MODEL 871
Laser Wavelength Meter

USER MANUAL

12/12/2019

BRISTOL
INSTRUMENTS

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

INTRODUCTION

Welcome

Thank you for purchasing the 871 Laser Wavelength Meter from Bristol Instruments. Two different models of this system are available: the 871A and 871B. The model 871A measures absolute laser wavelength to an accuracy of ± 0.2 parts per million. The 871B system has an accuracy of ± 0.75 parts per million with single mode fiber (± 1 part per million with multi-mode graded-index fiber ≤ 62.5 µm diameter).

Both models are available for operation over the wavelength ranges of 375–1100 nm (VIS version) and 630–1700 nm (NIR version). The B model is also available from 1.0–2.5 microns (NIR2 version).

This User's Manual includes information about the 871A and 871B Laser Wavelength Meter. It covers all the topics necessary to help you operate your system.

If you have any questions about the operation of your 871 system, please do not hesitate to contact us using the information below.

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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.

Laser Classification: This product is classified FDA Laser Class I (IEC Laser Class 1).

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.**

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.**

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

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.**

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 auto-ranging line voltage input. Be sure the supply voltage is within the specified range.

CAUTION Maximum safe input is 10 mW of CW or time-averaged optical power, or 0.5 mJ of pulsed laser energy (10 ns pulse). Laser input power in excess of these values 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.

Inspection

The 871 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 871 system includes the following components:

- ✓ Laser Wavelength Meter
- ✓ Power cord (North America and Japan only)
- ✓ USB 2.0 cable
- ✓ RS-422 to USB converter cable
- ✓ Trigger cable
- ✓ USB flash drive with *NuView* software, *User's Manual* and coding examples

INITIAL INSTRUMENT SETUP

General

1. Place the 871 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

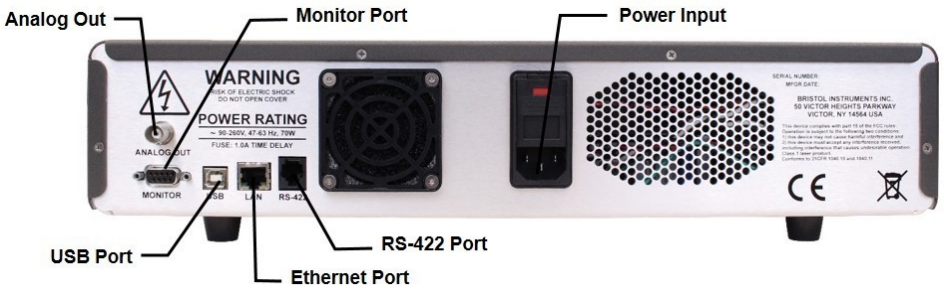
WARNING **This is a Safety Class 1 product (provided with protective ground). The mains plug shall only be inserted in a socket outlet provided with a protective ground contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional 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 auto-ranging line voltage input. Be sure the supply voltage is within the specified range.

1. Verify that the line power meets the requirements:
   - 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. (See graphic below.)
3. Connect the other end of the line-power cord to the power receptacle.



Back Panel

Signal Output Connections

The 871 Laser Wavelength Meter has the following connections for signal output and communications. These connections are located on the instrument's back panel. (See Back Panel graphic above.)

- USB Port - Interface to a PC for instrument control and data reporting.
- Ethernet Port – Interface to a network for instrument control and data reporting.
- RS-422 – Interface to a PC for real-time data reporting.
- DB-9 Monitor Port - Used to trigger measurements and view measurement timing. A full description of the external trigger and the measurement timing is provided in the Making Measurements 41 chapter.
- Analog Out – Used to supply voltage for stabilizing a laser source. A full description of the Analog Out and the PID Control function is described in the *NuView* 22 User Interface 22 chapter.

To connect the cable:

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* flash drive controls the 871 Laser Wavelength Meter and displays the collected data. The following computer hardware is required to run the software:

- A PC running Microsoft Windows 7, 8, or 10.
- At least 1 GB of available RAM.
- USB 2.0 (or later) or Ethernet port for instrument connection, or a wired or wireless network connection (to connect to the instrument over the network).
- A Monitor.
- A mouse or other pointing device.

To install the software:

1. Insert the *Application Software* flash drive into a USB port on your PC. Double click on the *NuView* software 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 **Model 871 User's Manual** to open a PDF file of the User's Manual (this file). This manual will describe installation and operation of the 871 system.
4. The USB connection to the PC uses a RNDIS driver for a virtual Ethernet connection with a fixed IP address of 10.199.199.1. The RNDIS driver is included with every Windows PC, but Windows 7 typically does not have this driver activated. Windows 8 and 10 automatically activate the driver when an RNDIS device is connected, but occasionally Windows 10 will incorrectly recognize a RNDIS device as a COM port. Please see RNDIS Troubleshooting 75 section in the appendix for information describing how to activate and troubleshoot the RNDIS driver.

