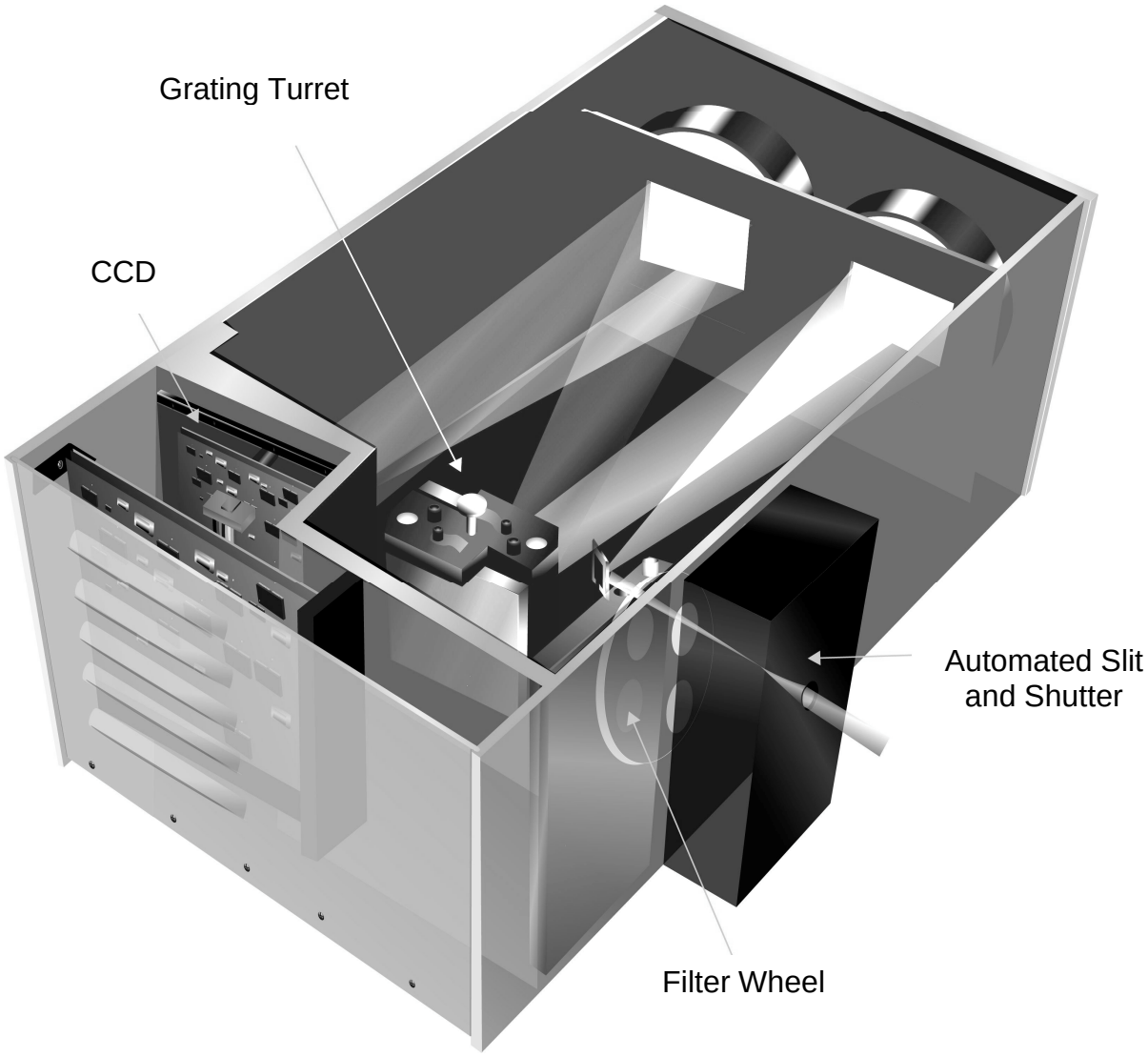
InSpectrum 300



Operating Manual

Acton Research Corporation Ver.02.04.26

Acton Research Corporation

Table of Contents

Thank you for your purchase of the Acton Research (Acton) ***InSpectrum*** integrated imaging spectrograph and for selecting Acton as your provider of precision spectroscopic equipment. Acton Research Corporation strives to manufacture equipment of the highest quality and ease of operation. If you should have any questions during the set up of your instrument, do not hesitate to call and speak with one of our experienced technical staff.

Introduction

This manual is intended to assist you in the set up and operation of your ***InSpectrum*** spectrometer. Although ***InSpectrum*** has been designed for virtual plug and play operation, it is highly recommended, even if you have experience in working with CCD based spectrographic instrumentation, that you follow the procedures presented in this document. If you should have any questions as to the material presented in this document, feel free to contact our customer service department.

InSpectrum Description

InSpectrum is a fully integrated CCD based imaging spectrograph. With a focal length of 0.3m and f/4.0 optics, it is extremely well suited to a very wide range of spectroscopic applications ranging from absorption and transmission measurement to fluorescence and Raman spectroscopy. The integrated thermoelectrically cooled CCD is the most sensitive detector for measuring light in the 200nm to 1100nm range. Designed to work under Windows 98, ME, 2000 and XP, ***InSpectrum*** is a true plug and play device. Once ***SpectraSense*** software is loaded on to your computer, the unit merely has to be plugged into an available USB port to begin taking data.

General

Astigmatism-corrected optics optimized for allowing multiple independent spectra to be collected simultaneously.

Automated slit mechanism with fixed apertures between 25u and 1.00mm.

Internal heavy-duty shutter.

Internal filter wheel with order sorting filters allows fiber bundles to be directly coupled to the entrance slit. The filters are specially chosen to minimize focus changes over the standard operation for each filter.

Interchangeable dual grating turrets with all gratings automatically referenced in ***InSpectrum*** internal memory.

A choice of front and back illuminated CCD detectors.

Optics and detection are pre-aligned at the factory.

USB interface between ***InSpectrum*** and your computer.

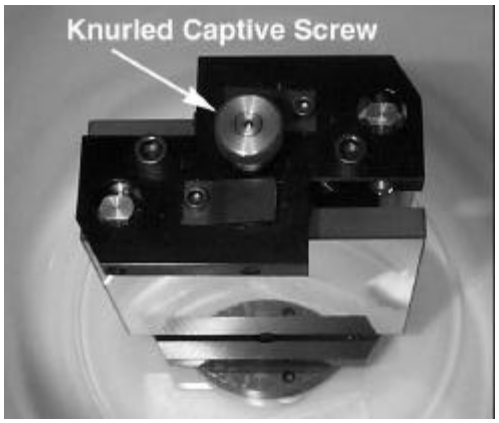
12V DC operation with included universal power supply.

Unpacking

InSpectrum is shipped in a heavy-duty carton with specially designed foam inserts to reduce the risk of damage or misalignment during transit. It is highly recommended that you save this container in the event that you may have to ship the unit to another location or back to Acton Research Corporation for service. In the event that you must ship the unit and you no longer have possession of the shipping carton, you can order one through the customer service department at Acton Research Corporation.

Acton Research Corporation assumes no liability for damages incurred to instruments caused by improper packaging.

The grating turrets supplied with ***InSpectrum*** are shipped in the same carton inside a sealed container. The surfaces of the diffraction gratings on the turrets are **extremely fragile** and can be permanently damaged by contact with anything. Never remove a turret from its container until the moment that it will be installed in the spectrograph. Keep the container firmly closed even when empty to reduce the possibility of contamination.



To remove the turret from the container, apply a slight downward pressure on the top of the turret and unscrew the knurled captive screw. Lift the turret out of the container by the capture screw being very careful so as to not allow the face of the grating to touch the wall of the container. To store the turret follow the reverse procedure.

In the case where *InSpectrum* has arrived from a cold environment, allow the packages to approach ambient room temperature before opening. Failure to do so may result in condensation on delicate optical surfaces inside the spectrograph and on the grating surfaces.

Under no circumstances attempt to wipe condensation or any other material from the optics.

Installing a Turret

InSpectrum has the information concerning the grating groove densities and positions on the turrets stored in an internal EPROM. If your system was supplied with multiple turrets refer to page 12 **The Monochromator (Spectrograph) Tab** for important instructions about setting up the hardware configuration screen in **SpectraSense**.

1. Remove the cover from ***InSpectrum*** by removing the six screws located in the cover.

2. Remove the grating turret from its enclosure, as per the previous instructions.

3. Refer to the figure below. Use one finger from one hand to steady the turret. Grasp the locking screw with the other hand. Guide the turret into place on the turret platform. Note that there are two alignment balls on the platform that must match with cone shaped indentations in the bottom of the turret. Assure the grating assembly is properly seated on the rotary table. When the turret sits flat on the platform tighten the knurled captive screw until it is just snug.

   Be very careful to not touch the grating surfaces or to allow the turret to hit the walls of the spectrograph.

4. Replace the cover panel.

5. Seal the grating storage container and place in an obvious location.

Software Installation

InSpectrum operates under **SpectraSense** software. Before any further checkout of the system can be made, the software must be installed. **SpectraSense** is a comprehensive software that controls all of Acton Research's single channel and multichannel spectrometers. ***InSpectrum*** shares most of the same functions found in Acton's SpectraPro line of imaging spectrometers and Roper Scientific's line of CCD detectors. There are some minor but subtle differences in the CCD functions.

