# MODEL 621
# LASER WAVELENGTH METER

Version 4.7


# USER'S MANUAL

The information contained in this publication is subject to change without notice.

# CONTENTS

# 1 INTRODUCTION

## Welcome

Thank you for purchasing the 621 Laser Wavelength Meter from Bristol Instruments. Two different models of this system are available: the 621A and 621B. The model 621A measures absolute laser wavelength to an accuracy of ± 0.2 parts per million. The 621B system has an accuracy of ± 0.75 parts per million.

The model 621A and model 621B are available for operation over the wavelength ranges of 375 – 1100 nm (VIS version), 520 – 1700 nm (NIR version), and 1 – 5 μm (IR version). The 621B system is also available for operation over the wavelength range of 2 to 12 μm (MIR version) with an accuracy of ± 1.0 part per million.

This *User's Manual* includes information about the 621A and 621B Laser Wavelength Meters. It covers all the topics necessary to help you operate your system.

If you have any questions about the operation of your 621 system, please do not hesitate to call Bristol Instruments at (585) 924-2620. Or, you can contact us at service@bristol-inst.com.

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## Safety Notices


Warning denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning sign until the indicated conditions are fully understood and met.


Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the product. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

## General Safety Considerations

This product has been designed and tested in accordance with IEC 61010-1 and has been supplied in a safe condition. The instruction documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

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**WARNING** **This instrument is a Class 2 Laser Product. It contains a laser that emits radiation that can seriously damage your eyesight. Less than 15 μW of this laser light is emitted from the fiber-optic connector of the VIS and NIR versions, and less than 50 μW of this laser light is emitted from the aperture of the IR and MIR versions. Do not stare into this beam or view it directly with an optical instrument. The Class 2 warning label, shown here, is located next to the fiber-optic input coupler (VIS and NIR) or the input aperture (IR and MIR) on the front panel of the model 621.**


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**WARNING** **If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in the specified mode without deviation from the written instructions. Use of this product in any manner other than described herein may cause permanent damage to eyesight and therefore is strictly prohibited.**

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**WARNING** ***Never* inspect or clean a fiber-optic cable without first disconnecting the entire cable assembly from the optical source. Failure to take this precaution can permanently damage your eyesight.**

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**WARNING** **No user serviceable parts are inside. Refer servicing to Bristol Instruments or its representatives only. To prevent electrical shock, do not remove covers.**

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**WARNING** **To prevent electrical shock, disconnect this instrument from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

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**WARNING** **This is a Safety Class 1 product (provided with protective ground). The mains plug shall only be inserted in a socket outlet provided with a protective ground contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

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**CAUTION** Always use the three-prong AC power cord supplied with this instrument. Failure to ensure adequate grounding by not using this cord may cause instrument damage.

**CAUTION** *Do not* connect AC power until you have verified the line voltage is properly grounded and within the specified range (90–260 VAC and 47–63 Hz). Damage to the instrument could result.

**CAUTION** This instrument has autoranging line voltage input. Be sure the supply voltage is within the specified range.

**CAUTION** Maximum safe input is 10 mW of optical power. Laser input power in excess of 10 mW can result in damage to the instrument.

**CAUTION** Use care in handling fiber-optic connectors. Always clean the fiber end prior to insertion into the instrument's fiber-optic connector for optimum performance. Failure to do so can result in damage to the instrument. To prolong instrument service life, it is advantageous to attach a new fiber-optic patchcord to the instrument and use its other end for the connect/disconnect procedure.

## Inspection

The 621 Laser Wavelength Meter is packed in a carton designed to give maximum protection during shipment. If the outside of the shipping carton is damaged, notify your shipping department immediately. Your shipping department may want to notify the carrier.

If the shipping carton is not damaged, carefully remove and identify all of the components listed below. Contact Bristol Instruments or your local representative if any of the components are missing. We recommend that you save the shipping carton for future storage or transportation.

The 621 system includes the following components:

- ✓ Laser Wavelength Meter chassis
- ✓ Three alignment leg/feet assemblies (IR and MIR versions)
- ✓ Power cord (North America and Japan only)
- ✓ USB 2.0 cable
- ✓ CD with *User's Manual* and *NuView Software*
- ✓ Fiber-optic cleaning kit

# 2 INITIAL INSTRUMENT SETUP

## General

**WARNING**

**This instrument is a Class 2 Laser Product. It contains a laser that emits radiation that can seriously damage your eyesight. Less than 15 μW of this laser light is emitted from the fiber-optic connector of the VIS and NIR versions, and less than 50 μW of this laser light is emitted from the aperture of the IR and MIR versions. Do not stare into this beam or view it directly with an optical instrument. The Class 2 warning label, shown here, is located next to the fiber-optic input coupler (VIS and NIR) or the input aperture (IR and MIR) on the front panel of the model 621.**


1 Place the 621 Laser Wavelength Meter on a firm horizontal surface.

2 Make sure that there is at least 2 inches (50 mm) of clearance on all sides of the instrument to allow for ventilation.

## Power Supply Connections

**WARNING**

**This is a Safety Class 1 product (provided with protective ground). The mains plug shall only be inserted in a socket outlet provided with a protective ground contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

**CAUTION**

Always use the three-prong AC power cord supplied with this instrument. Failure to ensure adequate grounding by not using this cord may cause instrument damage.

**CAUTION**

*Do not* connect AC power until you have verified the line voltage is properly grounded and within the specified range (90–260 VAC and 47–63 Hz). Damage to the instrument could result.

**CAUTION**

This instrument has autoranging line voltage input. Be sure the supply voltage is within the specified range.

1 Verify that the line power meets the requirements shown below.

- 95 to 260 VAC
- 47 to 63 Hz
- Protective Ground

2 Connect the line-power cord to the power input connector on the instrument's back panel (Figure 2.1).

3 Connect the other end of the line-power cord to the power receptacle.


**Figure 2.1: Back Panel**

## Signal Output Connections

The 621 Laser Wavelength Meter has the following connections for signal output and communications. These connections are located on the instrument's back panel (Figure 2.1).

- **USB Port** - Interface to a PC for instrument control and data reporting.
- **Ethernet Port** – Not currently supported.
- **DB-9 Monitor Port** - Used to monitor the interference fringe pattern and instrument timing signals with an oscilloscope. A full description is provided in Appendix D.

1 Connect the USB interface cable to the USB port on the back panel of the instrument.

2 Connect the other end of the USB cable to a USB port on your PC.

## Software Installation

The *NuView Software* provided on the *Application Software* CD controls the Laser Wavelength Meter and displays the collected data. The CD also includes the Silicon Labs USB drivers necessary to connect the PC to the Laser Wavelength Meter. The following computer hardware is required to run the software.

- A PC running Microsoft Windows 7 or Microsoft Windows 8
- At least 1 GB of available RAM
- USB 2.0 (or later)
- Monitor
- Mouse or other pointing device

**1** Insert the *Application Software* CD into your CD-ROM drive. If Autorun is enabled on your system, installation will start automatically. Otherwise, double click on the installer to begin.

**2** Once the software is installed, a shortcut to the *NuView Software* will automatically be placed on the Start Menu (or Application Menu) of the PC. Click on this icon to open the application.

**3** Navigate to the "Help" menu and select "Manual" to open a PDF file of the 621 *User's Manual* (this file). This *User's Manual* will describe installation and operation of the 621 system.

**4** Open the *Application Software* CD folder. Click the folder labeled "SiLabs," and then the folder labled "CP210x_VCP_Windows."

**5** For a 32-bit operating system, double click on CP210xVCPInstaller_x86.exe; for a 64-bit operating system, double click on CP210xVCPInstaller_x64.exe. The InstallShield Wizard will be activated, and follow the Wizard's instructions until the installation is complete.

# 3 LASER INPUT – VIS AND NIR VERSIONS

## Fiber-Optic Laser Input

**WARNING** **This instrument is a Class 2 Laser Product. It contains a laser that emits radiation that can seriously damage your eyesight. Less than 15 μW of this laser light is emitted from the fiber-optic connector of the VIS and NIR versions, and less than 50 μW of this laser light is emitted from the aperture of the IR and MIR versions. Do not stare into this beam or view it directly with an optical instrument. The Class 2 warning label, shown here, is located next to the fiber-optic input coupler (VIS and NIR) or the input aperture (IR and MIR) on the front panel of the model 621.**


**WARNING** ***Never* inspect or clean a fiber-optic cable without first disconnecting the entire cable assembly from the optical source. Failure to take this precaution can permanently damage your eyesight.**

**CAUTION** Use care in handling fiber-optic connectors. Always clean the fiber end prior to insertion into the instrument's fiber-optic connector for optimum performance. Failure to do so can result in damage to the instrument. To prolong instrument service life, it is advantageous to attach a new fiber-optic patchcord to the instrument and use its other end for the connect/disconnect procedure.