LASER INPUT – VIS AND NIR VERSIONS

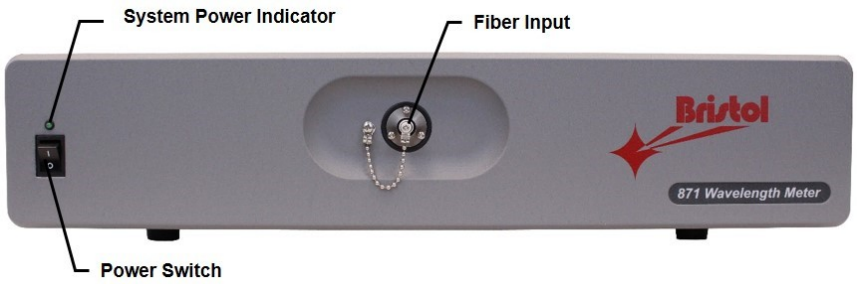
Fiber-Optic Laser Input

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. For optimum performance, always clean the fiber end prior to insertion into the instrument's fiber-optic connector. 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 CW or time-averaged optical power, or 0.5 mJ of pulsed laser energy (10 ns pulse). Laser input power in excess of these values can result in damage to the instrument.

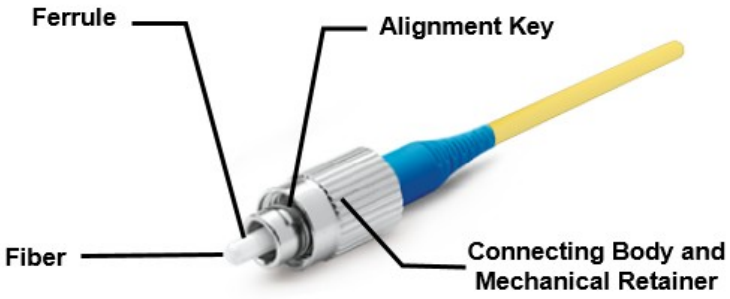
The laser under test is connected to the 871 system through an FC/PC fiber-optic connector on the front panel of the instrument.



Front Panel

To connect the fiber-optic connector:

1. Ensure that all fiber-optic connectors are clean and dry. The 871 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 Fiber Optic Cleaning Instructions 82 in Appendix Information for cleaning instructions.
2. Connect a 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 is properly seated in the slot of the input connector.



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 ***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.**

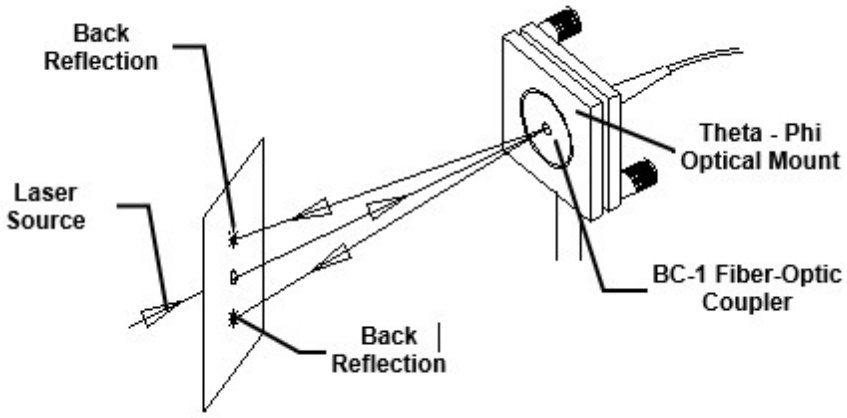
CAUTION Use care in handling fiber-optic connectors. For optimum performance, always clean the fiber end prior to insertion into the instrument's fiber-optic connector. Failure to do so can result in damage to the instrument. To prolong instrument service life, it is advantageous to attach a new fiber-optic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

CAUTION Maximum safe input is 10 mW of CW or time-averaged optical power, or 0.5 mJ of pulsed laser energy (10ns pulse). Laser input power in excess of these values can result in damage to the instrument.

CAUTION Maximum safe input for the BC-1 Series is limited by the fiber-optic patch cord connected to the BC-1. Refer to the maximum optical power and laser energy specifications provided by the fiber-optic patch cord manufacturer.

If the laser under test has a free space beam, it must be launched into a fiber-optic patchcord for entry into the 871 Laser Wavelength Meter. The LC-1 and BC-1 Fiber-Optic Input Couplers offered by Bristol Instruments are convenient methods of doing this.

1. Install the coupler in any two-axis (Θ – Φ) adjustable optical mount that can accommodate a 1 in. (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 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 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 below. Adjust the optical mount until the reflections symmetrically straddle the input beam.



