantity of gratings is depended on the grating configuration present. To view this information, go to the pulldown menu Monochromator → Setup Parameters. Unless a field calibration was performed or an offset was introduced, these values should match the values contained in the calibration data supplied with the instrument. The information displayed is read-only.

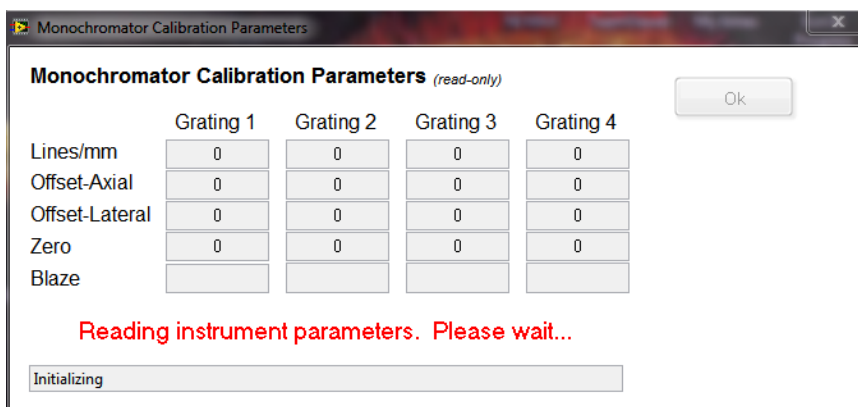


Figure 141: MS257 Monochromator Calibration Parameters

## 20.9 MOTORIZED SLIT CONTROL

Motorized slits may be set to a specific width either by manually entering the desired widths in microns or by enabling automatic bandpass control. To access the slit control feature, go to the pulldown menu Monochromator → Setup Parameters. Click on “Motorized Slits”.

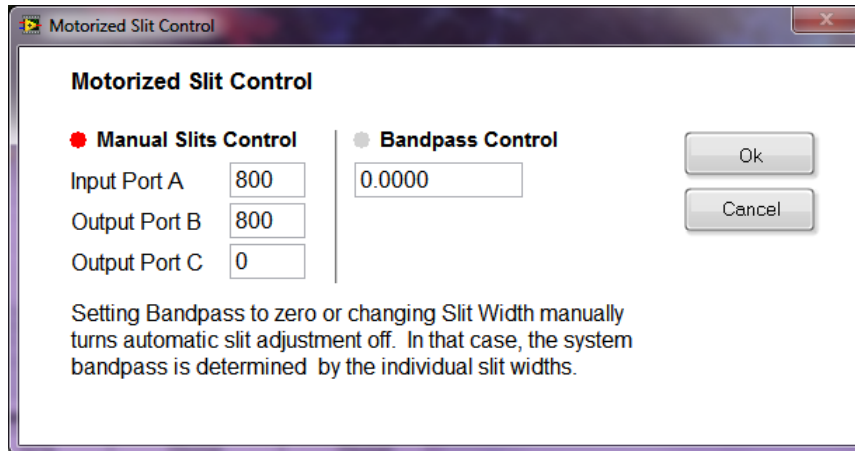


Figure 142: MS257 Motorized Slit Control Settings

## 20.10 OUTPUT PORT SELECTION

Dual output port selection is an optional feature with the MS257. To access this control feature, go to the pulldown menu Monochromator → Port.

To select a specific port, choose either Axial or Lateral. If the instrument is not equipped with a built-in motorized flip mirror to allow port selection to take place, using this feature in TracQ Basic will have no effect. To automatically change ports during a scan, select “Auto” instead of a specific port. Then fill out the automatic changeover wavelength.