**CAUTION** Maximum safe input is 10 mW of optical power. Laser input power in excess of 10 mW can result in damage to the instrument.

The laser under test enters the 621 system through an FC/PC fiber-optic connector on the front panel of the instrument (Figure 3.1).


**Figure 3.1: Front Panel of the VIS and NIR Versions**

1 Ensure that all fiber-optic connectors are clean and dry. The 621 system is shipped with a fiber cleaning kit consisting of a package of connector cleaning sticks, clean wipes, and fiber-optic splice & connector cleaner spray. See Appendix E for cleaning instructions.

2 Connect your fiber-optic patchcord to the pre-aligned FC/PC fiber-optic connector on the instrument's front panel. Make certain that the alignment key on the fiber-optic patchcord's connector (Figure 3.2) is properly seated in the slot of the input connector.

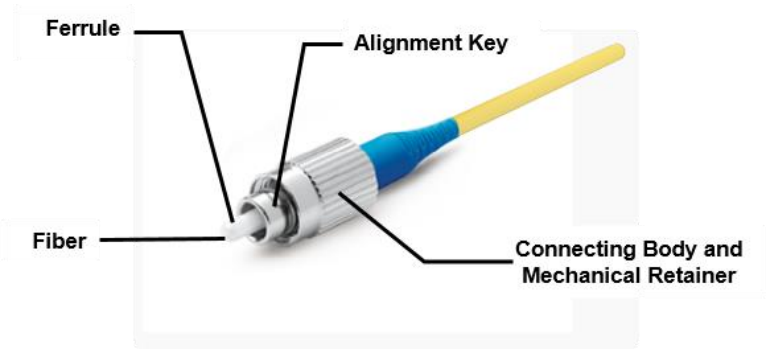


**Figure 3.2: Basic Components of an FC/PC Fiber-Optic Connector**

3 Tighten the mechanical retainer with a light to medium finger-tightness. Exceeding this torque may result in a poor connection or may damage the connector.

## Free-Beam Laser Input

**WARNING**

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**WARNING**

***Never* inspect or clean a fiber-optic cable without first disconnecting the entire cable assembly from the optical source. Failure to take this precaution can permanently damage your eyesight.**

**CAUTION** Use care in handling fiber-optic connectors. Always clean the fiber end prior to insertion into the instrument's fiber-optic connector for optimum performance. Failure to do so can result in damage to the instrument. To prolong instrument service life, it is advantageous to attach a new fiber-optic patchcord to the instrument and use its other end for the connect/disconnect procedure.

**CAUTION** Maximum safe input is 10 mW of optical power. Laser input power in excess of 10 mW can result in damage to the instrument.

If the laser under test has a free space beam, it must be launched into a fiber-optic patchcord for entry into the 621 Laser Wavelength Meter. The LC-1 Fiber-Optic Input Coupler offered by Bristol Instruments is a convenient method of doing this.

**1** Install the LC-1 coupler in any two-axis (Θ-Φ) adjustable optical mount that can accommodate a 1 inch (25.4 mm) diameter optic. Optical mounts with X–Y translational adjustment may be convenient in some laboratory configurations.

**2** Center the laser beam on the 2.5 mm input aperture of the LC-1 coupler. Using the angular adjustments of the optical mount, adjust the face of the beam coupler to be orthogonal to the laser beam.

**3** Two back reflections from the LC-1 coupler should be visible near the laser's output aperture. They can also be seen by placing a white card (with a hole in the center) in the beam path as shown in Figure 3.3. Adjust the optical mount until the reflections symmetrically straddle the input beam.

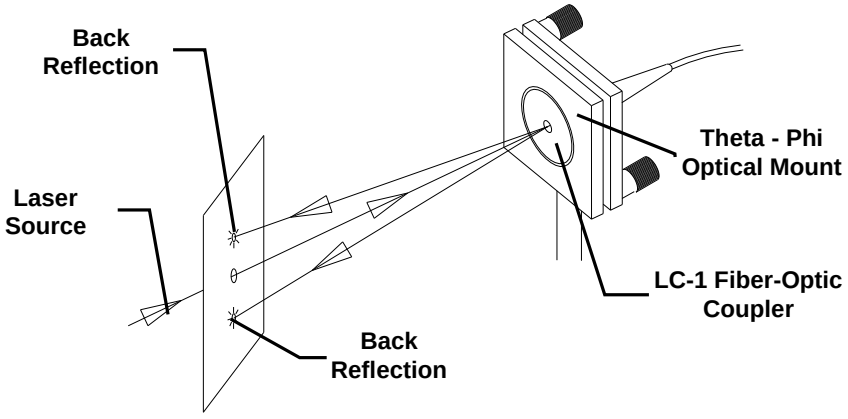



**Figure 3.3: Aligning the LC-1 Fiber-Optic Input Coupler**

**4** Maximize throughput, using visual or power meter detection, by making minor angular adjustments with the Θ-Φ optical mount.

# 4 LASER INPUT – IR AND MIR VERSIONS

## Installation of Adjustment Feet

The IR and MIR versions of the 621 Laser Wavelength Meter are supplied with three leg/feet assemblies (Figure 4.1) that are used to precisely align the instrument's Michelson interferometer to the laser under test.

**1** Firmly attach the leg/feet assemblies to the 621 system by threading them onto the three 10-32 x ¼ threaded studs emerging from the underside of the chassis.


**Figure 4.1: Model 621-IR/MIR Adjustment Feet**

If desired, the 621 Laser Wavelength Meter can be securely attached to an optical table using the Pedestal Legs and commonly available clamping forks.

**1** Remove the Lock Nut and Foot components from each leg assembly.

**2** Use three F1.0 Clamping Forks (not supplied) to secure each Pedestal Leg to the table.

**3** Align the laser under test to the 621 system using two mirrors in a centering/pointing configuration.

# Alignment of Laser Under Test

**WARNING** **This instrument is a Class 2 Laser Product. It contains a laser that emits radiation that can seriously damage your eyesight. Less than 15 μW of this laser light is emitted from the fiber-optic connector of the VIS and NIR versions, and less than 50 μW of this laser light is emitted from the aperture of the IR and MIR versions. Do not stare into this beam or view it directly with an optical instrument. The Class 2 warning label, shown here, is located next to the fiber-optic input coupler (VIS and NIR) or the input aperture (IR and MIR) on the front panel of the model 621.**


**CAUTION** Maximum safe input is 10 mW of optical power. Laser input power in excess of 10 mW can result in damage to the instrument.

The laser under test enters the IR and MIR versions of the 621 system through an input aperture on the front panel of the instrument (Figure 4.2).

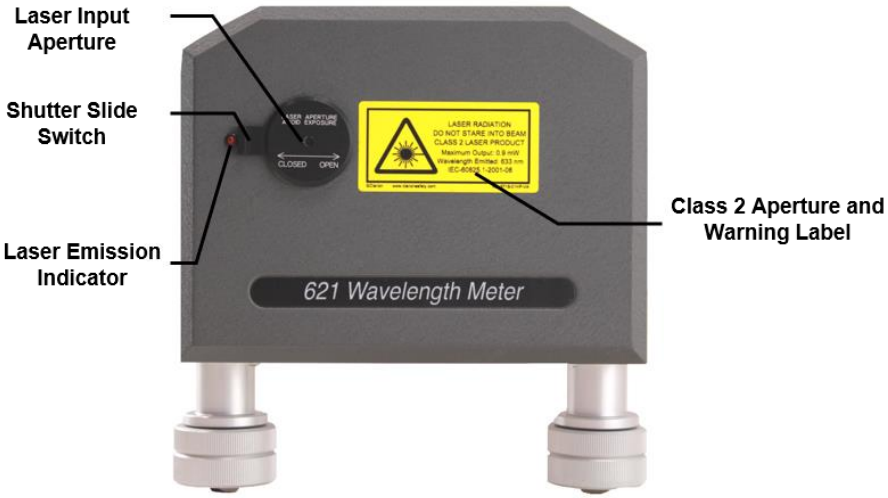



**Figure 4.2: Front Panel of the IR and MIR Versions**

To facilitate alignment of the laser under test, the internal HeNe reference laser is emitted from the input aperture as a weak visible tracer beam. This tracer beam defines the optical path of the HeNe reference laser through the instrument's Michelson interferometer. In order to achieve the specified wavelength measurement accuracy, the laser under test must follow exactly the same path.