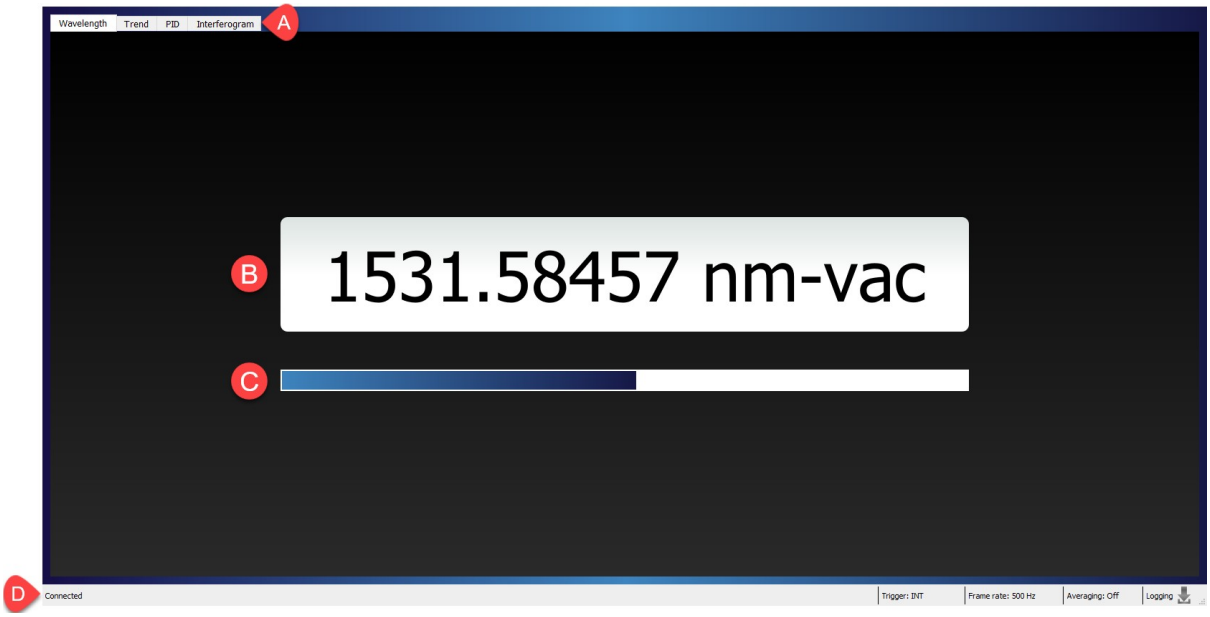
Aligning the Fiber-Optic Coupler

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

NUVIEW USER INTERFACE

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.



Wavelength Components

A -- Wavelength/Trend/PID/Interferogram Tabs

Allows the user to toggle between the Wavelength Screen, Trend Screen, PID Controller Screen, and Interferogram Screen.

B -- Wavelength Display

Displays the absolute wavelength, wavenumber, or frequency of the laser under test.

C -- Intensity Meter

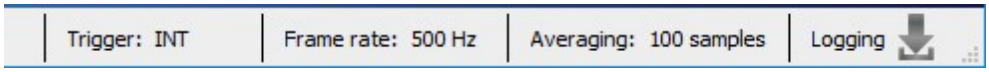
Graphically displays the relative intensity of the laser under test.

D -- 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.
- **Trigger Method** – Either Internal (**INT**), External Falling (**EXT Fall**), or External Rising (**EXT Rise**).
- **Frame Rate** – The detector's frame rate in Hz.