Although **SpectraSense** can run Acton's other instruments under Windows 95 and Windows NT, this not the case for ***InSpectrum***. The USB interface is not supported by these older operating systems. A computer loaded with either Windows 98, ME, 2000, or XP is required. The minimum system requirements are as follows: a Pentium II processor or equivalent, 64mb of RAM or more, a hard disk drive with a minimum of 200mb of available space, a SVGA or better graphics card, a monitor, a CD ROM reader, a Windows compatible mouse and a Windows compatible printer.

Place the SpectraSense CD-ROM in the drive. Click on the Start button, go up to Run. Click on the Browse button and find the drive and directory that contains **Autorun.exe**. Click on Autorun.exe and then Open. Click on OK. An installation panel will appear. Click on the install button that is appropriate for your operating system. Follow the directions on the screen to complete the installation. Your computer must be rebooted before you can use the software.

The complete manual in PDF format is also included on the installation CD-ROM. All topics in the table of contents and index are hot linked to the appropriate pages in the manual. In order to read the manual, you must have Adobe Acrobat Reader on your computer. If you do not have a copy, click on the install Adobe Acrobat Reader button.

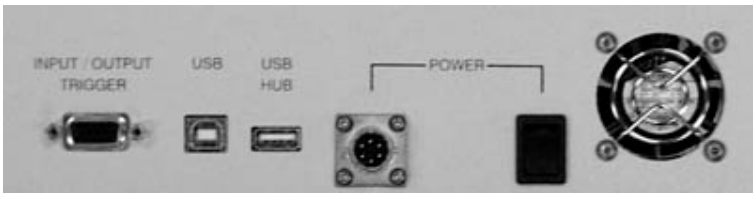
A complete Software Developer's Kit with sample code and a complete COM/DCOM library of functions that can be incorporated into programs written in higher level languages such as C++, Visual Basic, and Delphi is also included on the CD-ROM. These functions can also be incorporated in National Instrument's LabView applications. A complete catalog of Acton Research products and technical notes is also included on the CD-ROM.

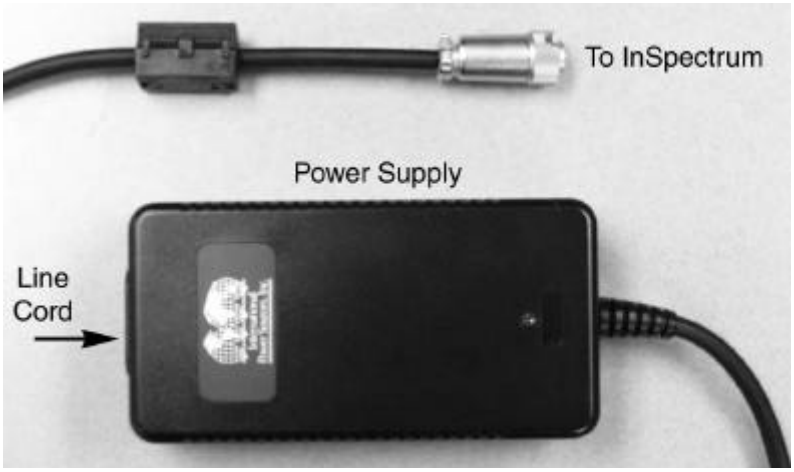
Hardware Installation

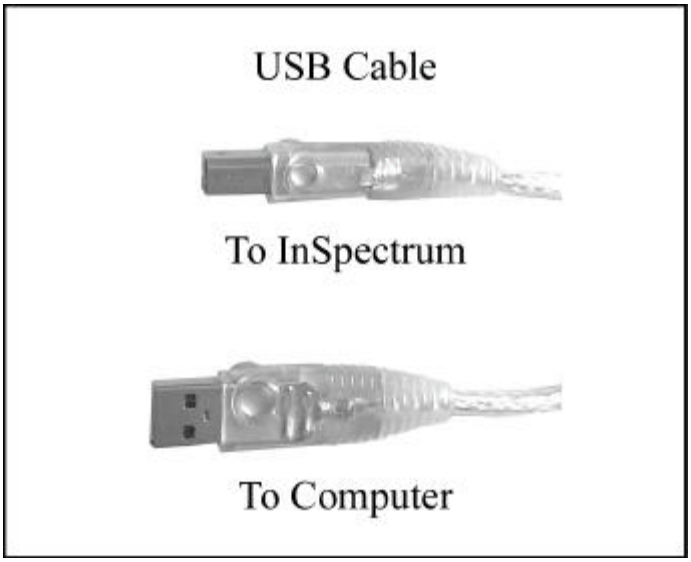
There is only one connection between the computer and ***InSpectrum***. The instrument is supplied with a USB cable. Although multiple cables can be linked together using a hub, we recommend that the total length not exceed 10 feet.

The power supply can be connected to any 100 to 240VAC, 50/60Hz line.

I/O line connections will be covered later in the document.







System Status Panel

The system status panel located on the side of the instrument provides information as to the status of the hardware. When the instrument is under power the Power/Ready lamp initially is illuminated yellow. After the spectrograph drive mechanics have fully initialized the lamp turns green. Whenever there is communications between ***InSpectrum*** and the computer the USB lamp blinks. The Temperature Lock indicator turns GREEN when the CCD has reached and has stabilized at its specified operating temperature.

Mounting Bundled Fibers and Accessories

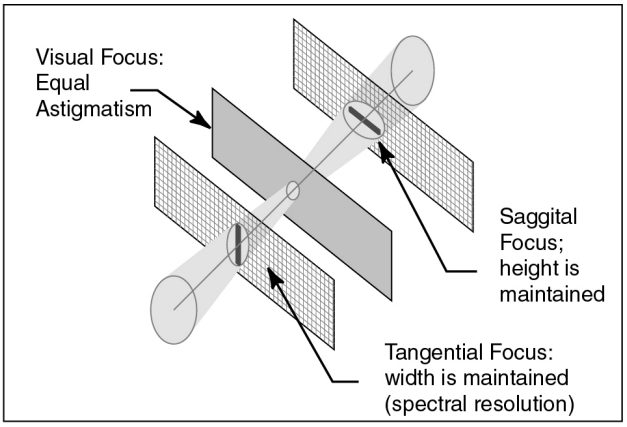
Input beams to the InSpectrum should be focused on the Entrance Slit and enter at an aperture ratio of f/4. The Entrance Slit Details drawing on page 24 shows the mounting dimensions.
If a fiber optic cable is to be used with the InSpectrum 300, it is recommended that the Acton FC-446-020 adapter be used or the Acton FC-446-030 be used if the beam needs to be refocused on the slit.

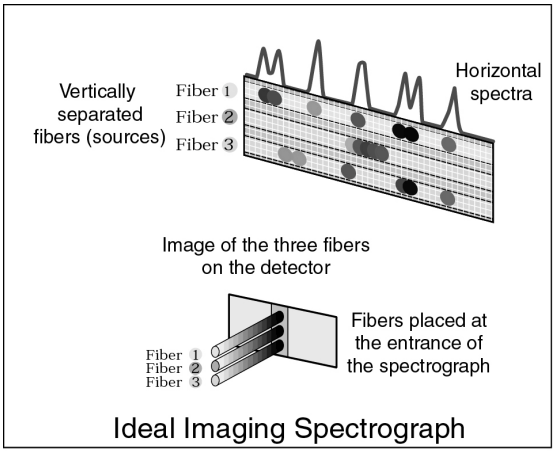
Basic Principles Of Operation

InSpectrum is an imaging spectrograph with an integrated 2 dimensional CCD detector. An imaging spectrograph differs from a classical spectrograph in that instead of employing two spherical mirrors, it has uses a toroid mirror to focus the slit image on to the detector.

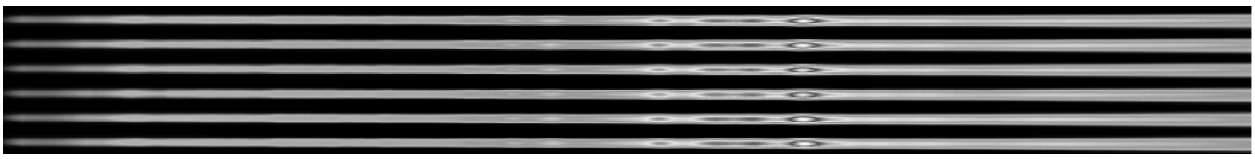
A classical spectrograph is configured such that the detector is placed in the tangential focal plane. At that position the image of a narrow point source becomes a tall ellipse. The width of the ellipse is extremely close to the diameter of the original point. This is good because the spectral dispersion is in the horizontal plane. The ability to differentiate between two spectral lines will not be compromised. In the vertical direction, however, the light is spread by a significant factor. This vertical astigmatism becomes more pronounced with high aperture instruments. As long as the detector is taller than the height of the ellipse, there is no appreciable signal loss. There could however be overlapping of the spectra of two vertically positioned point sources. This loss of spatial integrity only becomes important when there are vertically stacked detectors.

With the advent of 2 dimensional CCD detectors the possibility of reading stacked rows of pixels becomes very attractive. Given the right optics, several point sources, fiber optics for example, could be stacked in the entrance slit and their spectra could be differentiated. The toroid "corrects" the vertical astigmatism while producing little effect on the horizontal focus (spectral resolution) of the source. A spectrograph of this configuration is said to be an imaging spectrograph because it maintains both the vertical and horizontal integrity of the image.





The image below is from a series of 200micron fibers, separated by 200micron dead fibers. Each fiber is carrying the Raman spectral information of a sample of Anthracene.