To block the red tracer beam from exiting the instrument, the input aperture is equipped with a manual shutter. The input aperture is open when the shutter slide switch is in the right-most position. The input aperture is closed when the shutter slide switch is in the left-most position.

**WARNING** **The power of the red tracer beam is less than 50 μW, but do not stare into the beam or view it directly with an optical instrument.**

1 Set the height of the three adjustment feet to mid-range.

2 With appropriate mirrors, adjust the laser under test to be parallel to the optical table at a height of approximately 5 ½ inches (140 mm). Total travel of the 621 adjustment feet is ½ inch (13 mm). It is not advisable to have the instrument too close to the top of the adjustment range.

3 Set the model 621 in front of the laser beam about 1 meter from the source.

4 Adjust the position and height of the two front adjustment feet so that the red tracer beam and the laser under test are superimposed at the input aperture.

5 Adjust the height and position of the back adjustment foot until the red tracer beam is directed back along the path of the laser under test.

6 Steps 4 and 5 may have to be repeated in order to optimize alignment.

**IMPORTANT: In order to achieve the specified wavelength measurement accuracy, the red tracer beam and the laser under test must be precisely collinear (within 0.5 mm for the model 621A and within 1.5 mm for the model 621B) over a one meter path from the input aperture.**

7 Use the lock rings on the adjustment feet to secure the model 621 when alignment is complete. This is done by rotating the lock ring upward to snugly contact the leg, thereby preventing the adjustment foot from rotating. The lock ring does not require substantial tightening.

# 5 USING THE LASER WAVELENGTH METER

## Operation Instructions

**1** Turn on the power switch of the 621 Laser Wavelength Meter located on the back panel of the instrument.

**2** Make sure the supplied USB cable is connected to the USB connector on the back panel of the 621 system and to a USB port on the PC.

**3** Start the *NuView Software* by clicking on its icon. The *NuView Software* will display the Bristol Instruments logo before any instrument is connected (Figure 5.1)

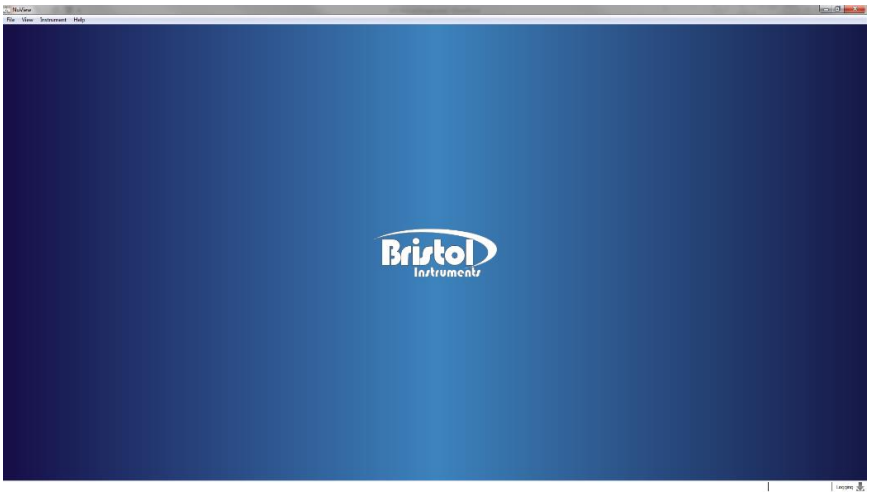
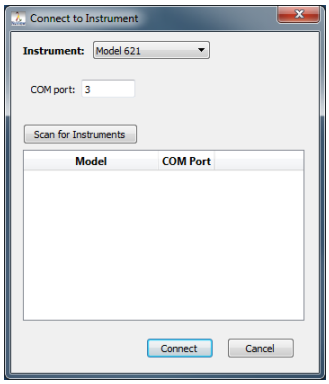



**Figure 5.1: Start-Up Screen**

**4** Open the Instrument Menu and select Connect.

**5** Select "Model 621" from the drop down list.

**6** Manually enter the COM port for the instrument and click "Connect." If the COM port is unknown, click "Scan for Instruments" to locate the instruments that are connected to the PC. Double click on the desired instrument from the list to populate the COM port field, and click "Connect." The status text at the bottom-left corner of the screen should change to "Connected." If an error message is displayed, check that the instrument is running and connected as described in Steps 1-3.



## Wavelength Screen

The Wavelength Screen of the *NuView Software* displays the absolute wavelength, wavenumber, or frequency of the laser under test. Once the application is connected to the instrument, the Wavelength display will update continuously until the connection is terminated.

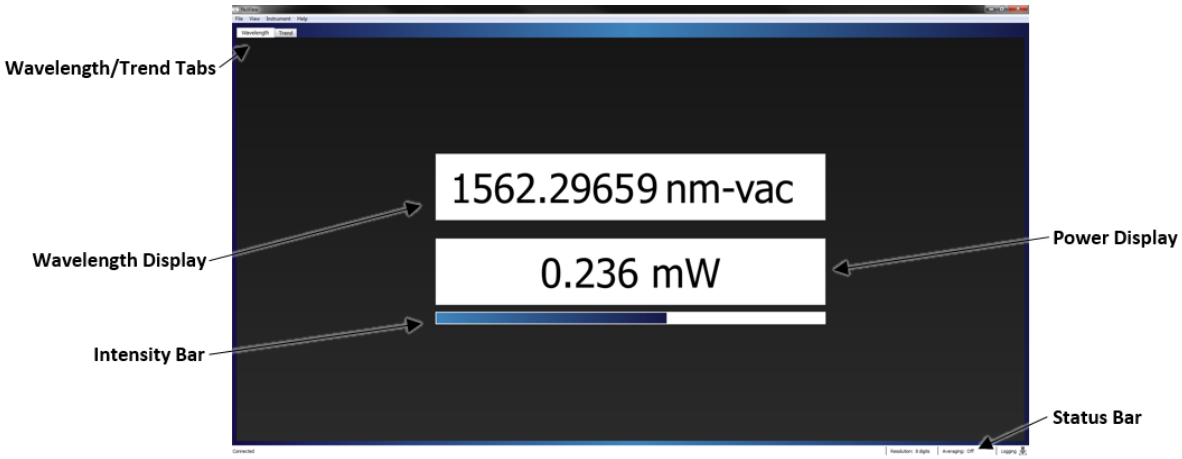



**Figure 5.2: Wavelength Screen of VIS and NIR Versions**

**Wavelength/Trend Tabs**
Allows the user to toggle between the Wavelength Screen and the Trend Screen.

**Wavelength Display**
Displays the absolute wavelength, wavenumber, or frequency of the laser under test. The value given is an intensity weighted average of the laser's spectrum.

**Power Display**
Displays the absolute power of the laser under test (VIS and NIR models only).

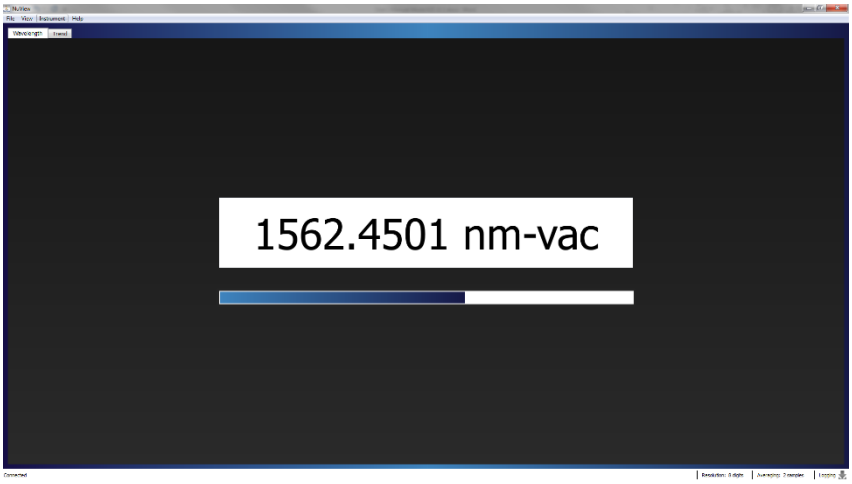



**Figure 5.3: Wavelength Screen of IR and MIR Versions**

**Intensity Meter**

Graphically displays the relative intensity of the laser under test.