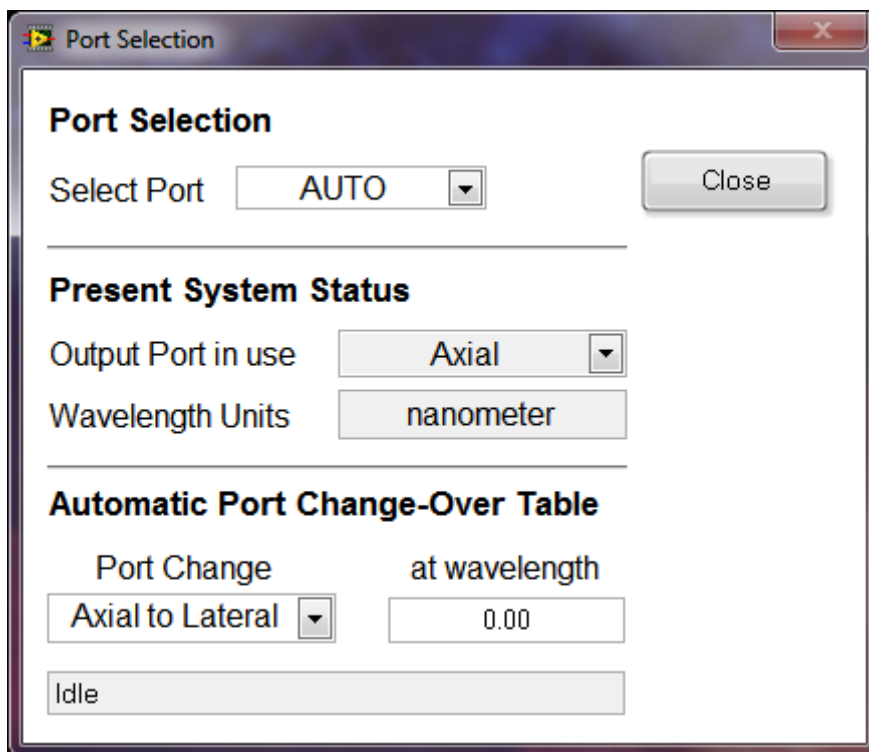


Figure 143: MS257 Output Port Selection

## 21 APPENDIX 5: TUNABLE LIGHT SOURCE SETUP

The Oriel model Tunable Light Source (TLS) is constructed using a Cornerstone 130 monochromator. Please read all documents provided with the TLS and refer to the information contained within this user manual in regards to the Cornerstone 130.

This section details the setup specific to the Cornerstone 130 monochromator when employed in the Oriel Tunable Light Source series. For customized TLS configurations, any supplementary literature provided supersedes the setup instructions contained within the TracQ Basic user manual.

### 21.1 TLS FILTER SELECTION

In order to ensure that the light produced by the Tunable Light Source system is monochromatic, it is necessary to incorporate optical filters into the design. The physics of diffraction gratings is such that higher order wavelengths need to be blocked. The order sorting filters selected for the Tunable Light Source have been chosen to block unwanted wavelengths.

By setting the filter parameters in the TracQ Basic software, the monochromator will automatically select the appropriate filter for any desired wavelength within the operating range of the TLS.

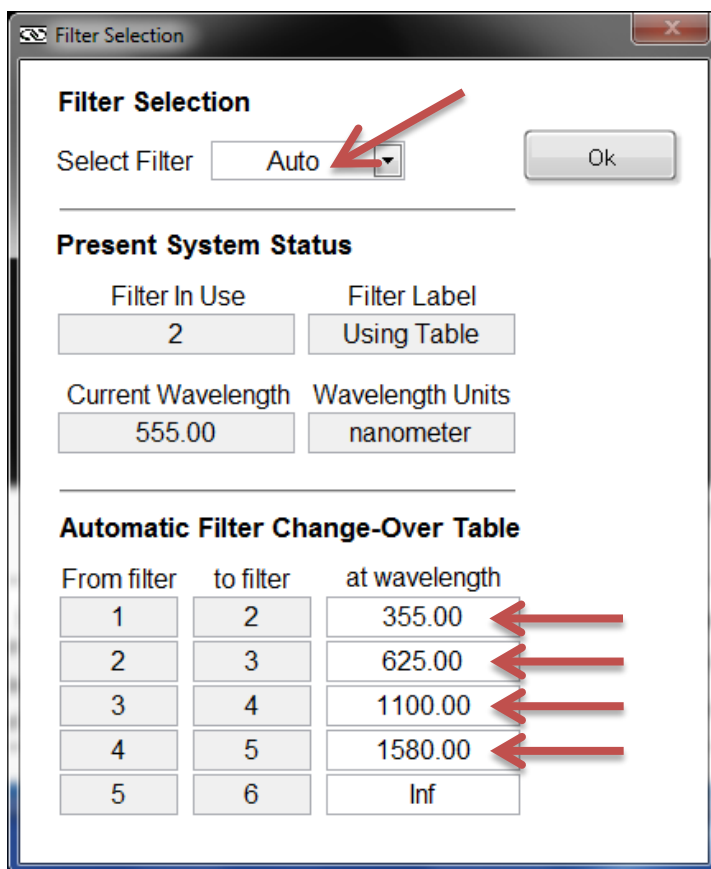


Figure 144: TLS Automatic Filter Selection

## 21.2 TLS GRATING SELECTION

In order to produce monochromatic light over the full wavelength range specified for a Tunable Light Source, Oriel's Cornerstone 130 monochromator contains two ruled diffraction gratings. Each grating is capable of working over a certain wavelength range based upon its design. By setting the grating parameters in the TracQ Basic software, the monochromator will automatically select the appropriate grating for any desired wavelength within the operating range of the TLS.