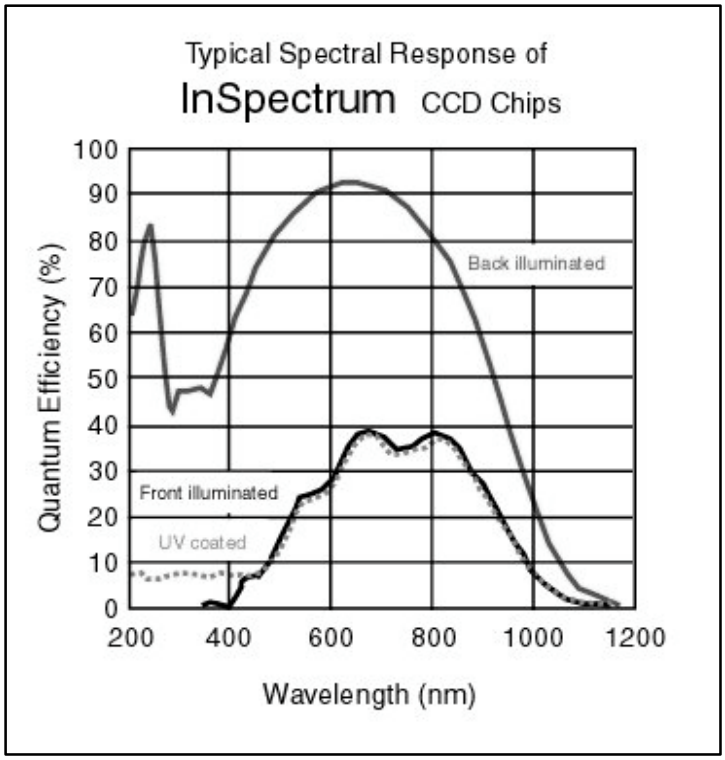


CCD Detection

CCD detectors come in a wide range of formats. The detectors used in ***InSpectrum*** are rectangular. All versions have 1024 pixels in the horizontal direction. The number of pixels, which are 24?[2], in the vertical direction was specified when the instrument was ordered. In essence there are 3mm high arrays and 6mm high arrays all of which are 24.6mm wide. The taller the array, the more light that can be captured, assuming the source is at least as high as the detector or the more discrete fiber inputs can be analyzed at the same time.

The detectors are available in both front illuminated versions and back illuminated versions. The front illuminated versions are lumogen coated have a spectral response between 200nm and 1100nm. The back illuminated versions have a spectral response from 200nm to 1100nm and are more sensitive. A complete discussion on CCD technology can be found on our sister company, Roper Scientific's, web site: www.roperscientific.com.

The chart below shows you the quantum efficiencies of the two types of detectors over their working spectral ranges.



In working with CCDs it is possible to take data from a portion of the chip as well as from the entire chip. These portions will be defined as **areas** for the remainder of this discussion.

InSpectrum is limited to areas that are the full width of the chip. There is also a limit of 32 areas that can be monitored simultaneously. This differs from the information in the **SpectraSense** manual in which it states that up 64 areas of any width may be specified, which is the case when working with Roper Scientific CCD detectors.

InSpectrum is limited to areas that are the full width of the chip. There is also a limit of 32 areas that can be monitored simultaneously.

The ability to define the height and number of areas read out on the chip provides a very powerful control for optimizing the signal to noise ratio of your spectra. In working with a CCD based spectrograph, there are several parameters that can be adjusted that will affect the quality of the spectra collected.

The discussion below is a brief summary of information contained in the SpectraSense manual. It is highly recommended that you consult the manual for a more detailed explanation of the parameters described below.

Integration Time The integration time is the length of time the CCD is exposed before being read out. Increasing the integration time will provide an improvement in the signal to noise ration of the spectrum. Increasing the integration time by a factor N will improve the s/n by √N.

Height of the Area In general the height of the area should match the height of the source. In the case of using a single fiber as the source, it would be of no advantage to read the signal from the dark pixels above and below. In fact, in some very low light cases, reading out the dark pixels will only increase the overall noise in the spectrum. It is often the case where the source is very intense and it saturates the detector. Under these circumstances choosing a shorter area will reduce the signal.

The following parameters, when adjusted, could affect the spectral resolution of narrow peaks spectral features

Slit Width The wider the slit, in most cases, the more light is collected. Doubling the slit width will double the intensity but will reduce the spectral resolution. If the spectrum being collected has broad features, it may be possible to open the slit and not affect the resolution. Opening the slit wider than the diameter of a fiber input produces no gain. In the case where there is too much signal, reducing the slit width will attenuate the signal and under certain conditions, improve the spectral resolution.

Horizontal Binning A full discussion on binning is covered in the **SpectraSense** manual. Under conditions where the spectral features are broad but not intense, it is possible to bin pixels horizontally. This will reduce the number of data points in the spectrum, and if too many pixels are binned, reduce the spectral resolution. However the spectrum will have an increase in the s/n by a factor of √N when N is the number of pixels horizontally binned.

Set Up

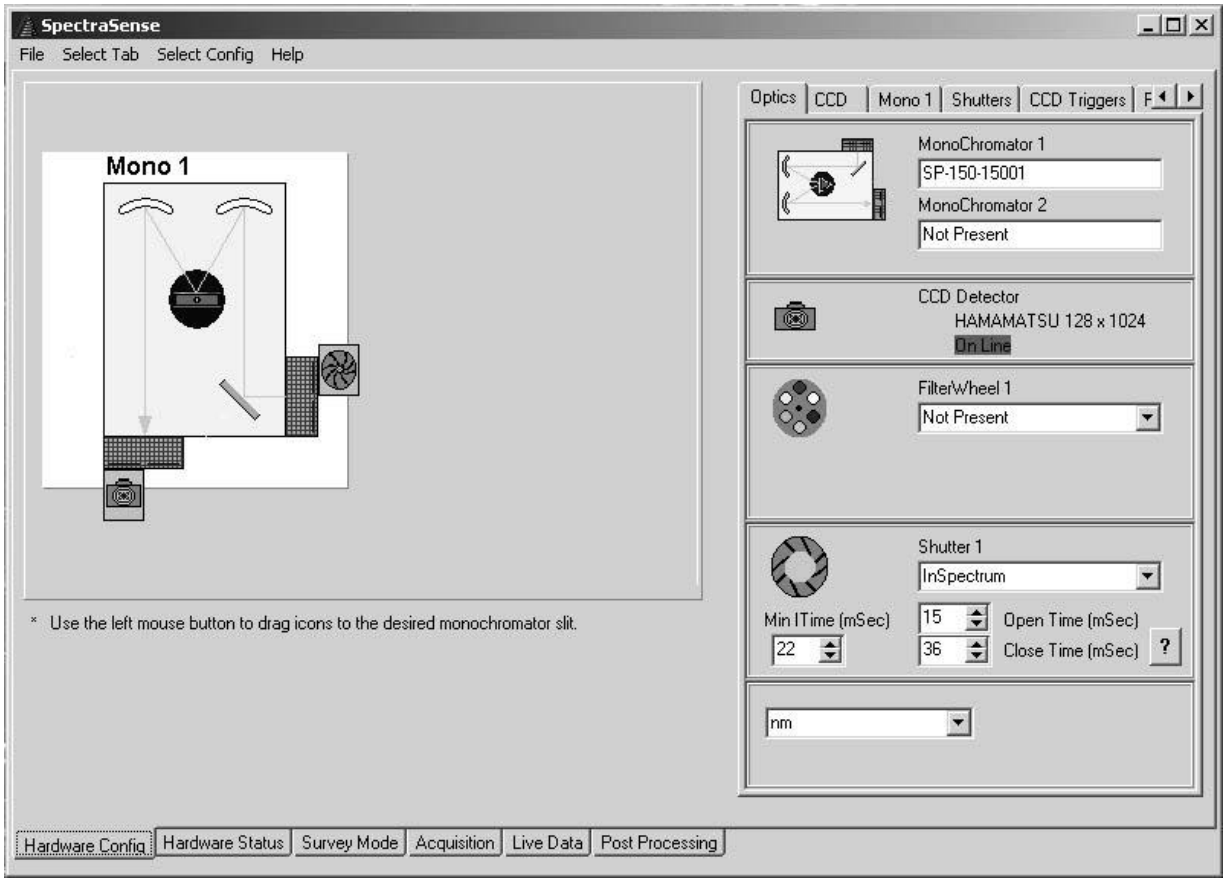
In order to operate ***InSpectrum***, it is necessary to run SpectraSense. The discussions that follow are abridged sections from the **SpectraSense** manual. Refer to it, if you require further clarification.

Plug the power supply into the wall and into ***InSpectrum***. Plug the USB cable into ***InSpectrum*** and into the computer. Wait for the ready LED to come on. Then start **SpectraSense**. If **SpectraSense** is running before you make the USB connection, it will not recognize the hardware and will default to a non-motorized monochromator.