**Status Bar**

The Status bar is located at the bottom of the Wavelength Screen and the Trend Screen. It provides information about the current state of the instrument as described below (from left to right).

- **Connection status** – Either connected or disconnected.
- **Resolution** – The Display Resolution setting of the collected data. The options are Auto or a fixed number of digits.
- **Averaging** – Either "Off" or the number of samples being averaged.
- **Logging** – The downloading icon is gray when logging status is inactive, and green when logging status is active.

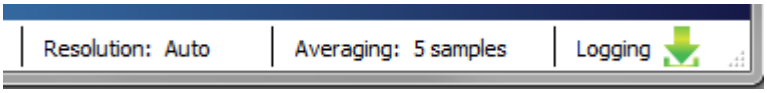



**Figure 5.4: Status Bar**

## Trend Screen

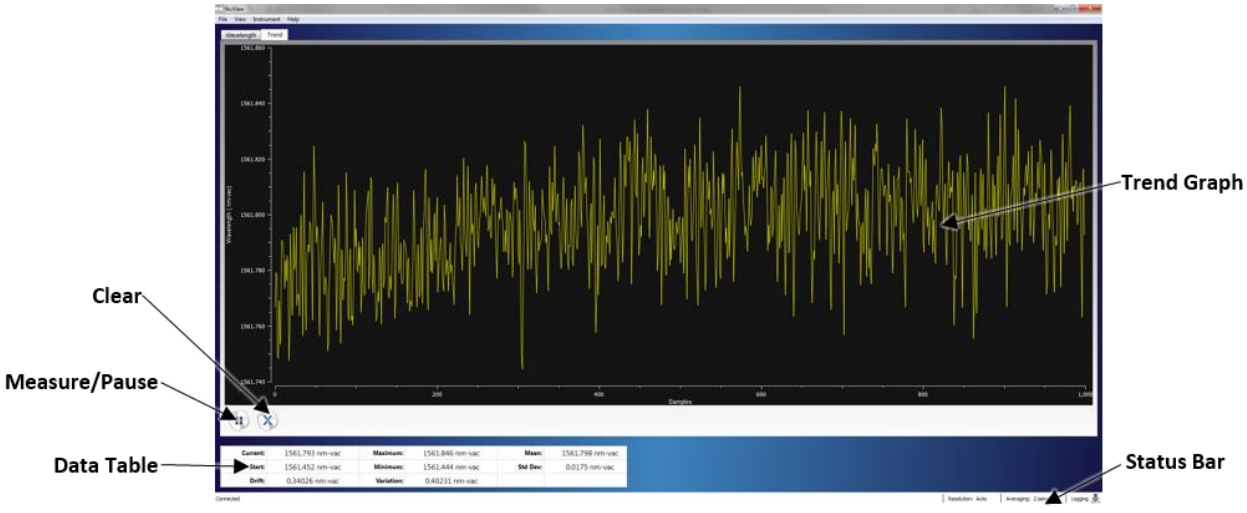



**Figure 5.5: Trend Screen**

**Measure/Pause**

Selecting the Measure button (left) initiates data collection. After the Measure button is selected, it changes its appearance to the Pause button (middle). The Trend Graph and Data Table are updated continuously until the Pause button is selected. Selecting the Pause button stops data collection, and the Trend Graph and Data Table display the last measured data. When the instrument is not connected, the Measure button changes its appearance to its greyed-out inactive state (right).

**Clear**

Selecting the Clear button (left) restarts the Trend Graph and resets the values in the Data Table. When the instrument is not connected, the Clear button changes its appearance to its greyed-out inactive state (right).

**Data Table**

The Data Table provides current and trending information about the laser's wavelength, frequency or wavenumber.

| | | | | | |
|---|---|---|---|---|---|
| **Current:** | 1532.8302 nm-vac | **Maximum:** | 1532.8306 nm-vac | **Mean:** | 1532.8299 nm-vac |
| **Start:** | 1532.8303 nm-vac | **Minimum:** | 1532.8291 nm-vac | **Std Dev:** | 0.0003 nm-vac |
| **Drift:** | -0.00010 nm-vac | **Variation:** | 0.00150 nm-vac | | |

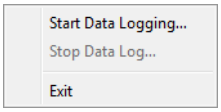
The first column of the Data Table provides laser drift information. This column displays the current measurement (Current), the first measurement taken after the Trend Graph is started/reset (Start), and the difference between the Current and Start measurements (Drift).

The second column provides the total measured variation of the laser under test. This column displays the maximum and minimum measurements recorded on the Trend Graph (Maximum and Minimum, respectively), and computes the difference between them (Variation).

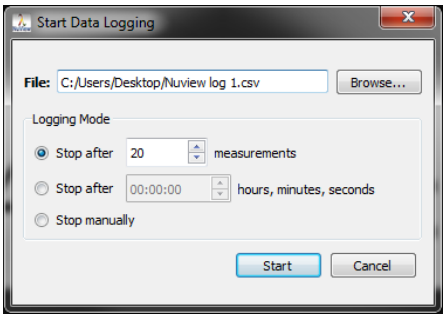
The third column provides some basic statistical information about the variation of the Trend Graph. This column provides the average (Mean) and standard deviation (Std Dev) of the Trend Graph.

# Menu Function Descriptions

### File Menu




- **Start Data Logging –** The wavelength measurements can be logged in a comma separated value (*.csv) file format for use in other graphing programs. If "Stop after measurements" or "Stop after hours, minutes, seconds" are selected, logging will stop automatically after the specified number of measurements or amount of time, respectively. If "Stop manually" is selected then logging must be stopped manually by clicking the Stop Data Logging menu item. The default file name is "Nuview log 1.csv"; if you use this filename then the number at the end will increment each time you begin a new log.

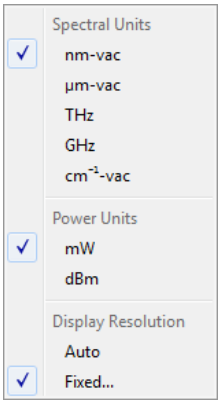



  Click on Start Data Logging, then change the log file name and location or use the default name and location. Select the radio button for the logging type. When "Stop after measurements" is selected, the number of measurements can be adjusted incrementally using the up/down arrows or by highlighting the current numeric value and entering a new numeric value with the keyboard. When "Stop after hours, minutes, seconds" is selected, the time can be adjusted incrementally using the up/down arrows or by highlighting the current time duration and entering a new time duration with the keyboard. Click Start to begin the logging of wavelength data.

- **Stop Data Logging –** Stops the current logging operation. Note that if you started logging using the "Stop after measurements" or "Stop after hours, minutes, seconds" options, logging will stop automatically and you do not need to click on Stop Data Logging unless you wish to abort early. In any case, the logging data will be written to the specified file when data logging is stopped.

- **Exit** - Exits out of the *NuView Software.*

### View Menu




- **Spectral Units –** Allows the user to select the measurement units for the Wavelength Screen and Trend Screen.
  - **nm-vac –** Sets measurement units to nanometers (vacuum values).
  - **µm-vac –** Sets measurement units to micrometers (vacuum values).
  - **GHz –** Sets measurement units to gigahertz.
  - **THz –** Sets measurement units to terahertz.
  - **$cm^{-1}$-vac –** Sets measurement units to wavenumbers (vacuum values).

  **NOTE:** In other scientific publications, the units of nanometers, micrometers, and wavenumbers may refer to the values in an air, standard air, or vacuum environment. The 621 Laser Wavelength Meter provides measurements as values in a vacuum environment, and units that are dependent on environment are given a "-vac" suffix to emphasize this fact.