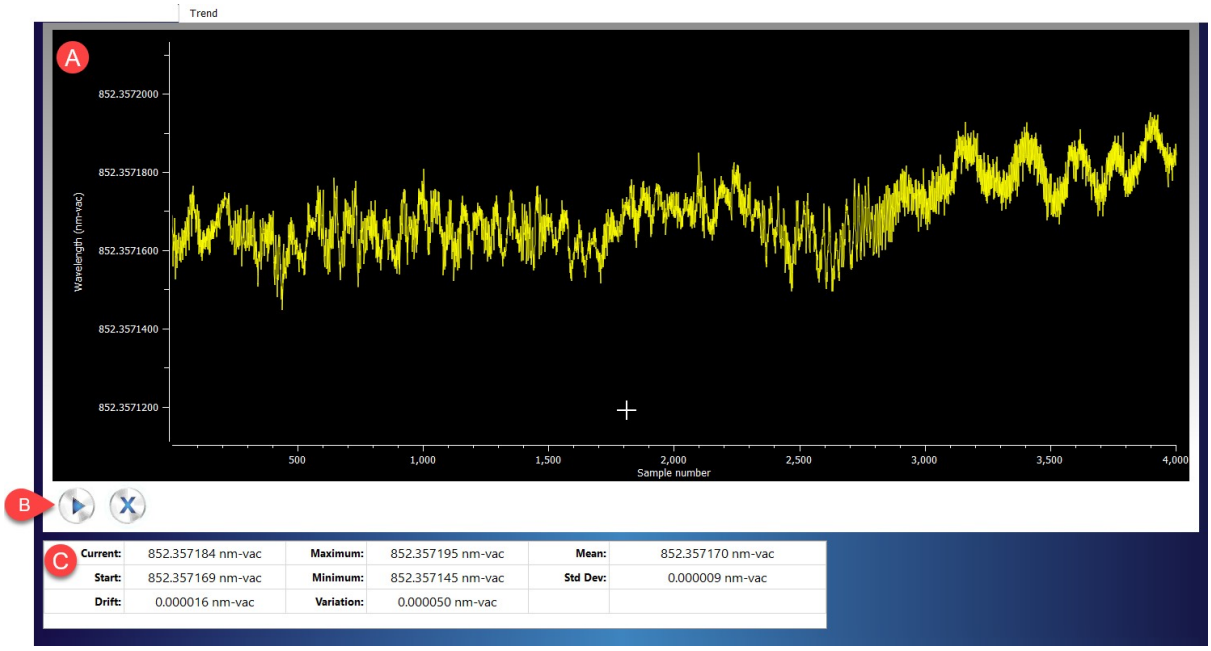
- **Averaging** – Either **"Off"** or the number of samples being averaged.
- **Logging** – The downloading icon is gray when logging status is inactive, and green when logging status is active.



Status Bar

Trend Screen

The Trend Screen displays a record of computed wavelength, frequency, or wavenumber, along with a table statistical values.



Trend Screen Components

A -- Trend Graph

Plot showing computed values of the laser's wavelength, frequency, or wavenumber. The Trend Graph can be magnified to focus on a portion of the trending data. Before zooming, left-click on the Trend Graph to ensure that the Trend Graph is active, and uncheck **Autoscale Axes** under the **View** menu.

- **Horizontal Zoom** – Scroll the mouse wheel upwards will zoom in horizontally on the spectrum at the mouse cursor location. Scroll the mouse wheel downwards will zoom out horizontally on the spectrum at the mouse cursor location.
- **Vertical Zoom** – Hold the **Shift** key and scroll the mouse wheel upwards will zoom in vertically on the Trend Graph at the mouse cursor location. Hold down the **Shift** key and scroll the mouse wheel downwards to zoom out vertically on the Trend Graph at the mouse cursor location.

When the Trend Graph is zoomed, left-click in the Trend Graph and drag to pan the trending data horizontally. Hold down the **Shift** key and left-click and drag to pan the trending data vertically.

B -- Measure/Clear Buttons

Select the **Measure** button (left) to initiate data collection. During data collection, the **Measure** button changes to the **Pause** button (middle). The Trend Graph and Data Table are updated continuously until the **Pause** button is selected. Select the **Pause** button to stop data collection, and the Trend Graph and Data Table display the last measured data. When the instrument is not connected, the **Measure** button is in its greyed-out, inactive state (right).

Select the **Clear** button (left) to restart the Trend Graph and reset the values in the Data Table. When the instrument is not connected, before any trending data is collected or after the trending data has been cleared, the **Clear** button changes to its greyed-out, inactive state (right).

C -- Data Table

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

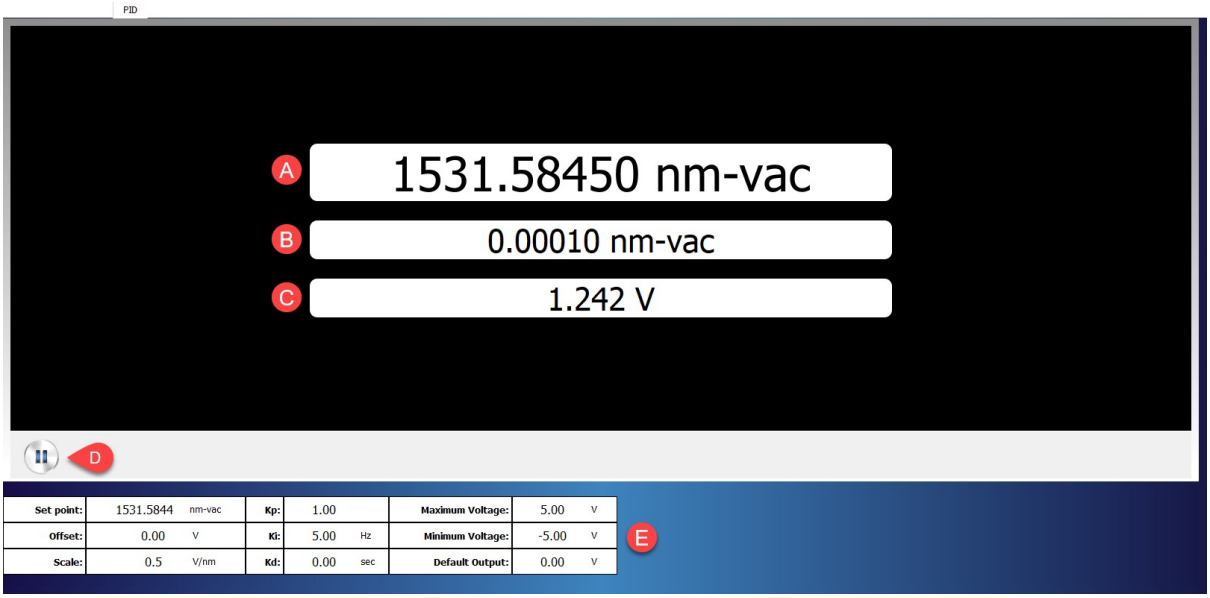
Current:	852.357184 nm-vac	**Maximum:**	852.357195 nm-vac	**Mean:**	852.357170 nm-vac
Start:	852.357169 nm-vac	**Minimum:**	852.357145 nm-vac	**Std Dev:**	0.000009 nm-vac
Drift:	0.000016 nm-vac	**Variation:**	0.000050 nm-vac		