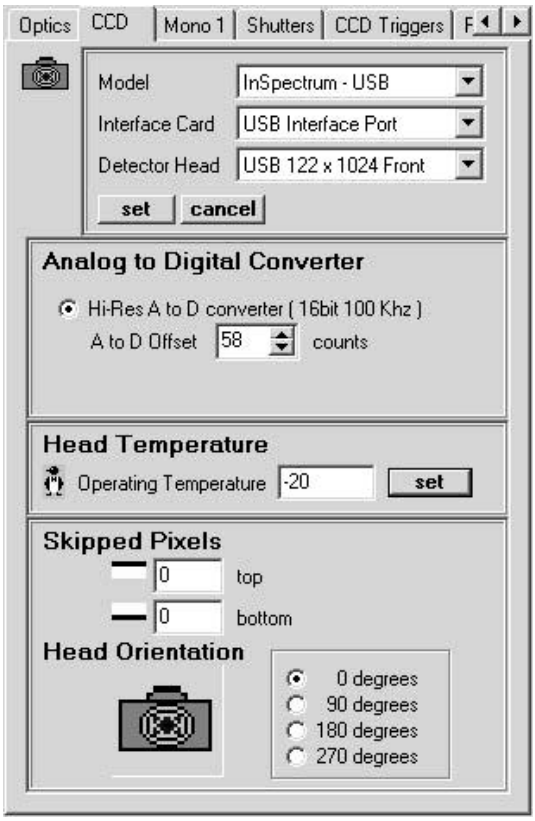
SpectraSense has 5 basic operating screens accessed via the tabs at the bottom of the window and one other screen, called the Hardware Configuration Screen which is accessible only from the Tabs menu choice.

Select the Hardware Configure tab. This tab is only accessed on the initial set up of the instrument, whenever turrets are changed, and to change the working spectral units, for example nm to wavenumbers.

The Hardware Configuration screen should look similar to the screen below. Verify that the shutter specified is for ***InSpectrum*** and, if there is a filter wheel installed in your instrument, that it is activated. In this introduction to the instrument, we will work in nm. After verifying this information, click on the CCD tab so that you can review the parameters that are appropriate for your particular CCD chip.



The CCD Tab



Select INS-300 in the model field.

Select USB in the Interface Card field.

Select the model CCD in the Detector Head field that corresponds to the model installed in your instrument

The USB port field must be specified by the user. If there is only one InSpectrum attached to the computer, there will be only one choice. If this field is not present, no user input is required.

Once all of these fields are correct, click on the **set** button.

The Head Temperature should be set to -20 degrees C. Enter that value in the field and click on the **set** button.

InSpectrum is equipped with one analog to digital converter. It is the 16bit 100kHz version.

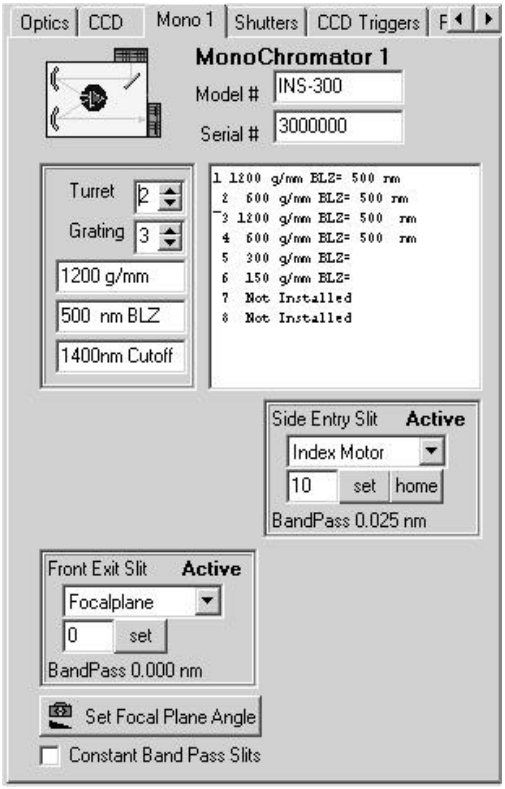
The A to D Offset controls the minimum count level for a dark scan of 1ms. Set the integration time to 1ms, and adjust the A to D Offset until the image signal from a scan is between 50-100. A typical value for the A to D Offset is between 55 and 90 counts.

A discussion on skipped pixels can be found in the **SpectraSense** manual.

The orientation of the head is fixed at 0 degrees in this instrument.

After this tab has been properly set, click on the **Mono 1** tab.

The Monochromator (Spectrograph) Tab



The monochromator tab contains all of the information concerning the spectrograph configuration. The model number and serial number are read into the software from a NOVRAM in ***InSpectrum***. Information as to the type of grating installed in each position of each turret is also stored in the NOVRAM. Gratings 1 and 2 are in turret 1, gratings 3 and 4 are in turret 2 etc.

Although the software knows which grating is in which position on each turret, it has no way of automatically determining which turret is installed.

> Each time that you install a different turret in the instrument you must return to this tab and input the correct turret number in the turret field. **Failure to do so will result in erroneous positioning of the grating and incorrect wavelength calibration of the spectra.**

The side entrance slit is motorized. If there should ever be a power failure while the slit mechanism is in motion, you can reinitialize the setting in this screen.

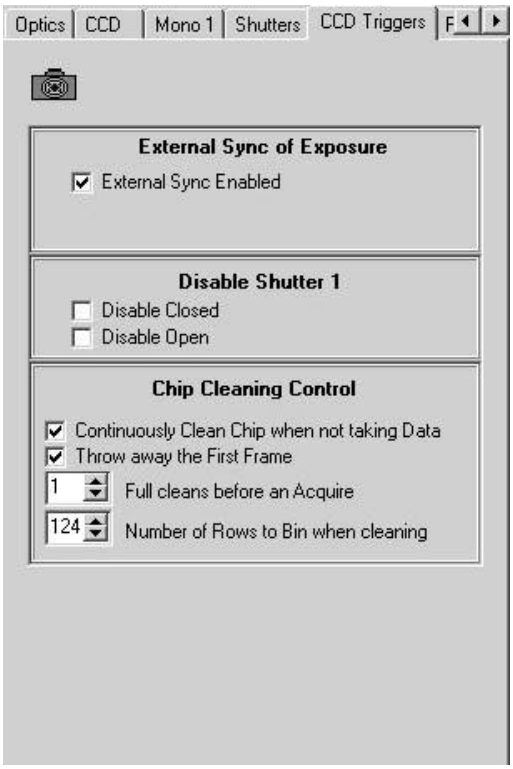
Information concerning the focal plane angle adjustment and constant band pass slit adjustment can be found in the **SpectraSense** manual.

The CCD Shutter Tab

For the initial set up of the system, verify that the External Sync Enabled is deselected and that the Disable Closed and Disable Open are deselected. As the chip accumulates charge constantly, the excess charge must be "cleaned" before each acquisition.

Activate the Continuously Clean option and put in 2 full cleans for a starting value.

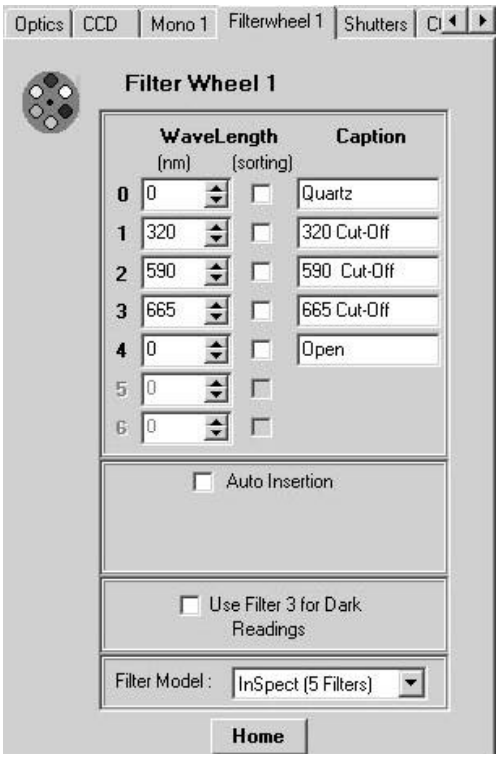
Consult the SpectraSense manual to learn more about these features and the effects of changing the values.



At this point your instrument has been successfully configured to run. Click on the **Hardware Status** tab.

The Filter Wheel Tab

If the filter wheel option was included in your ***InSpectrum,*** the filter wheel tab will display the parameters necessary to configure it. The ***InSpectrum*** filter wheel holds 5 filters. The wheel can be set up to automatically insert cut off filters at specified wavelengths and to allow insertion of a specific filter to remain in place for the entire acquisition.



Special order sorting filters are installed that minimize focus changes over the standard operation for each filter. A special compensation window is installed in position 1 to minimize focus changes. Use of an open position will cause the beam to be out of focus. The sorting filters are installed in specific positions; enter the cutoff wavelength in nm of the filter and check the sorting box. A caption may be entered if desired. The figure to the right shows the values for the standard filters. The sorting and Auto Insertion boxes must be checked to automatically insert cut off filters at specified wavelengths. Other types of filters such as neutral density filters can be installed in the wheel. For these types of filters the sorting box is left unchecked and a caption box is opened for naming the filter. Any filters other than those supplied with the instrument by Acton may cause a change in focus.

The **HOME** button will reset the wheel in the case of power interruption during positioning.