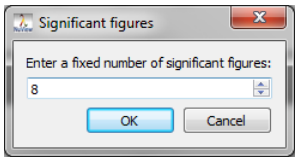
- **Power Units –** Allows the user to select the power units for the Power Meter.
  - **mW –** Sets power units to milliwatts.
  - **dBm –** Sets power units to decibel-milliwatts.
- **Display Resolution –** In order to realize the specified accuracy from the 621A Laser Wavelength Meter (± 0.2 ppm), the bandwidth of the laser under test must be less than 1 GHz (FWHM). The bandwidth of the laser under test must be less than 10 GHz (FWHM) in order to achieve the specified accuracy from the model 621B (± 0.75 ppm). If the laser under test has a bandwidth that is larger than these values, the measurement accuracy will be reduced approximately according to the following table.

| Laser Bandwidth ($\Delta\nu$) | Accuracy |
|---|---|
| $\Delta\nu \leq 1$ GHz | ± 0.2 ppm (± 0.0002 nm at 1000 nm) |
| 1 GHz < $\Delta\nu \leq 10$ GHz | ± 1.0 ppm (± 0.001 nm at 1000 nm) |
| 10 GHz < $\Delta\nu \leq 100$ GHz | ± 10 ppm (± 0.01 nm at 1000 nm) |
| 100 GHz < $\Delta\nu \leq 1$ THz | ± 100 ppm (± 0.1 nm at 1000 nm) |

The Display Resolution setting matches the number of displayed digits to the accuracy of the instrument due to the bandwidth of the laser under test. The maximum number of digits displayed by the model 621A is 9 (minimum of 5). The maximum number of digits displayed by the model 621B is 8 (minimum of 4). Two modes for Display Resolution are available.

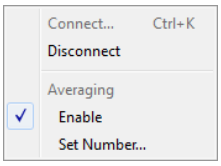
- **Auto –** Automatically determines the appropriate display resolution based on the bandwidth of the laser under test. Broadband input lasers will have a reduced number of digits, which corresponds to the instrument's decrease in accuracy.

- **Fixed –** The Display Resolution is set by the user. The number of digits can be adjusted incrementally by using the up/down arrows or by highlighting the current numeric value and entering a new numeric value with the keyboard.

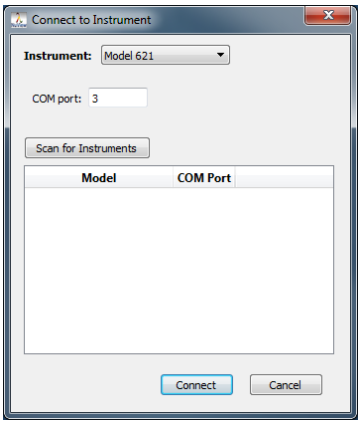



Although this mode allows the user to specify the number of digits to be displayed, the accuracy of the wavelength measurement is still limited by the bandwidth of the laser under test.

**Instrument Menu**




- **Connect –** Manually enter the COM port for the instrument and click "Connect." If the COM port is unknown, click "Scan for Instruments" to locate the instruments that are connected to the PC. Double click on the desired instrument from the list to populate the COM port field, and click "Connect."



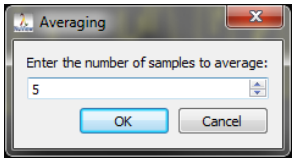

- **Disconnect –** Used to disconnect the 621 system from the PC.

- **Averaging –** This function automatically calculates a running average of as many as 100 measurements.

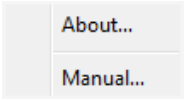
  When averaging is selected, the Wavelength Display or Trend Screen will display a single measurement after the chosen number of measurements is collected and averaged. The Wavelength Display or Trend Screen will then be updated with each successive measurement.

  – **Enable/Disable –** Averaging can be turned on by clicking Enable. This changes the menu option to Disable. Averaging is turned off by clicking Disable.

  – **Set Number –** Allows the user to enter the number of averages between 2 and 100. The number of averages can be adjusted incrementally by using the up/down arrows or by highlighting the current numeric value and entering a new numeric value with the keyboard.

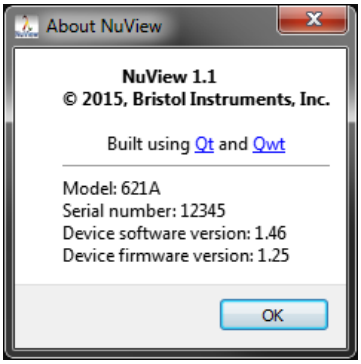



**Help Menu**




- **Manual -** Opens a PDF file of the 621 *User's Manual*.

- **About -** Displays the *NuView Software* version, the embedded software versions, and information about the 621 system.



# 6 APPLICATION PROGRAMMING INTERFACE (API)

## LabVIEW Program Interface

Two sample LabVIEW .vi's can be found in the Programming Interface folder on the *NuView Software* CD. The sample in the LabVIEW Example I folder, (getWavelength_v80.vi) uses calls to functions in the Windows dll CLDeviceIface.dll to access the wavelength meter. The functionality of this sample can be increased, or a new .vi can be written, by incorporating function calls using the following procedure.

**1** Add a Library Function Node to the .vi.

**2** Right click on this node to configure it.

**3** In this configure window, click on Browse and find the path to the CLDevIface.dll. This file is found on the *NuView Software* CD in the Bristol Wavelength Meter folder.

**4** Click on the drop-down arrow next to Function Name to choose the function call needed. For this example, the CLOpenUSBSerialDevice call is used. This should be the first function call in the .vi.

**5** Add the Return Type this function call expects. For the CLOpenUSBSerialDevice, the return type is long. Refer to the cldevdll.h file for the return types and parameters for each function. This file is found in the Bristol Wavelength Meter folder on the *NuView Software* CD.

**7** If the function call requires input parameters, these need to be specified by clicking Add a Parameter After. The parameter will be added in the parentheses.

**8** When finished, the configuration window for the CLOpenUSBSerialDevice call should look like the image below.

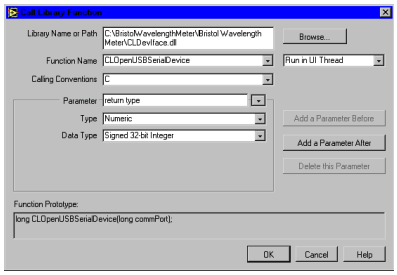



**Figure 6.1: Configuration Window for the CLOpenUSBSerialDevice Call**

**8** Repeat the steps to configure any other function calls needed and then wire the nodes together. The sample .vi getWavelength_v80.vi (Figure 6.2) opens the serial device based on the com port specified, and then gets the wavelength every time the user clicks on "Get Wavelength".

**9** When finished with the application, click on "Done" and the getWavelength_v80.vi will close the com port and exit. Sample getWavelength_v60.vi does not close the com port, and is only included here for reference.

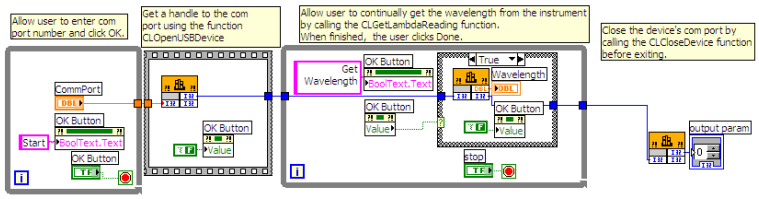



**Figure 6.2: Sample getWavelength_v80.vi.**

The sample .vi located in the LabVIEW Example II folder, BristolExample.vi, demonstrates how to interface LabVIEW directly to the 621 Laser Wavelength Meter without using the Windows dll. Because the communications functions that are contained in the dll are replicated in the .vi, the .vi is considerably more complex than the sample described above, which accesses the 621 Laser Wavelength Meter via the dll.

In order to interface directly with LabVIEW, the National Instruments' NI-VISA API/code library must be installed on the PC. This software is available for download at no charge from the National Instruments website.

Direct communication between LabVIEW and the 621 Laser Wavelength Meter can be initiated using the BristolExample.vi and the following instructions.

**1** On the BristolExample.vi Front Panel, shown in Figure 6.3, choose the appropriate com port from the pull-down list under the label "Port." The appropriate com port is the same port that was indicated in the PC's device manager when the instrument software was initially installed.

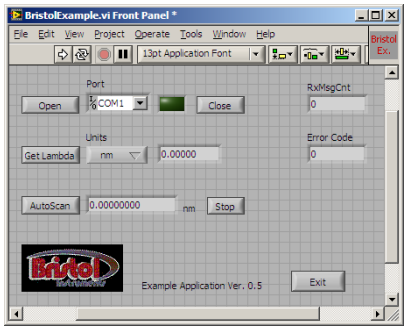



**Figure 6.3: Sample BristolExample.vi.**

**2** If the appropriate com port is not shown, select "Refresh" at the end of the pull-down list. Also, make sure that the instrument is powered on and that the USB cable is properly connected.