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.

PID Controller Screen



PID Controller Screen

The PID Controller Screen displays the settings for the 871-system's internal PID controller and reports the most recent wavelength reading and output voltage supplied through the Analog Out BNC connector on the back panel of the wavelength meter.

The calculation behind the PID Controller Screen consists of three separate voltage parameters input by the user. These three components ensure swift correction of the laser to the desired frequency with minimal overshooting or oscillation.

1. **Kp** – accounts for the current (Proportional) error magnitude and has the highest contribution to guiding the measured wavelength towards the set point.
2. **Ki** – accounts for the sum of past errors (Integral) to minimize the effects of outlying data peaks or spikes on the correction voltage.
3. **Kd** – factors in the current rate of change (Derivative) to avoid oscillation about the desired wavelength.

A -- Wavelength Display

The most recent wavelength measurement.

B -- Error Display

The difference between the target wavelength and the Wavelength Display.

C -- Output Display

The current voltage output being delivered through the BNC connector on the back panel of the 871 instrument.

D -- Measure/Pause

Enables the PID calculations to determine the output voltage. Select the **Measure** button (left) to initiate the PID calculation. After the **Measure** button is selected, it changes to the **Pause** button (middle). The PID calculation updates continuously until the **Pause** button is selected. Select the **Pause** button to stop the PID calculation and return to outputting the default voltage. When the instrument is not connected, the **Measure** button is in its greyed-out, inactive state (right).

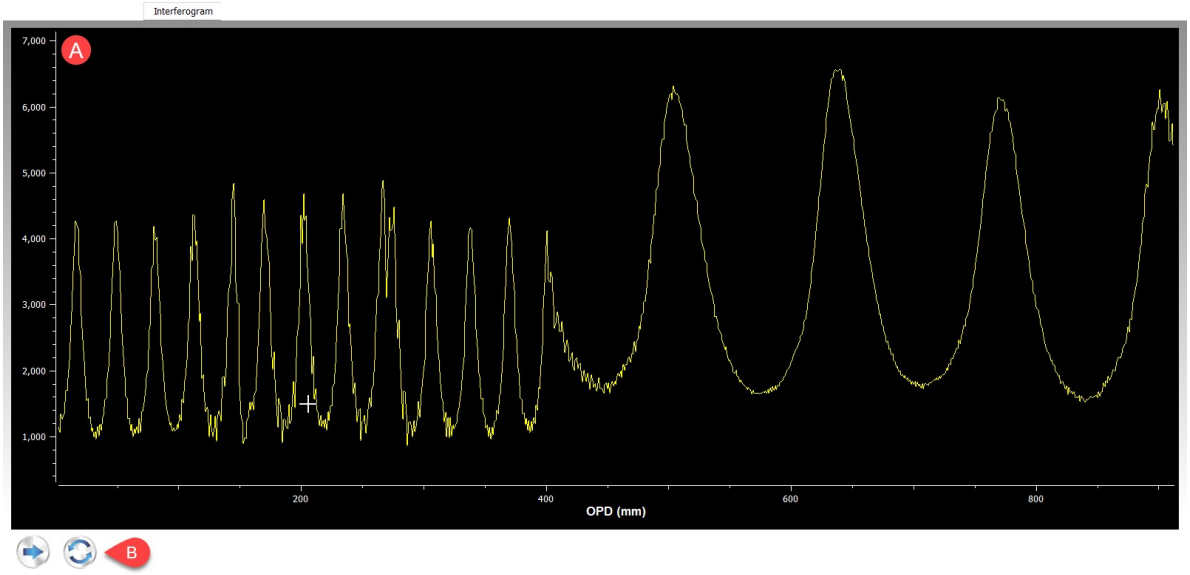
Data Table

Allows entry of the PID parameters, default output voltage, and voltage offset values. To change the value, click on any field and type the desired value using the keyboard. Click **Save Instrument Settings** from the Instrument menu, or use the key sequence (**Ctrl + I**) to commit these changes to the PID calculation.