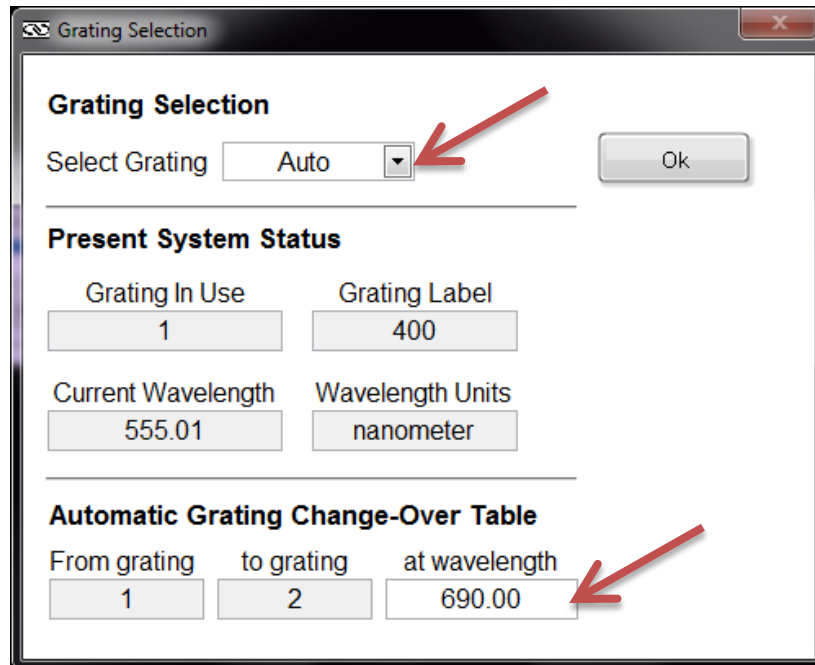


Figure 145: TLS Automatic Grating Selection

## 22 APPENDIX 6: NEWPORT 19xx POWER METER SETUP

This section details all settings that may be configured in TracQ Basic for the Newport 19xx series power meters.

Please read all documents provided with the instrument to understand its operation. To set up the instrument, go to the pulldown menu named "Detection Instr.," shown in Figure 146.

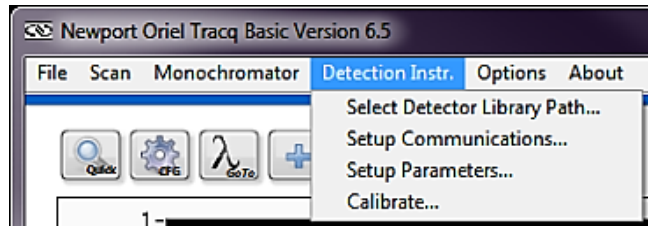


Figure 146: Detection Instrument Configuration Menu

### 22.1 COMMUNICATION SETUP

This option is not enabled for the 19xx series power meters.

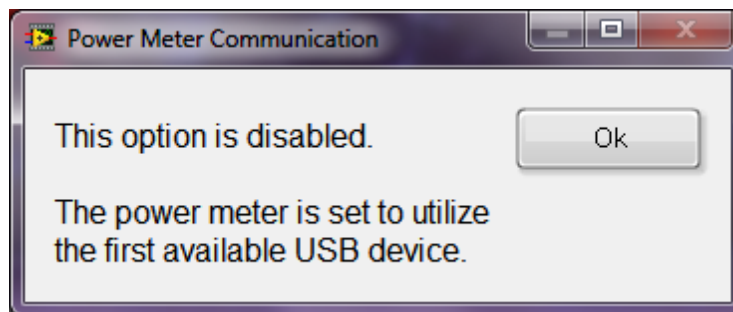


Figure 147: 19xx USB Communication Setup

## 22.2 SETTING UP PARAMETERS

To access and set up the features for this power meter, go to the pulldown menu Detection Instr. → Setup Parameters. Channel A is utilized for single output instruments, while Channel B may be selected if using a dual channel power meter model. A number of Mode and Filter choices are available, with DC Continuous and no filtering as the defaults. Consult the power meter's user manual for more information on these settings.

The wavelength may be set when utilizing a single wavelength source, such as a laser. When using this instrument with a monochromator, it is not necessary to set the wavelength. TracQ Basic will update the wavelength as a scan proceeds.

It is possible to zero the meter using this menu. Please note that background subtraction is also supported by TracQ Basic.

Units may be selected as amps, volts, watts, watts/cm<sup>2</sup>, joules, joules/cm<sup>2</sup> or dBm. The use of watts requires that the detector be calibrated with the calibration data contained in the PROM module used by the meter. If that is not available, the detector radiometry scans also may be used to obtain power measurements.