**3** Once the com port is selected, click on "Open." When the port is opened, the indicator to the right of the port list will change to a bright green.

Within the .vi, there are two modes of communication available with the 621 Laser Wavelength Meter.

- **Get Lambda:** Clicking on the "Get Lambda" button accesses the first mode. This mode consists of sending a single request to the instrument for the wavelength, and then waiting for a reply. The instrument returns the requested information in the units chosen on the "Units" pull-down menu.

- **AutoScan:** Clicking on the "AutoScan" button accesses the second mode of communication. In this mode, the instrument automatically broadcasts every new wavelength measurement. The wavelength is given as the vacuum value in units of nanometers. To stop the broadcast of wavelength values, click on the "Stop" button.

When finished with the .vi, click on the "Stop" button if AutoScan is enabled. Then click on the "Exit" button to halt operation and properly close the com port.

## Custom Program Interface - Windows .dll Function Calls

This section describes the remote communication between a custom program and the 621 Laser Wavelength Meter using the Windows dll "CLDevIface.dll" provided on the *NuView Software* CD. For information describing the bypassing of the dll and communicating directly with the instrument from a custom program, see the next section: Custom Program Interface - Direct Communication.

The 621 Laser Wavelength Meter uses a Silicon Labs CP2101 USB to UART bridge controller. The drivers are provided on the *NuView Software* CD, and must be installed before remote communication can occur. This installation was done during the Software Installation described in Section 2. The device must first be opened using the CLOpenUSBSerialDevice command. This command returns a DeviceHandle that will be used for all other commands. The port must be closed at the end of your program by using a call to CLCloseDevice.

The following files will need to be examined and compiled with your custom program. These files are found on the *NuView Software* CD in the Bristol Wavelength Meter folder.

- **CLDevIface.dll**
- **cldevdll.h:** In the Programming Interface folder.
- **CLDevIFace.lib:** From the Microsoft_C folder, within the Libraries folder.
- **CLDevIFace.lib:** From the Borland_C folder, within the Libraries folder.

**DECLSPEC int __cdecl CLOpenUSBSerialDevice(int ComNumber);**

Function:

Opens the device using a USB Serial Port Interface.

Parameters:

ComNumber: the windows COM port number where the USB driver is installed.

Returns:

A valid CLDevice handle number, or –1 on failure. This device handle will be used with all commands to identify the port.

**DECLSPEC int __cdecl CLCloseDevice(int DeviceHandle)**

Function:
Closes the device using a USB Serial Port Interface. This command must be called at the end of the program to properly release the port.

Parameters:
DeviceHandle: the device handle returned by the call to the CLOpenUSBSerialDevice function.

Returns:
An integer error of –1 on failure, otherwise zero.

**DECLSPEC int __cdecl CLSetMeasHBCallback(int DeviceHandle, MEASHBCALLBACK ProcessMeasHBData)**

Function:
Set a user defined callback function to receive measurement information from the instrument when it is available.

Parameters:
DeviceHandle: a valid CLDevice handle.
ProcessMeasHBData: user supplied callback function.

Returns:
A valid CLDevice handle number, or –1 on failure.

**DECLSPEC int __cdecl CLGet MeasurementData(int DevHandle, tsMeasurementDataType*data)**

Function:
Set a user defined callback function to receive measurement information from the instrument when it is available.

Parameters:
DeviceHandle: a valid CLDevice handle.
Data: pointer to location to write data of type tsMeasurementDataType.

Returns:
–1 on failure.

**DECLSPEC double __cdecl CLGetLambdaReading(int DevHandle);**

Function:
Get the current wavelength reading.

Parameters:
DeviceHandle: a valid CLDevice handle.

Returns:
64 bit floating point wavelength reading in units of nanometers (nm).

**DECLSPEC float __cdecl CLGetPowerReading(int DevHandle);**

Function:
Get the current power reading.

Parameters:
DeviceHandle: a valid CLDevice handle.

Returns:
32 bit floating point value of the power in units of milliwatts (mW).

## Custom Program Interface - Direct Communication

Remote communication directly between a custom program and the 621 Laser Wavelength Meter, without using the Windows dll, is described in this section.

The 621 Laser Wavelength Meter uses a Silicon Labs CP2101 USB to UART bridge controller. The drivers, provided on the *NuView Software* CD, must be installed before remote communication can occur. This installation was done during the Software Installation described in Section 2. The port must first be opened to access the instrument and then the port must be closed at the end of your program.

Acronyms used in this section:

| | |
|---|---|
| APC | Application Personal Computer |
| ET | Escape Token |
| DSPB | DSP Board inside the wavelength meter |
| PC | Personal Computer |
| PPP | Point-to-Point Protocol |
| RFC | Request for Comment |
| ST | Start Token |

**Interface Overview**

A scheme implemented within the PPP as defined in the document RFC 1549 will be utilized to uniquely identify the start of messages. RFC 1549 is a document created by the Network Working Group as the PPP was being established. The PPP uses a 0x7E to indicate the start/end of packets and 0x7D as an escape byte. The escape byte is used to indicate that the next byte has been converted to a different value using a well-known conversion function. This escaping of bytes allows the values of 0x7E and 0x7D to be sent as data but in a converted format. The receiver of the converted values must convert them back to their original values using the same well-known function. The APC-DSPB will utilize this same scheme.

In order to facilitate the detection of message boundaries, all messages will begin with the control byte 0x7E. Messages will not be terminated with a control byte. The 0x7E byte will be referred to as the start token, abbreviated "ST". Since messages can contain the value 0x7E as part of its data, an escape byte, 0x7D, will be used to escape occurrences of 0x7E. The 0x7D will be used to escape itself in data as well. The 0x7D byte will be referred to as the escape token, abbreviated "ET". Escaped values will be calculated as the exclusive OR of the byte with the value 0x20. This same operation is used to un-escape the byte.

0x7E XOR 0x20 = 0x5E escaping an ST
0x5E XOR 0x20 = 0x7E un-escaping an ST
0x7D XOR 0x20 = 0x5D escaping an ET
0x5D XOR 0x20 = 0x7D un-escaping an ET

The rules for escaping bytes on send are as follows:

| Originating Data | Send Bytes on Interface As |
|---|---|
| Start of message | Send 0x7E |
| Non ST and non ET | Send byte value as is |
| 0x7E as part of message data | Send 0x7D (0x20 XOR 0x7E) |
| 0x7D as part of message data | Send 0x7D (0x20 XOR 0x7D) |

The rules for un-escaping bytes on receive are as follows:

| Received Bytes on Interface | Interpret Data As |
|---|---|
| ST | Start of message |
| Non ST and non ET | Receive byte value as is |
| ET | XOR of next byte with 0x20 |

Messages sent over the serial interface will begin with a message ID followed by a message sequence number, followed by a checksum, followed by the data length, followed by the message data.

Message sequence numbers will work through the values 0x01 to 0xFF and will rollover from 0xFF back to 0x01. The value 0x00 will never be used as a sequence number. The sender is responsible for initializing the sequence number to 0x01 for the first send, incrementing the sequence number by one for each successive send and rolling the sequence number over from 0xFF to 0x01. The receiver should flag an error if either 1) two successive messages are received that contain the same sequence number or 2) two successive messages are received that have a sequence number delta greater than one.

The checksum is the exclusive OR of all word (16 bit) values of the message without embedded escapes. For odd length messages, the final word is exclusive OR'd with the high byte set to zero. The checksum location is not included when calculating. When verifying, the entire message, included checksum, is used and should result in a checksum of zero.

Data lengths will indicate the length of the un-escaped data. The maximum data component length is 0xFF. This is a result of the maximum value that can be represented in a byte.