- **Set Point** – The target wavelength, frequency, or wavenumber for the PID calculation.
- **Offset** – An additional voltage offset added to the PID computed voltage. This is useful for centering the voltage output swing at a value other than zero.
- **Scale** – Multiplier for converting the error signal into a voltage, expressed in volts per nanometer. Even when multiplied by the Scale, the output voltage remains capped by the instrument limits of ± 5 volts or the user defined maximum and minimum voltages.
- **Kp** – Proportional gain constant. The Proportional gain constant is unit-less and has the highest contribution to guiding the measured wavelength towards the desired frequency.
- **Ki** – Integral gain constant. The Integral gain constant, expressed in Hz, accounts for the sum of past errors to minimize the effects of outlying data peaks or spikes on the output voltage.
- **Kd** – Derivative gain constant. The Derivative gain constant, expressed in seconds, factors in the current rate of change to avoid oscillation about the desired wavelength.
- **Minimum Voltage** – The lower limit, expressed in volts, for the output voltage. This voltage is automatically limited by the instrument to - 5 volts.
- **Maximum Voltage** – The upper limit, expressed in volts, for the output voltage. This voltage is automatically limited by the instrument to + 5 volts.
- **Default Output** – The voltage output when the PID calculation is paused. The Default Output is expressed in volts and must be within the instrument limits of ± 5 volts.

Interferogram Screen

The Interferogram Screen displays the raw interferogram used for the spectrum and wavelength computation.



Interferogram Screen Components

A -- Interferogram Display

Displays the captures interferogram as Optical Path Difference (OPD) in millimeters versus intensity.

- **Horizontal Zoom** – Scroll the mouse wheel upwards will zoom in horizontally on the spectrum at the mouse cursor location. Scroll the mouse wheel downwards will zoom out horizontally on the spectrum at the mouse cursor location.
- **Vertical Zoom** – Hold the **Shift** key and scroll the mouse wheel upwards will zoom in vertically at the mouse cursor location. Hold down the **Shift** key and scroll the mouse wheel downwards to zoom out vertically at the mouse cursor location.

When the Interferogram Display is zoomed, left-click and drag to pan the trending data horizontally or hold down the **Shift** key and left-click and drag to pan the vertically. To display the full interferogram or return to a previous zoom right-click on the graph to access the context menu shown below:

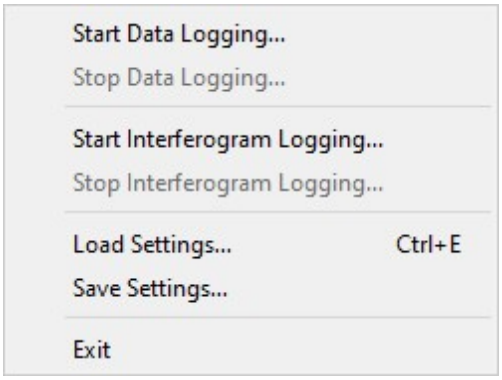
B -- Interferogram Update Control

Select the **Single Scan** button (left) to initiate a single interferogram measurement. The Coherence Length calculation is updated for measurement. During the measurement, the **Single Scan** button changes to its greyed-out, inactive state (right).

Select the **Continuous Scan** button (left) to initiate the continuous measurement of interferogram data. After the **Continuous Scan** button is selected, it changes to the **Pause** button (right). The Coherence Length is updated continuously until the **Pause** button is selected. Selecting the **Pause** button stops data collection and the Interferogram Display and Coherence Length show the last measured data.

Menu Function Descriptions

File Menu



File Menu

- **Start Data Logging** – Instrument measurement data 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, the number at the end will increment each time you begin a new log.

  Each measurement can be logged, or measurements can be recorded at a measurement or time interval.

  The columns of the CSV file are defined by the available measurement parameters listed below. The first column of the log file is a time stamp for each measurement, followed by the selected parameters. Click the check box next to a parameter to include that column in the CSV file.

  - **Instrument Status** – A hexadecimal number corresponding to the instrument status at each measurement. The status numbers are defined in the Status Byte Definitions 85 section of the Appendix Information.
  - **Max Peak Wavelength** – The absolute wavelength, wavenumber, or frequency of the laser under test.
  - **Max Peak Intensity** – A linear value representing the illumination of the detector array. This value ranges from 0 (no light) to 1 (fully saturated detector).

  To start data logging:

  1. Click on **Start Data Logging** and then change the log file name and location or use the default name and location.
  2. Select the radio button for the **Logging Mode**.
     a. 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.

b. 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.