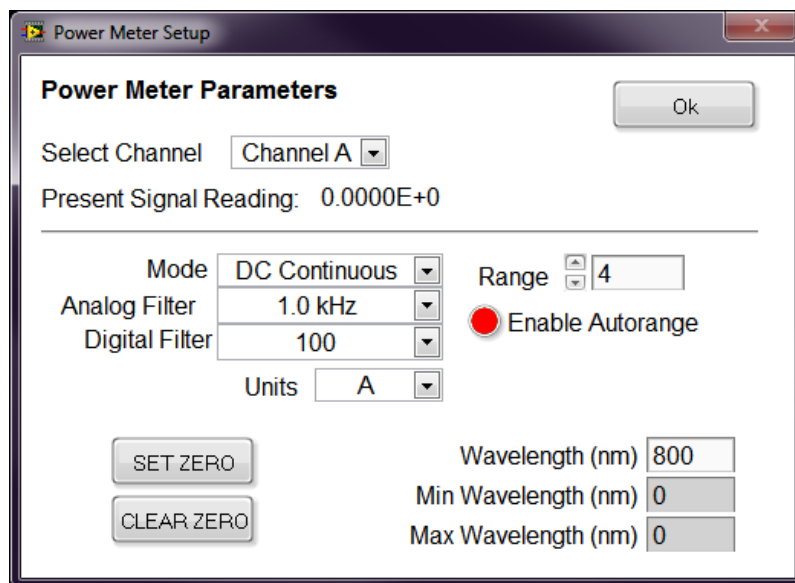


Figure 148: 19xx Operating Parameters Setup

## 22.3 CALIBRATION

To access this feature, go to the pulldown menu Detection Instr. → Setup Parameters. This will freeze the present reading.



Figure 149: 19xx Calibration

## 23 APPENDIX 7: SR810, LIDA-SRS-KIT SETUP

This section details all settings that may be configured in TracQ Basic for the Oriel LIDA-SRS-KIT, as well as the Stanford Research Systems model SR810 lock-in digital amplifier.

Please read all documents provided with the instrument to understand its operation. To set up the instrument, go to the pulldown menu named "Detection Instr.," shown in Figure 150.

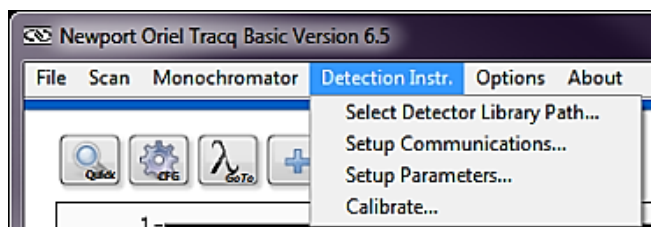


Figure 150: Detection Instrument Configuration Menu

### 23.1 COMMUNICATION

Communication may be established using GPIB. To change the default communication setup, go to the pulldown menu Detector Instr. → Setup Communications. Enter the GPIB Board Index and Address, and then click "OK".



Figure 151: LIDA GPIB Communication Setup



## 23.2 SETTING UP PARAMETERS

To access and set up the features for this instrument, go to the pulldown menu Detection Instr. → Setup Parameters. The settings available are shown in Figure 152.