The Hardware Status Screen

The hardware status screen gives you a concise overview of the current state of ***InSpectrum***. From this screen you can:

Verify or change the current grating

Verify or change the slit width

Verify or change the current position of the spectrograph

Verify the current temperature of the detector

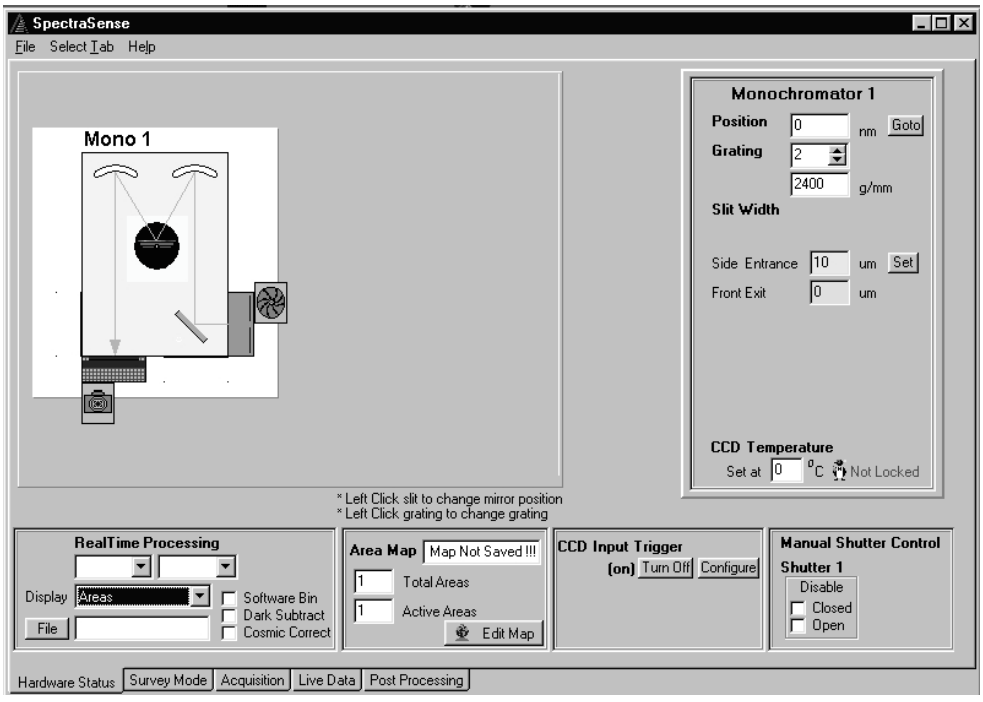
Verify or change the current level of real-time processing on incoming data

Verify or change the number of currently active areas

Verify or change the activation of triggers

Verify or change the current filter

Verify or change the state of the shutter activation



When you start **SpectraSense,** go to this screen first. This especially important if there are multiple users that work under different operating parameters.

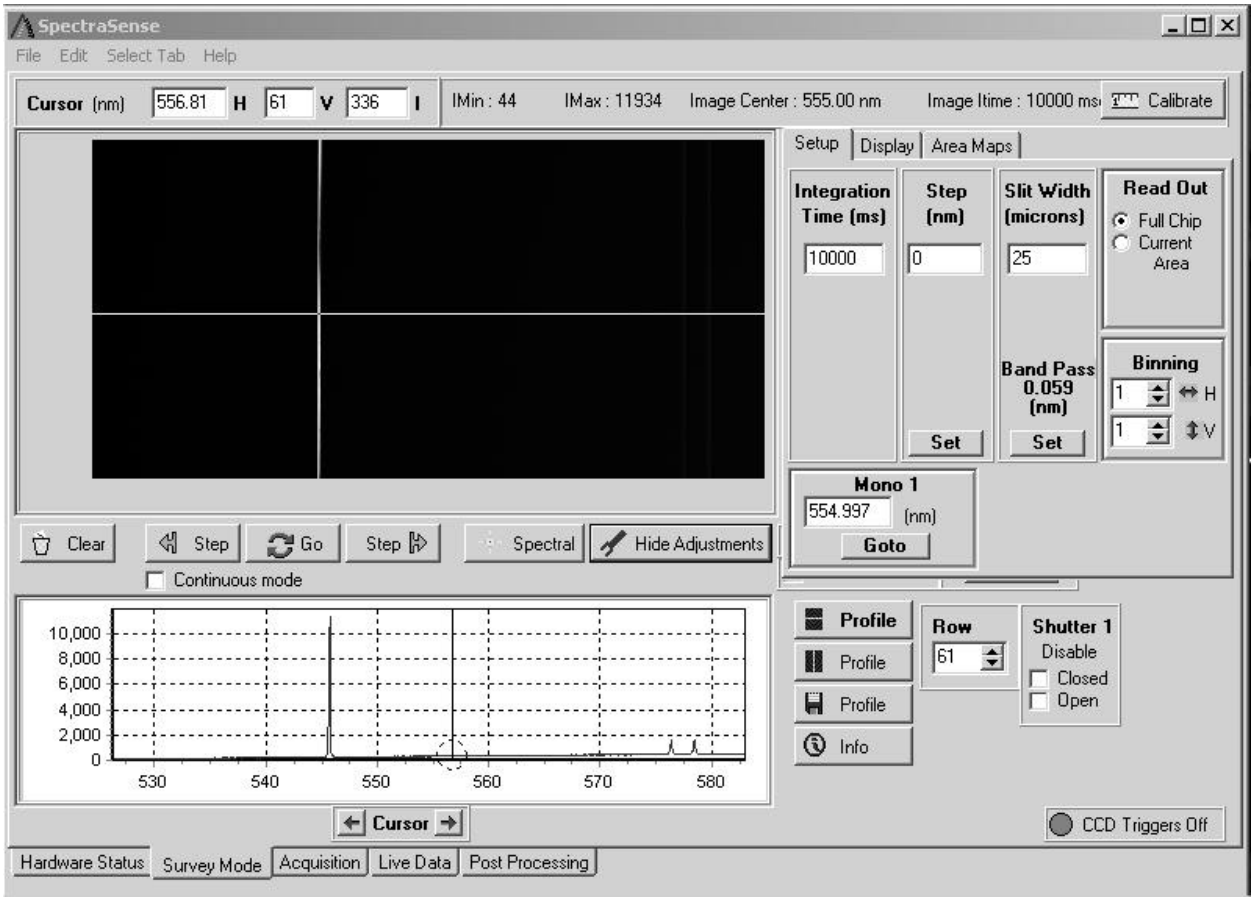
The Survey Screen

The Survey Screen is where the spectra are taken and acquisition parameters are optimized. In this discussion we will only touch upon the basic functions found in this screen. It is imperative that you read the survey screen section of the **SpectraSense** manual.

All of the parameters that affect the quality of the spectra are adjustable in real-time or near real-time from this screen. The parameters are:

Integration time
Slit width
Area size
Binning
Dark subtraction
Real-time spectral mathematics
Cosmic correction
Spectrograph positioning.

In addition an "imaging" mode allows you to see where the signal is hitting the chip. This is advantageous for optimizing area sizes and positions. It also provides diagnostics for determining the vertical alignment of fibers in the slit plane, as well as the focus of projected sources on to the entrance slit. We will use this screen to take our first spectra with ***InSpectrum***.



Checkout: First Step

1. Verify that the power indicator is lit, that the temperature lock indicator is green, and that communications has been established by noting the blinking of the USB indicator when new commands are sent to the instrument.

2. Verify that the CCD has been set to an operating temperature below 0 degrees by looking at the right side of the Survey Mode screen. Click on the hide adjustments button if you do not see it.

3. Click on the **adjustments button** to bring up the **setup tab**.

4. Click on the **Spectral/Imaging button** so that **Imaging** is on the label. This puts you in spectral mode. (It makes sense: click on the button to change to the labeled mode.)

5. Verify that the **Dark Subtract** box is unchecked.

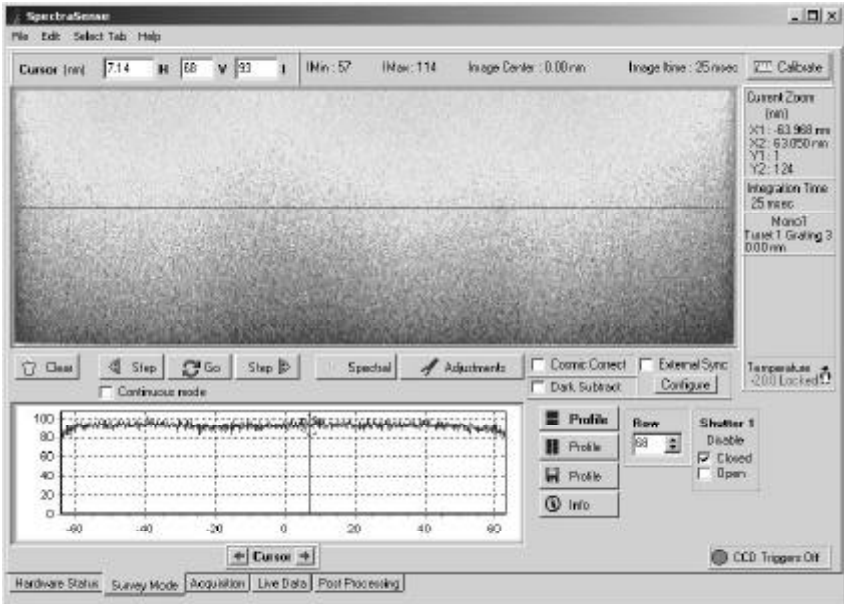
6. Set the integration time in the setup tab to 10ms.

7. Set the Mono position to 500nm

8. Block the entrance slit or disable the shutter (check box in bottom right of the screen)

9. Click on the **GO** button.

You should first see the USB indicator blink and then see a noisy line across the screen at some number counts (in the hundreds), which is not necessarily straight. At this point, the important issue is that you see something and that the software has not hung up. If you have gotten this far, ***InSpectrum*** is communicating with the software and data is being collected and transferred. Refer to Appendix B, Troubleshooting part 1 if there are any problems.