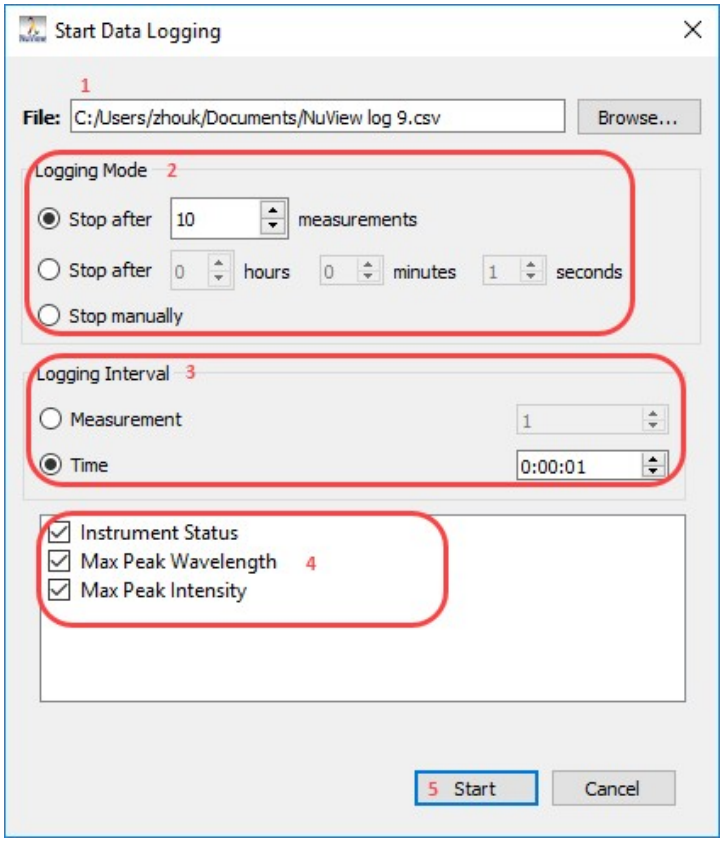
3. Select the radio button for the **Logging Interval**.

   a. When **Measurement** is selected, the number of measurements can be adjusted incrementally using the up/down arrows or by highlighting the current measurement interval and entering a new measurement interval with the keyboard.

   b. When **Time** 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 interval with the keyboard.

4. Check the boxes next to each measurement parameter you wish to track.

5. Click **Start** to begin logging the wavelength data.



Start Data Logging Screen

- **Stop Data Logging –** Stops the current logging operation. Note that if you started logging using the **Stop after measurements** or the **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 either case, the logging data will be written to the specified file every 5 seconds or when data logging is stopped.

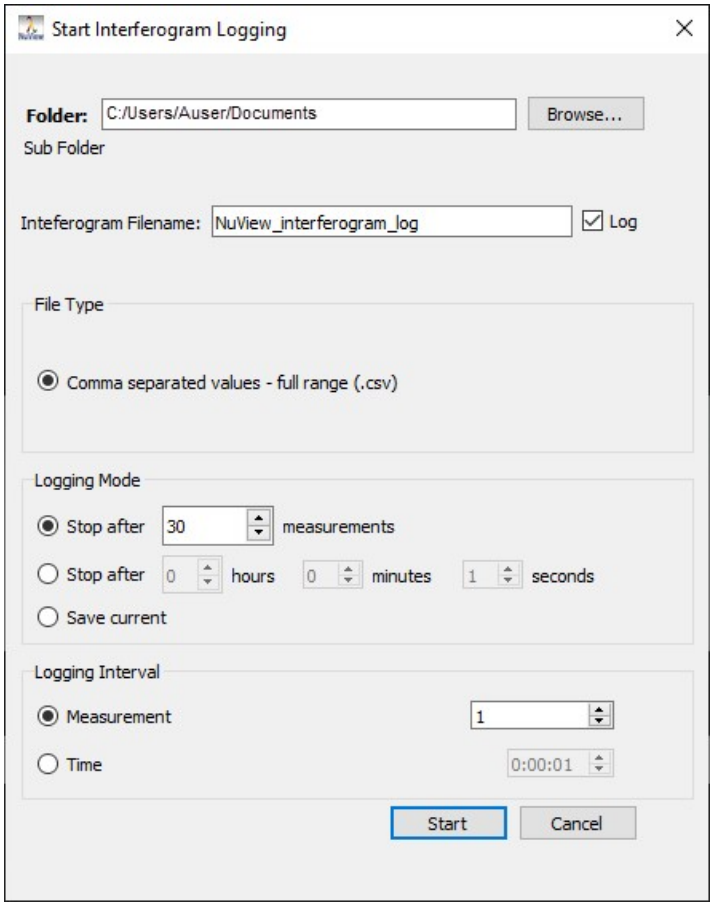
- **Start Interferogram Logging** – Saves a single interferogram or multiple interferograms to a Comma-Separated Value (*.csv) format file. Each line of the CSV file contains the scan index, a time stamp, and the intensity values of the interferogram.