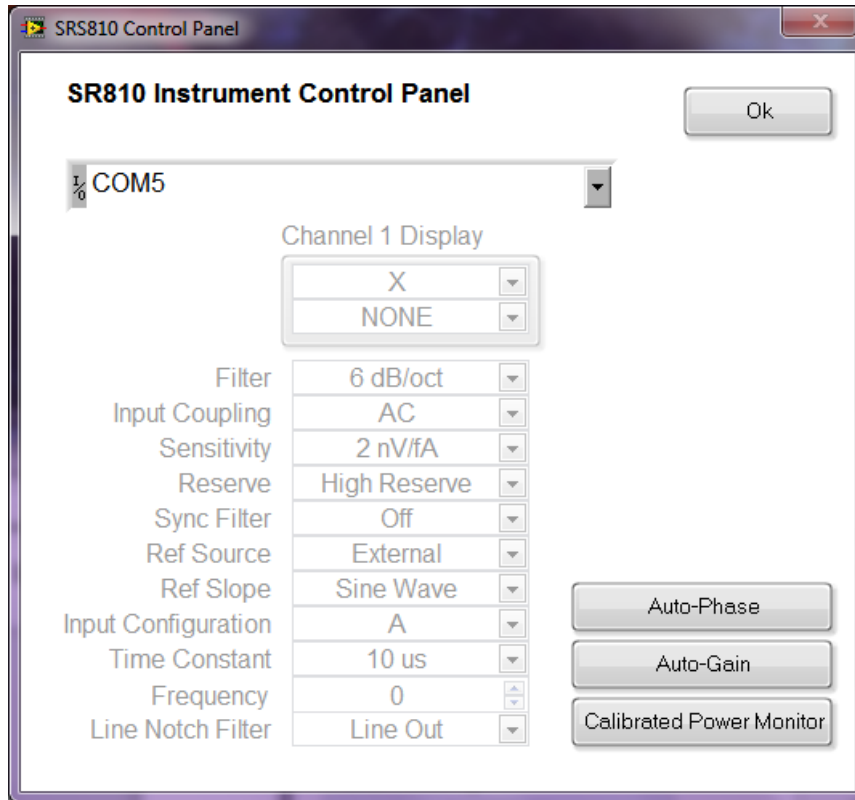


Figure 152: LIDA Operating Parameters Setup

### 23.3 CALIBRATION

To display the power at a particular wavelength, enter the detector gain switch settings and the wavelength. The calculated power shall be displayed. To access and set up the features for this power meter, go to the pulldown menu Detection Instr. → Calibrate.

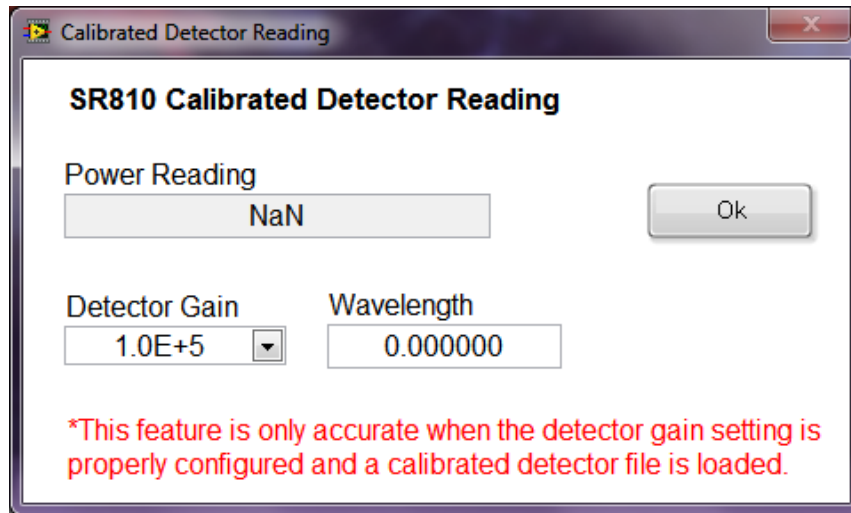


Figure 153: LIDA Calibration

## 24 APPENDIX 8: MERLIN LOCK-IN DIGITAL AMPLIFIER SETUP

This section details all settings that may be configured in TracQ Basic for the legacy Oriel Merlin series lock-in digital amplifiers.

Please read all documents provided with the instrument to understand its operation. To set up the instrument, go to the pulldown menu named "Detection Instr.," shown in Figure 150.

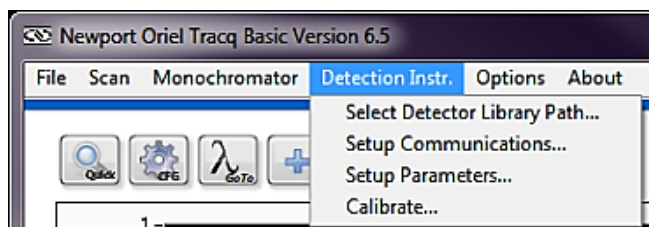


Figure 154: Detection Instrument Configuration Menu

### 24.1 COMMUNICATION

Depending on the exact model of instrument, communication may be established using RS232 or GPIB. To change the default communication setup, go to the pulldown menu Detection Instr. → Setup Communications. Enter the Com Port number or the GPIB Board Index and Address, then click "OK".