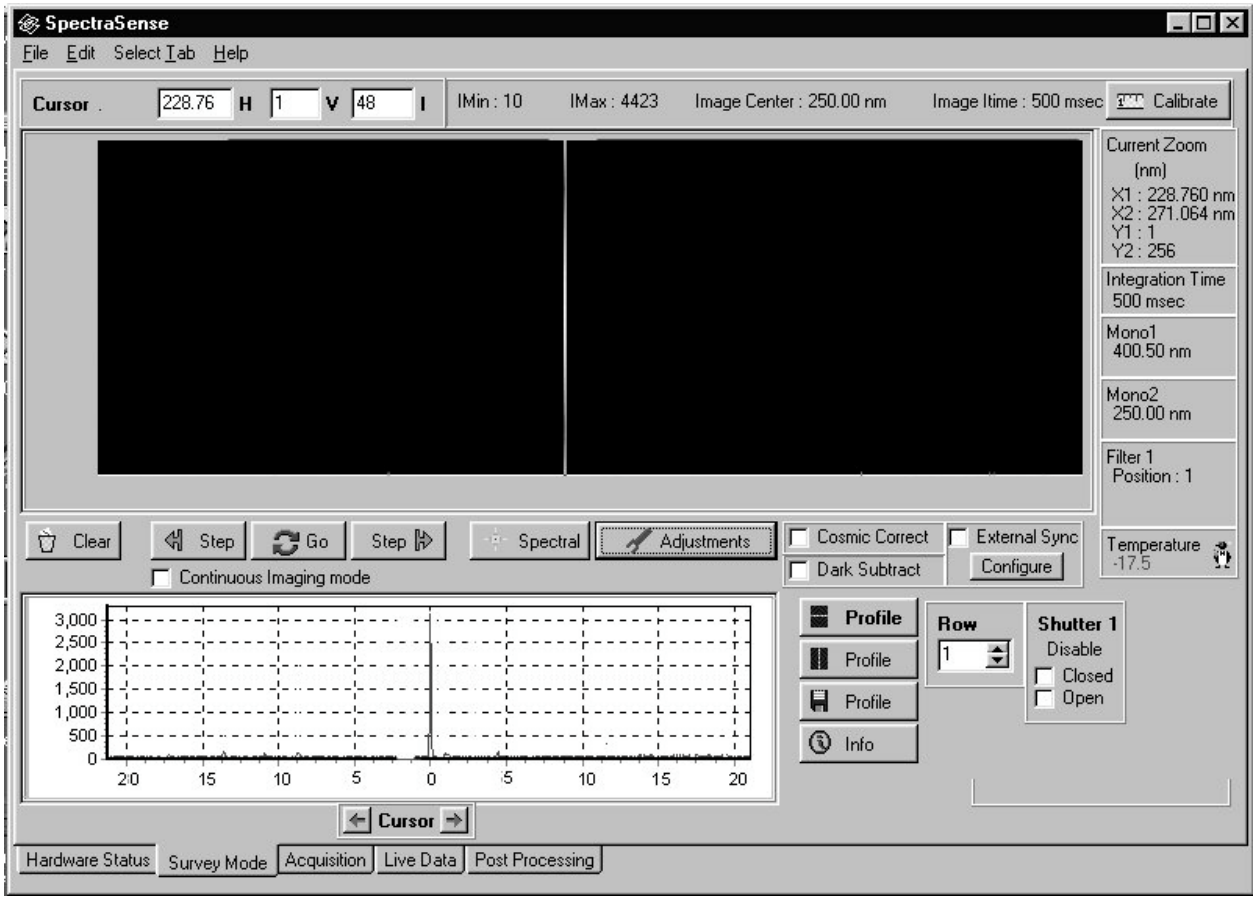


Second Step

Now that we know that the electronics is working and that there is communications, we will verify that it sees light.

1. Set the slit to 250microns.
2. Move the spectrograph to 0nm
3. Set the integration time to 500ms.
4. Click on the Image button. (After being clicked it should read Spectral)
5. Place a white card in front of the slit to reflect some light into the spectrograph.
6. Press **GO**.

In the top window you should see a dark background with a colored vertical line in the center. If the line is pink and splayed out at the top and bottom, you have saturated the detector. Reduce the slit width and/or the integration time so that the line is not saturated. If you see a very faint line, deep blue in color, increase the slit width and/or the integration time. In the window below, note that there will be a peak at 0nm. If you still do not see anything, click on the **Spectral** button and click **GO** again. At this point you should see a peak at 0nm on the top display.



If your instrument passed step one, but failed step 2, it is highly probable that light is not entering the spectrograph. Perform the diagnostics in part 2 of the troubleshooting section.

Taking your first spectrum

If you have a mercury pen lamp, use it as the source for this procedure. If you do not have a mercury lamp but have fluorescent lighting, you may use that for this procedure. If you have neither, secure a source with known narrow peaks and position the spectrograph at one of those peaks.

If you are using the overhead lights, place a white card in front of the entrance slit, tilted at approximately 45 degrees to send light into the spectrograph.

1. Set the spectrograph at 546nm.

2. Set the slit to 100 microns or less, if the source is intense.

3. Set the integration time to 100ms.

4. Select spectral mode.

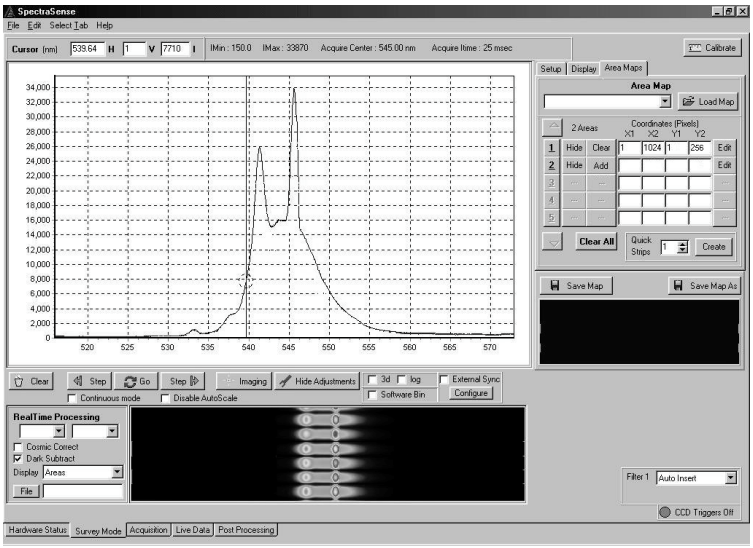
5. Click on **GO**.

You should see a peak at 546nm, and others at 577nm and 578nm with a grating with a groove density above 300g/mm. Depending on the type of fluorescent lamps used, you may see additional peaks and or a broad background under the spectrum.

6. Click on the **Area Map** tab.

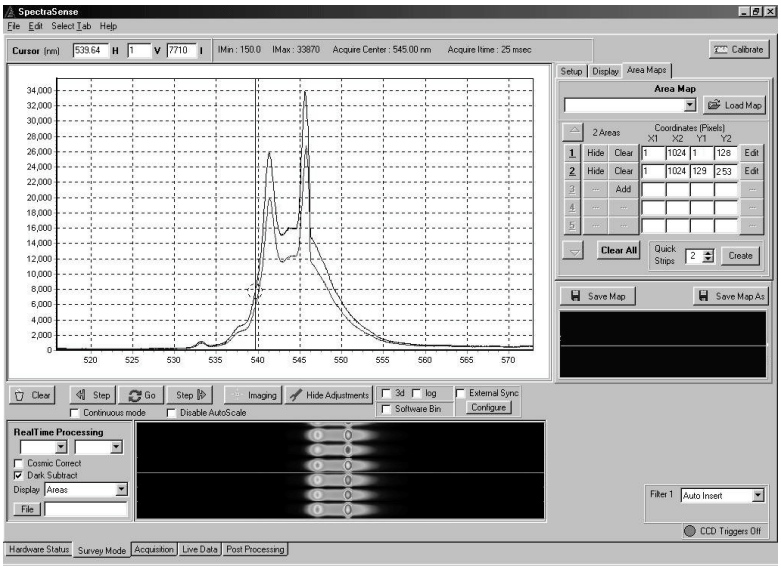
7. On the quick strips panel enter 2 and press the **Create button**.

8. Click on **GO**.



You should now see two spectra on the screen. Their intensities may not be equal, however the peak positions should be the same. If there is a greater than 2 pixel shift in the positions of the peaks, perform the same procedure with the other grating on the turret. If the peaks superimpose with one grating and not the other follow the procedure

in appendix A for aligning the grating producing the offset. If both gratings produce offset spectra contact customer service before attempting an alignment. If you are using a fiber optic bundle to illuminate the slit, it is possible to have the peaks shifted if the bundle isn't vertically aligned with the slit. Take an image and verify that all of the fibers are aligned vertically (as in the lower display in the screen below).



At this point you have verified that your ***InSpectrum*** is functional and well aligned. Refer to the calibration procedure in the **SpectaSense** manual to wavelength calibrate your instrument.

Specifications

Spectrograph

Optical Configuration:	300mm f/4.0 imaging Czerny Turner
Mirrors	Proprietary Acton enhanced reflective coating
Gratings	68mm x 68mm
Turret	Interchangeable dual grating
Entrance Slit	Automated selection: 25µ, 50µ, 100µ, 250µ, 500µ, 1mm
Shutter	Internal
Resolution:	Better than 3 pixels over 6-mm height @435nm with 1200g/mm grating,
Spectral Coverage (nominal) Coverage will vary with central wavelength and with minor variances in focal length tolerance between individual units.	150g/mm grating 530nm 300g/mm grating 260nm 600g/mm grating 127nm 1200g/mm grating 58nm Others on request
Internal filter wheel (optional)	5 position, with automated insertion.