***Communication Message Set***

The message ID values are segmented as follows:

| Range | Description |
|---|---|
| 0x00 – 0x1F | Reserved |
| 0x20 – 0x5F | APC to instrument message Ids |
| 0x60 – 0x9F | Instrument to APC message Ids |
| 0xA0 – 0xFF | Not used |

The table below gives the message IDs for communication between the APC and the DSPB. All numeric values in this section are in hexadecimal format.

| Message ID | Description | Comments |
|---|---|---|
| 0x28 | Set Auto Send | 0 = off; 2 = measurement data |
| 0x30 | Read-back Measurement | Returns measurement data; see 0x60 |
| 0x40 | Request Power | Returns power in current units; see 0x22 |
| 0x45 | Read-back Lambda 1 | Returns wavelength; uses current units and medium; see 0x23 and 0x25 |
| | | |
| 0x60 | Measurement Data Response | |
| 0x61 | Unit Info Response | |
| 0x68 | Power Read | |
| 0x69 | Read ADC Response | |
| 0x6A | Scan Data Response | |
| 0x6B | Lambda Response | |
| 0x6C | Lambda 2 Response | |
| 0x6E | Measurement heartbeat | |
| 0x6F | Head best message | |

**Detailed examples**

Note that byte offset and byte value fields are represented in hexadecimal values.

**Request Wavelength (Read Back Lambda 1):** Direction: APC → DSPB

| Byte Offset | Byte Name | Byte value(s) | Byte Description |
|---|---|---|---|
| 00 | Start Token | 7E | Generic message start identifier |
| 01 | Message ID | 45 | Unique message identifier |
| 02 | Sequence Number | 01 – FF | Sequential message identifier |
| 3-4 | Checksum | 0000 – FFFF | Checksum (2 bytes) |
| 5-6 | Payload Length | 0000 | Data length (2 bytes) |
| 7-8 | Pad | xxxx | Pad to word boundary (2 bytes) |

Response example: actual bytes sent and bytes received from wavelength meter using message 0x45, Read Back Lambda 1 (response wavelength = 0):

WRITE Length 9 bytes: 7E 45 06 40 07 00 00 05 01

READ Length 17 bytes: 7E 6B 35 63 B5 08 00 00 80 00 00 00 00 00 00 00 00

**Request Power:** Direction: APC → DSPB

| Byte Offset | Byte Name | Byte value(s) | Byte Description |
|---|---|---|---|
| 00 | Start Token | 7E | Generic message start identifier |
| 01 | Message ID | 40 | Unique message identifier |
| 02 | Sequence Number | 01 – FF | Sequential message identifier |
| 3-4 | Checksum | 0000 – FFFF | Checksum (2 bytes) |
| 5-6 | Payload Length | 0000 | Data length (2 bytes) |
| 7-8 | Pad | xxxx | Pad to word boundary (2 bytes) |

Response example: actual bytes sent and bytes received from wavelength meter using message 0x40, Request Power:

WRITE Length 9 bytes: 7E 40 03 52 03 00 00 12 00

READ Length 15 bytes: 7E 68 84 2F B1 06 00 20 A8 86 01 C7 3E 20 A2

# APPENDIX A – SPECIFICATIONS

| | 621A | 621B |
|---|---|---|
| **LASER TYPE** | CW and quasi-CW (repetition rate >10 MHz) | |
| **WAVELENGTH** | | |
| Range | *VIS:* 375 - 1100 nm<br>*NIR:* 520 - 1700 nm<br>*IR:* 1 - 5 µm | *VIS:* 375 - 1100 nm<br>*NIR:* 520 - 1700 nm<br>*IR:* 1 - 5 µm<br>*MIR:* 2 - 12 µm |
| Absolute Accuracy [1] | ± 0.2 ppm<br>± 0.0002 nm @ 1000 nm<br>± 0.002 $cm^{-1}$ @ 10,000 $cm^{-1}$<br>± 60 MHz @ 300,000 GHz | ± 0.75 ppm (± 1 ppm for MIR)<br>± 0.0008 nm @ 1000 nm<br>± 0.008 $cm^{-1}$ @ 10,000 $cm^{-1}$<br>± 225 MHz @ 300,000 GHz |
| Repeatability [2, 3] | *VIS / NIR:* ± 0.03 ppm (± 0.03 pm @ 1 µm)<br>*IR:* ± 0.06 ppm (± 0.2 pm @ 3 µm) | ± 0.1 ppm (± 0.1 pm @ 1000 nm) |
| Calibration | Continuous - built-in stabilized single-frequency HeNe laser | Continuous - built-in standard HeNe laser |
| Display Resolution | 9 digits | 8 digits |
| Units [4] | nm, µm, $cm^{-1}$, GHz, THz | |
| **POWER (VIS / NIR)** [5] | | |
| Calibration Accuracy | ± 15% | |
| Resolution | 2% | |
| Units | mW, µW, dBm | |
| **OPTICAL INPUT SIGNAL** | | |
| Maximum Bandwidth [6] | 1 GHz | 10 GHz |
| Minimum Input [7, 8, 9] | *VIS:* 250 µW (375 nm) 30 µW (750 nm) 125 µW (1100 nm)<br>*NIR:* 500 µW (520 nm) 25 µW (1100 nm) 50 µW (1700 nm)<br>*IR:* 550 µW (1 µm) 80 µW (3 µm) 750 µW (5 µm)<br>*MIR:* 600 µW (2 µm) 150 µW (7 µm) 950 µW (12 µm) | |
| **MEASUREMENT RATE** | *VIS / NIR:* 4 Hz<br>*IR:* 2.5 Hz | *VIS / NIR:* 10 Hz<br>*IR / MIR:* 2.5 Hz |
| **INPUTS/OUTPUTS** | | |
| Optical Input [10] | *VIS / NIR:* Pre-aligned FC/UPC connector (9/125 µm core diameter) - optional free beam-to-fiber coupler<br>*IR / MIR:* Collimated beam, 2-3 mm diameter aperture, visible tracer beam to facilitate alignment | |
| Instrument Interface | High-speed USB 2.0 interface with Windows-based display program<br>Library of commands for custom and LabVIEW programming | |
| **COMPUTER REQUIREMENTS** | PC running Windows 7 or 8, at least 1 GB of available RAM,<br>USB 2.0 (or later) port, monitor, mouse or other pointing device | |
| **ENVIRONMENTAL** [7] | | |
| Warm-Up Time | < 15 minutes | None |
| Temperature | +15°C to +30°C (-10°C to +70°C storage) | |
| Pressure | 500 - 900 mm Hg | |
| Humidity | ≤ 90% R.H. at + 40°C (no condensation) | |
| **DIMENSIONS AND WEIGHT** | | |
| Dimensions (H x W x L) [11] | *VIS / NIR:* 5.6" x 6.5" x 15.0" (142 mm x 165 mm x 381 mm)<br>*IR / MIR:* 7.5" x 6.5" x 15.0" (191 mm x 165 mm x 381 mm) | |
| Weight | 14 lbs (6.3 kg) | |
| **POWER REQUIREMENTS** | 90 - 264 VAC, 47 - 63 Hz, 50 VA max | |

(1) Confidence level of 3σ (≥99.6%) and traceable to accepted physical standards.
(2) Standard deviation for a 5 minute measurement period after the instrument has reached thermal equilibrium.
(3) Wavelength resolution is approximately two times repeatability.
(4) Data in units of nm, µm, and $cm^{-1}$ are given as vacuum values.
(5) The IR / MIR versions do not measure absolute power. An intensity meter displays relative power.
(6) Bandwidth is FWHM. When bandwidth is greater, wavelength accuracy is reduced.
(7) Characteristic performance, but non-warranted.
(8) For 621B-VIS and 621B-NIR, required input power is about half of values given.
(9) Sensitivity at other wavelengths can be determined from graphs available upon request.
(10) IR and MIR required beam height is 5.4 ± 0.25"
(11) IR and MIR instrument height is adjustable (7.25 ± 0.25") for alignment purposes.

# APPENDIX B – WARRANTY & SERVICE

## Warranty

The 621 Laser Wavelength Meter is warranted against defects in material and workmanship for a period of five years from date of shipment for everything except the HeNe laser, which will be warranted for two years from the date of shipment. During the warranty period, Bristol Instruments will repair, or at its option, replace parts that prove to be defective when the instrument is returned prepaid to Bristol Instruments. Before returning an instrument, always call Bristol Instruments for return authorization. The warranty will not apply if the instrument has been damaged by accident, misuse, or as a result of modification by persons other than Bristol Instruments personnel.

It is important to call Bristol Instruments or your local sales representative in advance of returning the unit for a Return Authorization Number (RA#). This will ensure the prompt handling of the repair, as well as provide important tracking information.