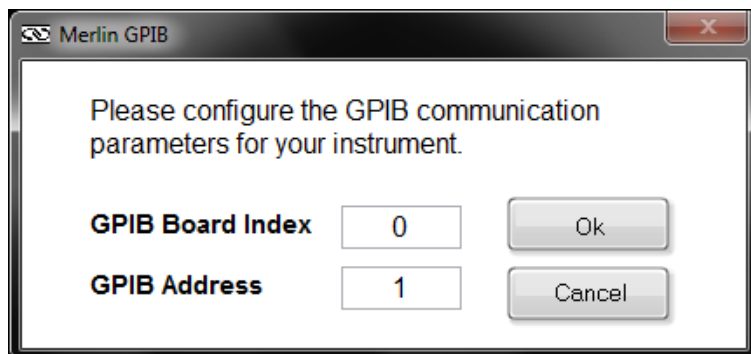


Figure 155: Merlin GPIB Communication Setup

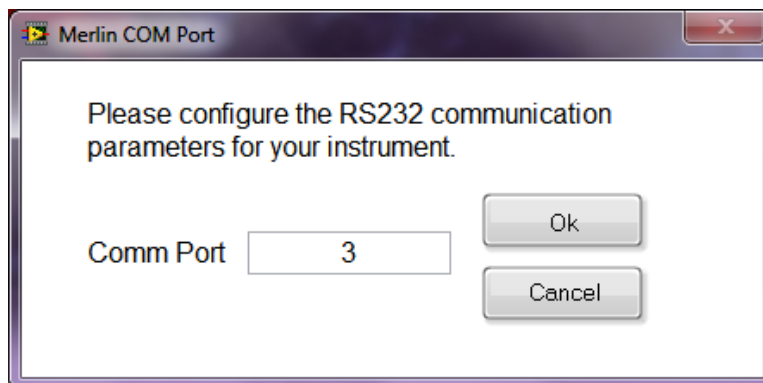


Figure 156: Merlin RS232 Communication Setup

## 24.2 SETTING UP PARAMETERS

To access and set up the features for the Merlin, go to the pulldown menu Detection Instr. → Setup Parameters. Each channel has two setups. Always ensure the correct setup and channel are selected. It is suggested to disable to Merlin’s front panel buttons to ensure there are no communication conflicts while operating the software. Additional features may be accessed by clicking on the “Reference Levels Setup” button.