Detection

Hamamatsu CCDs with integrated TE Coolers
Versions:
Single stage TE cooler:
INS-124F 1024x124 pixels, lumogen coating, front-illuminated, 24 µ square pixels (24.6mm x 3mm)
INS-122B 1024x122 pixels, back-illuminated , 24 µ square pixels (24.6mm x 3mm)
INS-252F 1024x252 pixels, lumogen coating, front-illuminated, 24 µ square pixels (24.6mm x 6mm)
INS-250B 1024x250 pixels, back-illuminated, 24 µ square pixels (24.6mm x 6mm)

Cooling	single stage: ~-20 degrees C
Full Well Capacity per pixel	300,000 electrons
Digitization	16 bits 100kHz
Read Out Format	Selectable areas for imaging and spectral acquisition featuring horizontal and vertical hardware binning. Areas fixed width 1024 pixels. Maximum areas 32. Software vertical binning.
Read Out Rate	10 spectra/sec with shutter full vertical bin. ~50 spectra/sec no shutter
Triggers	External start of scan External sync Trigger out

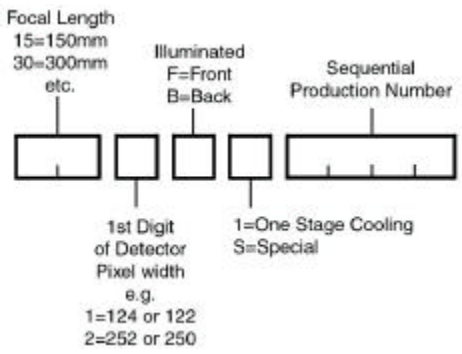
Communications

USB interface to PC compatible computer running Windows 98, ME, 2000, XP
(Windows NT and Windows 95 not supported)

Software

SpectraSense including	Full spectrograph and detector control Active X link into GRAMS/32 5.0 and LabVIEW COM/DCOM functions for rapid customization with VB, C++, and Delphi with complete documentation and sample code. Also compatible with Roper Scientific WinSpec, PVCAM, and Easy DLLs
Computer requirements	IBM PC compatible with Pentium II 300Mhz or better 128Mbytes RAM Hard drive 500Mbytes free CD-ROM reader SVGA graphics card or better (600x800) Color monitor Mouse Keyboard Windows 98, ME, 2000, or XP operating system USB port
Power	12VDC 3A regulated. Supplied with power supply 100-240VAC 50 to 60Hz operation
Weight	15.9Kg (35lbs)
Dimensions	L 492mm (19.4 in) W 297mm (11.7 in) H 211mm (8.3 in)

Serial Number



Examples:
Serial Number 302B10007; InSpectrum 300 with 250 back illuminated CCD and single stage cooling
Serial Number:152F10010; InSpectrum 150 with 252 front illuminated CCD and single stage cooling

Specifications subject to modification without notice

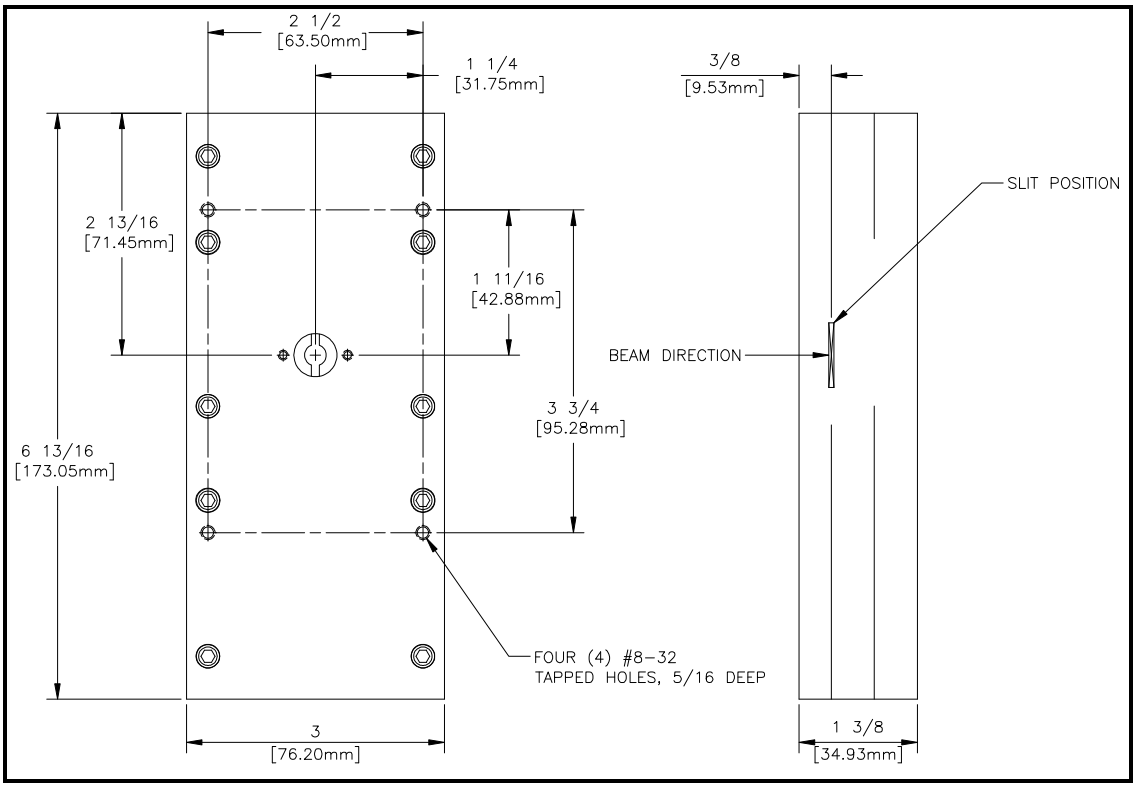
Grating Options

Acton Research has a full compliment of gratings that can be installed in ***InSpectrum***. It should be noted that many of the 68mm x 68mm gratings listed in the catalog are not appropriate due to the fact that the spectral responsivity of the CCD detectors falls off after 1µ. The table below shows the approximate spectral coverage that can be expected with the most common gratings. It is important to note that these values are at specified central wavelength. Centering on shorter wavelengths will increase the coverage slightly while centering at longer wavelengths will reduce the coverage slightly.

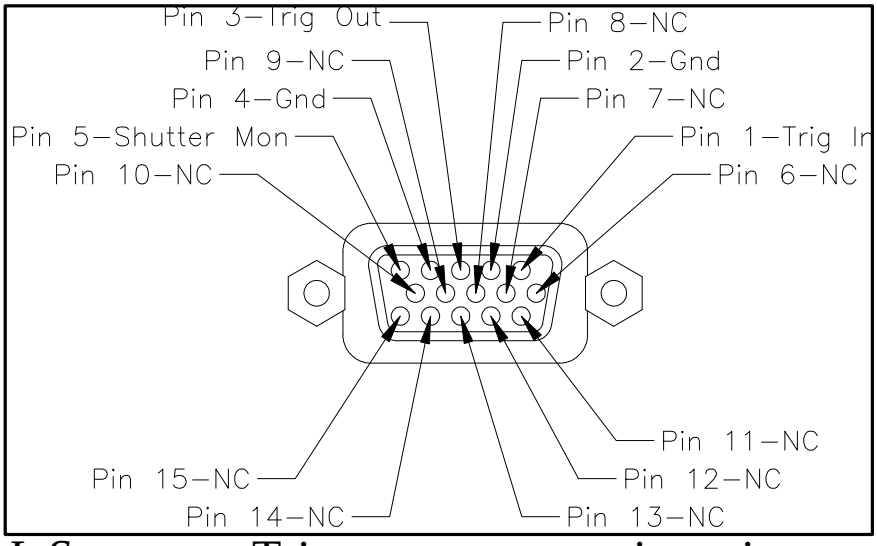
Density	Center Wavelength	Coverage at Center Wavelength	Total nm Covered	Approximate Band Pass (nm/pixel)
75g/mm	550nm	27nm to 1067nm	1040	1
150g/mm	550nm	290nm to 808nm	518	0.5
300g/mm	550nm	422nm to 677nm	255	0.25
600g/mm	550nm	488nm to 612nm	124	0.125
1200g/mm	550nm	520nm to 578nm	58	0.06
2400g/mm	550nm	540nm to 560nm	20	0.02
3600g/mm	300nm	290nm to 307nm	17	0.0166

The following gratings from our catalog are appropriate for use with ***InSpectrum***.