The liability of Bristol Instruments, (except as to title) arising out of supplying said product, or its use, whether under the foregoing warranty, a claim of negligence, or otherwise, shall not in any case exceed the cost of correcting defects in the products as herein provided. Upon expiration of the warranty period specified herein, all liability shall terminate. The foregoing shall constitute the sole remedy of the buyer. In no event shall the seller be liable for consequential or special damages.

## Service

There are no user serviceable parts inside the 621 Laser Wavelength Meter. All service and repair work for the instrument is to be done at Bristol Instruments.

If you have any questions about the operation of your 621 system or need to have your 621 system serviced, please call Bristol Instruments at (585) 924-2620. Or, you can contact us at service@bristol-inst.com.

**Bristol Instruments, Inc.**
**50 Victor Heights Parkway**
**Victor, NY 14564**
**Tel: (585) 924-2620**
**Fax: (585) 924-2623**
**service@bristol-inst.com**
**www.bristol-inst.com**

# APPENDIX C – CODE UPDATES

## General Information

Updating the 621 Laser Wavelength Meter uses a utility called Bristol621Update.bat. It can be found on the *NuView Software* CD, in the folder Update Utility.

You can contact Bristol Instruments to see if there are any updates available for this product. Prior to doing this, please get your current version information by selecting the Help – About… menu item in the software. Note this requires the instrument to be turned on and connected to the PC.

## Process

1) Connect the PC to the 621 system using the provided USB cable and turn the instrument on.
2) Copy the utility Bristol621Update.bat to a folder on your PC.
3) Copy the update files to the same folder as Bristol621Update.bat. Any 1, 2 or all 3 can be updated at once:
    a. bristol_621
    b. Bristol157_top.bin
    c. Bristol621DSP.out
4) At a command prompt, run the utility Bristol621Update.

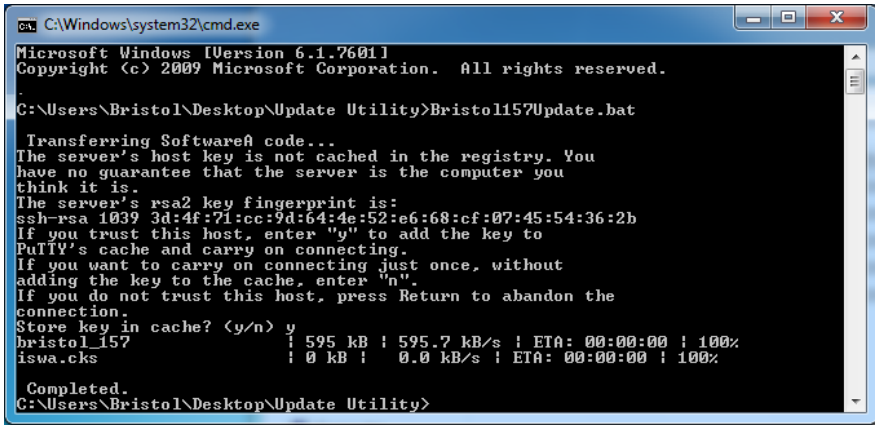
As code is being transferred it will indicate that by one or more of the following messages showing on the display:

```
Transferred FW code...
Transferred SoftwareA code...
Transferred SoftwareD code...
Completed.
```

If no files available to transfer then the following message will display:

```
No Files to Update!
```

The following figure shows an example of a successful code update. You may be asked to "Store key in cache? (y/n)." If so, enter "y".



# APPENDIX D – MONITOR PORT

The Monitor Port on the rear panel of the 621 Laser Wavelength Meter provides a combination of analog and digital signals for observing the interference fringe signals and measurement timing signals using an oscilloscope. The Monitor Port uses a 9-pin, female, D-sub style connector shown in Figure D-1 and with a pinout described in the table below.

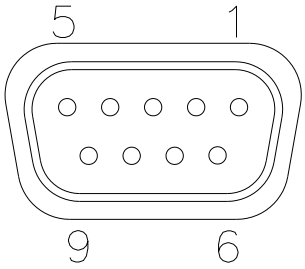



**Figure E-1: Monitor Port**

| Pin Number | Signal Name | Signal Type | Description |
|---|---|---|---|
| 1 | REFERENCE | Analog | Reference laser sinusoidal interference fringe signal. |
| 2 | INPUT | Analog | Input laser sinusoidal interference fringe signal. |
| 3 | | | N/C |
| 4 | | | N/C |
| 5 | GROUND | - | Circuit ground. |
| 6 | | | N/C |
| 7 | TRIGGER | TTL | Scanning Window Trigger is a digital pulse with a duration that defines the maximum measurement interval for the interferometer scan. It goes active (H=active) during the allowed measurement interval. |
| 8 | ZOP | TTL | Zero Optical Path (ZOP) is a digital signal that indicates the location (timing) of equal path length in the arms of the interferometer. For scans of one direction, a positive edge indicates ZOP. For scans of the other direction, a negative edge indicates ZOP. |
| 9 | | | N/C |

# APPENDIX E – TROUBLESHOOTING

The 621 Laser Wavelength Meter continually checks the quality of the signal it is analyzing and alerts the user to unusual conditions that might affect the precision of the wavelength measurement.

## Error Messages

The following table provides a list of error messages and what they mean. If an error message is displayed, please call Bristol Instruments for additional information and/or instructions.

| Error Message | Description |
|---|---|
| **Power Out of Bounds** | The instrument has detected a power measurement that is outside of the specified range of the instrument. |
| **Laser Not Stable** | This indicates that the internal HeNe reference laser of the model A has not stabilized yet. |
| **Temperature Out of Bounds** | This indicates that the instrument temperature is outside of the allowed range of 0°C to 50°C for the temperature sensor, or that there is a problem with the sensor. Measurement will continue using the temperature at the end of the allowed range closest to the temperature sensor's reading. |
| **Pressure Out of Bounds** | This indicates that the ambient pressure is outside of the allowed range of 500 to 900 mm Hg, or that there is a problem with the pressure sensor. Measurement will continue using the pressure at the end of the allowed range closest to the pressure sensor's reading. |
| **Wavelength Out of Bounds** | The instrument has detected a wavelength that is outside the operating range of the instrument. |
| **Reference Fringes Low** | The instrument has detected that there are insufficient reference fringes to perform an accurate measurement. This may be due to either a failing reference laser, or misalignment in the interferometer. |

# APPENDIX F – FIBER-OPTIC CLEANING INSTRUCTIONS

## General Information

Ensure that all fiber-optic connectors are clean and dry. The 621 Laser Wavelength Meter is shipped with a fiber-optic cleaning kit consisting of a package of connector cleaning sticks, clean wipes, and fiber-optic splice & connector cleaner spray.

**Sticklers CleanWipes**

1) Hold wipe in hand.
2) Spray wipe with Sticklers Fiber Optic Splice & Connector Cleaner.
3) Rub fiber against wipe.
4) Discard wipe.

**Sticklers CLEANSTIXX Connector Cleaning Sticks**

1) Tip can of Sticklers Fiber Optic Splice & Connector Cleaner. Press button to fill orange cap well.
2) Moisten stick tip in well for one second. Do not saturate stick.
3) To clean fiber-optic input connector, rotate the stick 10 times.
4) Discard stick.

# *EC and FCC*
# *Declaration of Conformity*

**Manufacturer's Name:** Bristol Instruments, Inc.

**Manufacturer's Address:** 50 Victor Heights Parkway
Victor, NY 14564 USA

*declares this product:*

**Product Name:** Wavelength Meters

**Model Number(s):** 621-VIS, 621-NIR, 621-IR, 621-MIR

*conforms to the following directives:*

**73/23/EEC**
**89/336/EMC**

*as a result of having been tested satisfactorily to the following standards:*

**Safety:** EN-61010-1: IEC 1010-1

**EMC:**

| | |
|---|---|
| EN61326: 1997+A1: 1998+A2: 2001 | **Class A** |
| EN61000-4-2: 1995 | **±4KV Air & Contact** |
| EN61000-4-3: 1996 | **3V/m 80MHz-2.7GHz** |
| EN61000-4-4: 1995 | **±1KV** |
| EN61000-4-5: 1995 | **±1KV(L-G) ±0.5KV(L-L)** |
| EN61000-4-6: 1996 | **3V 0.15-80MHz** |
| EN61000-4-11: 1994 | **1 Cycle 100%** |
| EN61000-3-2: 2000 | |
| EN61000-3-3: 2002 | |

**FCC:** FCC per CFR 47 Part 15; Class A – Unintentional Radiators

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CE

Signed:

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