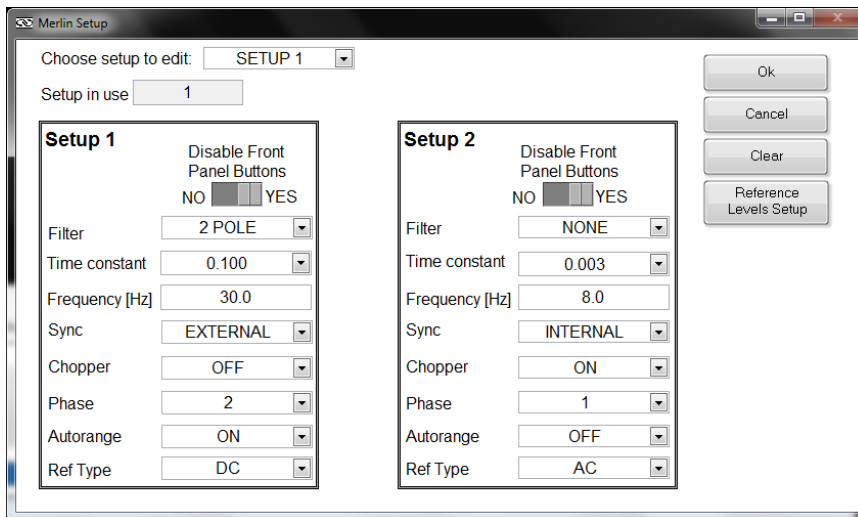


Figure 157: Merlin Operating Parameters Setup, Single Channel

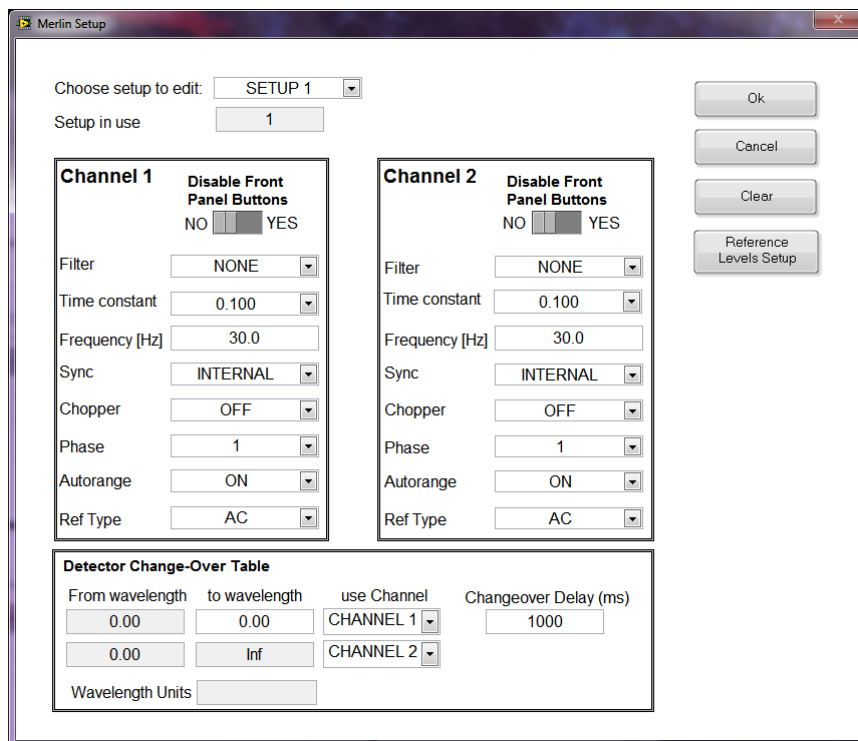


Figure 158: Merlin Operating Parameters Setup, Dual Channel

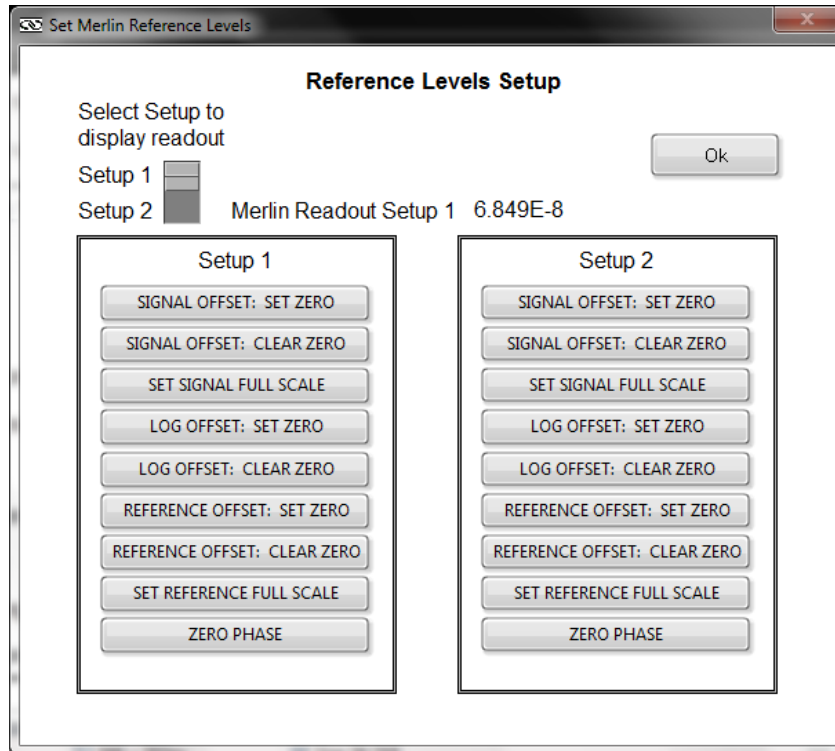


Figure 159: Merlin Reference Levels Setup

## 24.3 CALIBRATION

To access and set up this feature for the Merlin, go to the pulldown menu Detection Instr. → Calibrate.

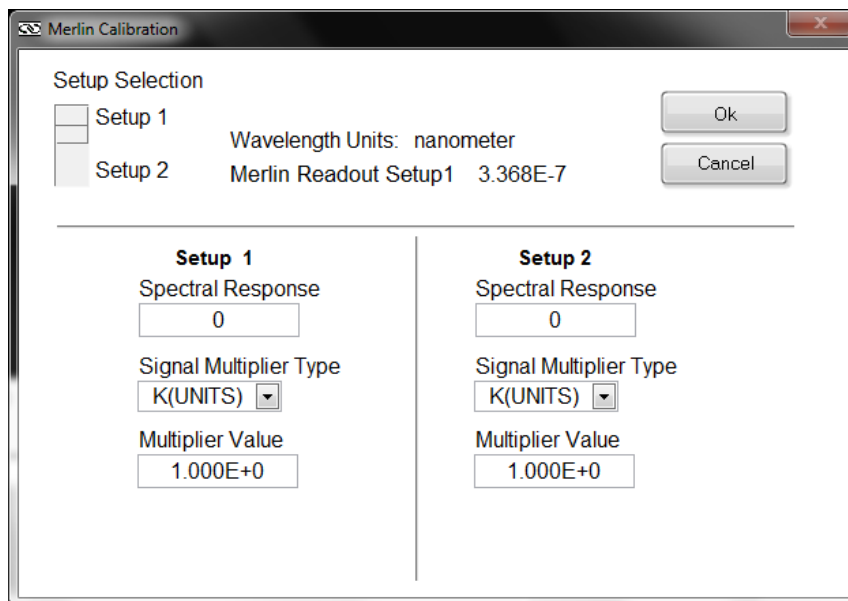


Figure 160: Merlin Calibration

## 25 WARRANTY AND SERVICE

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Oriel Instruments belongs to Newport Corporation's family of brands. Thanks to a steadfast commitment to quality, innovation, hard work and customer care, Newport is trusted the world over as the complete source for all photonics and laser technology and equipment.