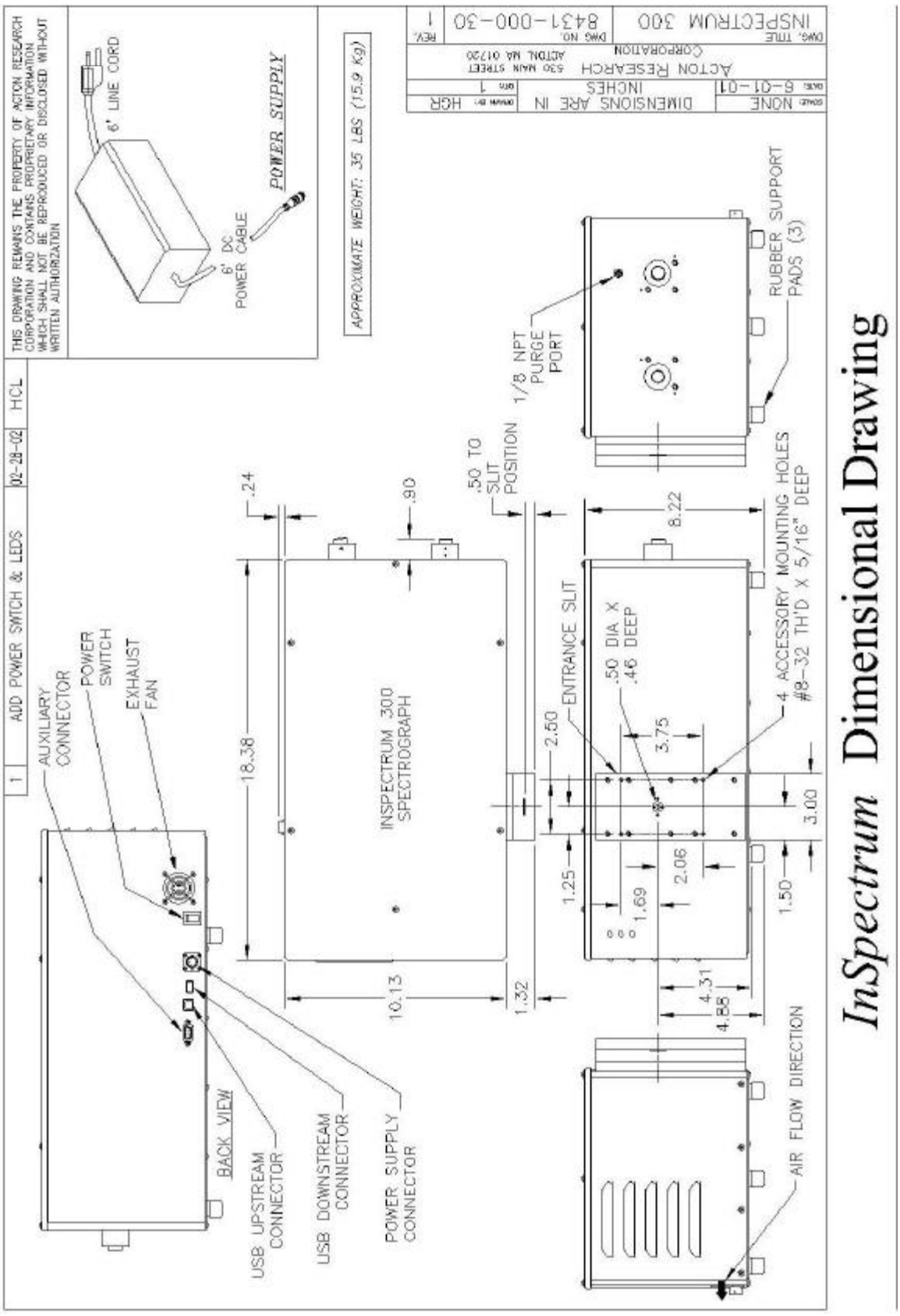
Density	**Blaze Wavelength**	**Part Number**
150g/mm	500nm	1-015-500
300g/mm	300nm	1-030-300
300g/mm	500nm	1-030-500
600g/mm	300nm	1-060-300
600g/mm	1µ	1-060-1
1200g/mm	300nm	1-120-300
1200g/mm	500nm	1-120-500
1200g/mm	750nm	1-120-750
1200g/mm	Holographic	1-120-HUV
1200g/mm	Holographic	1-120-HVIS
1800g/mm	250nm	1-180-250
1800g/mm	500nm	1-180-500
2400g/mm	240nm	1-240-240
2400g/mm	Holographic	1-240-H
3600	240nm	1-360-24-



InSpectrum Entrance slit details



InSpectrum Trigger connector pin assignments


InSpectrum Dimensional Drawing
INSPECTRUM 300
8431-000-30
REV. 1
ACTON RESEARCH CORPORATION
DIMENSIONS ARE IN INCHES
SCALE: NONE
DATE: 5-01-01
DRAWN BY: HGR
SHT. 1
APPROXIMATE WEIGHT: 35 LBS (15.9 Kg)
THIS DRAWING REMAINS THE PROPERTY OF ACTON RESEARCH CORPORATION AND CONTAINS PROPRIETARY INFORMATION WHICH SHALL NOT BE REPRODUCED OR DISCLOSED WITHOUT WRITTEN AUTHORIZATION
1 ADD POWER SWITCH & LEDS 02-28-02 HCL
6' LINE CORD
6' DC POWER CABLE
POWER SUPPLY
AUXILIARY CONNECTOR
POWER SWITCH
EXHAUST FAN
BACK VIEW
USB UPSTREAM CONNECTOR
USB DOWNSTREAM CONNECTOR
POWER SUPPLY CONNECTOR
INSPECTRUM 300 SPECTROGRAPH
18.38
.24
.90
10.13
1.32
.50 TO SLIT POSITION
2.50
ENTRANCE SLIT
1/8 NPT PURGE PORT
8.22
RUBBER SUPPORT PADS (3)
.50 DIA X .46 DEEP
3.75
4 ACCESSORY MOUNTING HOLES #8-32 TH'D X 5/16" DEEP
1.25
1.69
2.06
3.00
1.50
4.31
4.88
AIR FLOW DIRECTION

Appendix A:

Troubleshooting common problems

Part 1: Communications

Your ***InSpectrum*** will perform an automatic opto-mechanical initialization each time that it is powered up. The procedure will cause the green Power/Ready indicator to change from yellow to green. If this does not occur, verify that there is nothing in the instrument that is blocking the turret from rotating. If the instrument fails to initialize, contact the Acton Research service department.

If the instrument initializes but there is not data coming out verify the following:

1. The USB cable is connected.
2. The yellow USB indicator blinks when the software initiates an action such as moving the spectrograph or acquiring data. If the USB lamp does not blink, verify that your computer has recognized the ***InSpectrum*** interface. In Windows 98 go to the Windows **Star**t >**Settings** > **Control Panel** > **System** > **Device Manager** >**Universal Serial Bus Controller**. Click on the + sign. If ***InSpectrum*** is connected and powered up, you should see it here. If it isn't, remove the USB cable and try again. If you started **SpectraSense** before connecting ***InSpectrum***, it will not be recognized. Verify that the CCD set up parameters in the Hardware Configuration screen CCD tab match your CCD. When using Windows 2000 go to the Windows **Star**t >**Settings** > **Control Panel** > **System** > >**Hardware**>**Device Manager** >**Universal Serial Bus Controller** then follow the above directions.

Part 2: Seeing Light

If there is proper communications between the Instrument and the computer, but you do not see light perform the following analysis.

1. With no light entering ***InSpectrum***, take a 10 second integration. You should seen a non-uniform line across the spectrum window as per the illustration on page 19. If you do not see this, contact the Acton Research service department.

2. In the set up tab, move the spectrograph to 500nm. Watch it move. If it doesn't move, contact customer service.

3. Set the integration time to 3000ms, click on **GO**. Listen to the shutter. You should hear it open and close. If it doesn't, verify that it is not disabled closed. {See lower right hand corner of screen.} If it is not disabled, verify that it was properly defined and activated in the Hardware Configuration screen.

4. Set the slit to 1000 microns. Dim the lights in the room. Shine a flashlight into the entrance slit. Click on **GO**. You should be able to see the light enter the spectrograph during the 3 second exposure.

5. Turn on the lights, leaving the cover off. Click **GO** again and look at the spectrum on the screen. If it is not a flat line at 65K counts, contact customer service.

Certification

Acton Research Corporation (Acton) certifies that this instrument was thoroughly tested and inspected and found to meet the specifications furnished by Acton when it was shipped from the factory.

Warranty

Acton Research Corporation (Acton) instruments and accessories are warranted for a period of one full year from date of delivery to be free from defects in material and to conform to the specifications furnished by Acton. The corporation's obligation under this warranty is limited to servicing or adjusting an instrument returned to the factory, prepaid, and to repairing or replacing at the factory any part or parts thereof. All purchased items carry the original manufacturer's warranty.

Acton Research Corporation shall not be liable for consequential damages resulting from accident, alteration, misuse, improper installation, operation on low or excessive voltages or any use in violation of the operating instructions furnished by Acton.

If any defect appears within the warranty period, the purchaser shall promptly notify Acton. No material will be accepted for repair or replacement without prior authorization from Acton. Upon such authorization and in accordance with instructions of Acton Research Corporation, parts, materials or equipment for which repair or replacement is requested shall be returned to Acton for examination, with shipping charges prepaid by the purchaser. Final determination as to whether a product or part is actually defective rests with Acton Research Corporation.

In such cases where necessary repairs are not covered by this warranty, an estimate of repair charges will be submitted to the purchaser before servicing the equipment.

In the event that the unit has to be shipped to another location or back to Acton Research Corporation for service, it is highly recommended that the original container and packing materials be used. In the event that you must ship the unit and you no longer have possession of the shipping carton, you can order one through the customer service department at Acton Research Corporation.

Acton Research Corporation assumes no liability for damages incurred to instruments caused by improper packaging.

Acton Research Corporation reserves the right to make changes or improvements upon its products without imposing any obligations upon itself to install the same upon its products previously manufactured.

This warranty is expressly in lieu of all other obligations or liabilities on the part of Acton, and Acton neither assumes, nor authorizes any other person to assume for them, other obligations or liability in connection with the sale of equipment manufactured by Acton Research Corporation.

Notes