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Newport - Oriel Instruments  
1791 Deere Avenue  
Irvine, CA 92606 USA

Telephone: 800-222-6440 (toll-free in United States)  
949-863-3144

Fax: 949-253-1680

Sales: [oriel.sales@newport.com](mailto:oriel.sales@newport.com)  
Technical assistance: [oriel.tech@newport.com](mailto:oriel.tech@newport.com)  
Repair Service: [rma.service@newport.com](mailto:rma.service@newport.com)

Customers outside of the United States must contact their regional representative for all sales, technical support and service inquiries. A list of worldwide representatives can be found on the following website: <http://www.newport.com/oriel>.

## 25.2 REQUEST FOR ASSISTANCE / SERVICE

Please have the following information available when requesting assistance or service:

Contact information for the owner of the product.  
Instrument model number (located on the product label).  
Product serial number and date of manufacture (located on the product label).  
Description of the problem.

To help Newport's Technical Support Representatives diagnose the problem, please note the following:

Is the system used for manufacturing or research and development?  
What was the state of the system right before the problem?  
Had this problem occurred before? If so, when and how frequently?  
Can the system continue to operate with this problem, or is it non-operational?  
Were there any differences in the application or environment before the problem occurred?

## 25.3 REPAIR SERVICE

If the instrument needs to be returned, a Return Material Authorization (RMA) number or Return (RE) number must be obtained prior to shipment to Newport. This RMA or RE number must appear on both the shipping container and the package documents.

Return the product to Newport, freight prepaid, clearly marked with the RMA or RE number and it either will be repaired or replaced at Newport's discretion.

Newport is not responsible for damage occurring in transit. The Owner of the product bears all risk of loss or damage to the returned Products until delivery at Newport's facility. Newport is not responsible for product damage once it has left the facility after repair or replacement has been completed.

Newport is not obligated to accept products returned without an RMA number. Any return shipment received by Newport without an RMA number may be reshipped by Newport, freight collect, to the Owner of the product.

## 25.4 NON-WARRANTY SERVICE

For Products returned for repair that are not covered under warranty, Newport's standard repair charges shall be applicable in addition to all shipping expenses. Unless otherwise stated in Newport's repair quote, any such out-of-warranty repairs are warranted for ninety (90) days from date of shipment of the repaired Product.

Newport will charge an evaluation fee to examine the product and determine the most appropriate course of action. Payment information must be obtained prior to having an RMA number assigned. Customers may use a valid credit card, and those who have an existing account with Newport Corporation may use a purchase order.

When the evaluation had been completed, the owner of the product will be contacted and notified of the final cost to repair or replace the item. If the decision is made to not proceed with the repair, only the evaluation fee will be billed. If authorization to perform the repair or provide a replacement is obtained, the evaluation fee will be applied to the final cost. A revised purchase order must be submitted for the final cost. If paying by credit card, written authorization must be provided that will allow the full repair cost to be charged to the card.

## 25.5 WARRANTY SERVICE

If there are any defects in material or workmanship or a failure to meet specifications, notify Newport Corporation promptly, prior to the expiration of the warranty.

Except as otherwise expressly stated in Newport's quote or in the current operating manual or other written guarantee for any of the Products, Newport warrants that, for the period of time set forth below with respect to each Product or component type (the "Warranty Period"), the Products sold hereunder will be free from defects in material and workmanship, and will conform to the applicable specifications, under normal use and service when correctly installed and maintained. Newport shall repair or replace, at Newport's sole option, any defective or nonconforming Product or part thereof which is returned at Buyer's expense to Newport's facility, provided, that Buyer notifies Newport in writing promptly after discovery of the defect or nonconformity and within the Warranty Period. Products may only be returned by Buyer when accompanied by a return material authorization number ("RMA number") issued by Newport, with freight prepaid by Buyer. Newport shall not be responsible for any damage occurring in transit or obligated to accept Products returned for warranty repair without an RMA number. The buyer bears all risk of loss or damage to the Products until delivery at Newport's facility. Newport shall pay for shipment back to Buyer for Products repaired under warranty.

### WARRANTY PERIOD

All Products (except consumables such as lamps, filters, etc.) described here are warranted for a period of twelve (12) months from the date of shipment or 3000 hours of operation, whichever comes first.

Lamps, gratings, optical filters and other consumables / spare parts (whether sold as separate Products or constituting components of other Products) are warranted for a period of ninety (90) days from the date of shipment.

### WARRANTY EXCLUSIONS

The above warranty does not apply to Products which are (a) repaired, modified or altered by any party other than Newport; (b) used in conjunction with equipment not provided or authorized by Newport; (c) subjected to unusual physical, thermal, or electrical stress, improper installation, misuse, abuse, accident or negligence in use, storage, transportation or handling, alteration, or tampering, or (d) considered a consumable item or an item requiring repair or replacement due to normal wear and tear.



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Persons receiving goods for demonstrations or temporary use or in any manner in which title is not transferred from Newport shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their original condition upon delivery, and for assuming all costs and charges.

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First printing 2014

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