  The **Logging Mode** radio button options allow the user to choose a specific number of interferograms to save, a time duration for logging interferograms, or saving the currently displayed interferogram.

  To start Interferogram Logging:

  1. Click on **Start Interferogram Logging**.
  2. Enter the folder location.
  3. Enter the base file name
  4. Select the desired **Logging Mode** and **Logging Interval** using the radio buttons.
  5. Click **Start**.

  NOTE: **Continuous Scan** on the Interferogram Screen must be selected to log one or more interferogram files.

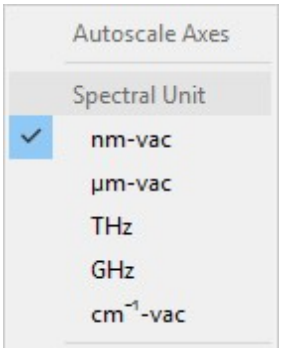


Start Interferogram Logging Screen

- **Stop Interferogram Logging** – Ends the current logging of interferogram data.

- **Load Settings –** Opens a previously saved Settings file from a text-based initialization (*.ini) format file. These files can be used to quickly configure the *NuView* software for different users or experimental setups. The *NuView* software displays up to 5 of the most recently used settings or spectrum files. Click **Load Settings**, browse to find the desired settings file, select it, and click **Open** to load the Settings file.
- **Save Settings** – Saves the current *NuView* software settings to a text-based initialization (*ini) format file. Click on **Save Settings**, enter the file name and folder location, and click **Save**. The Settings file saves the following parameters:
    - **Spectral Units** – The units for the Wavelength Display in nanometers, microns, gigahertz, terahertz, or wavenumbers.
    - **Logging Type** – The type of measurement logging, specified as number of measurements, measurement time, or continuous measurement.
    - **Logged Measurement Settings** – The checklist of measurement parameters (Instrument Status, Max Peak Wavelength, and Max Peak Intensity).
    - **Save Location** – The log file location.
    - **Averaging Status** – Whether averaging is enabled or disabled.
    - **Number of Averages** – The number of wavelength measurements averaged.
    - **Input Laser Type** – The type of laser being measured, specified as pulsed or continuous wave (CW).
    - **Triggering Method** – How the instrument is triggered to make a measurement, specified as Internal, External Rising, or External Falling.
    - **Frame Rate** – The internal measurement speed that the instrument is triggered to make measurements, specified in Hz.
    - **Calibration Method** – The type of event that triggers an instrument calibration, specified as temperature, time, or at manual calibration intervals.
    - **Time/Temperature Delta** – The amount of time or temperature that triggers an instrument calibration, specified in minutes or 1/10th degree Celsius, respectively.
- **Exit** - Exits out of the *NuView* software.

View Menu

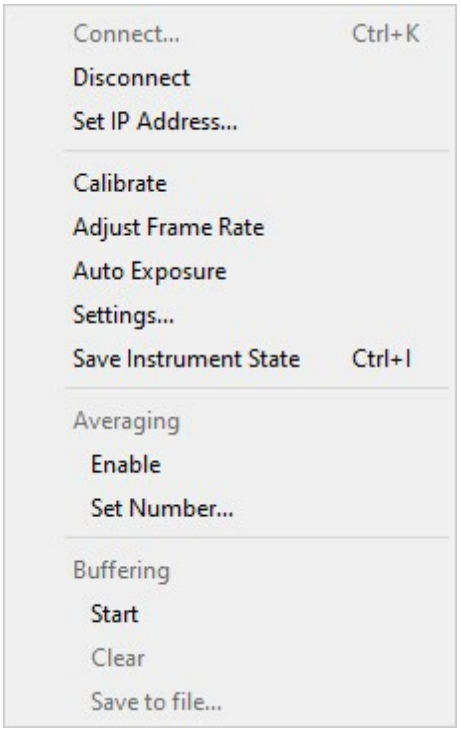


View Menu

- **Autoscale Axes** – Automatically and continuously expands the x- and y-axes of the Trend Graph as necessary to fit the updating trending data into the display area. **Autoscale Axes** is only available on the Trend Screen, and appears grayed out on the Wavelength Screen.
- **Spectral Unit** – Allows the user to select the measurement unit for the Wavelength, Trend, and PID Screens.
    - **nm-vac** – Sets the measurement unit to nanometers (vacuum values).
    - **µm-vac** – Sets measurement unit to micrometers (vacuum values).
    - **GHz** – Sets the measurement unit to gigahertz.
    - **THz** – Sets the measurement unit to terahertz.
    - **cm^{-1}-vac** – Sets the measurement unit to wavenumbers (vacuum values).

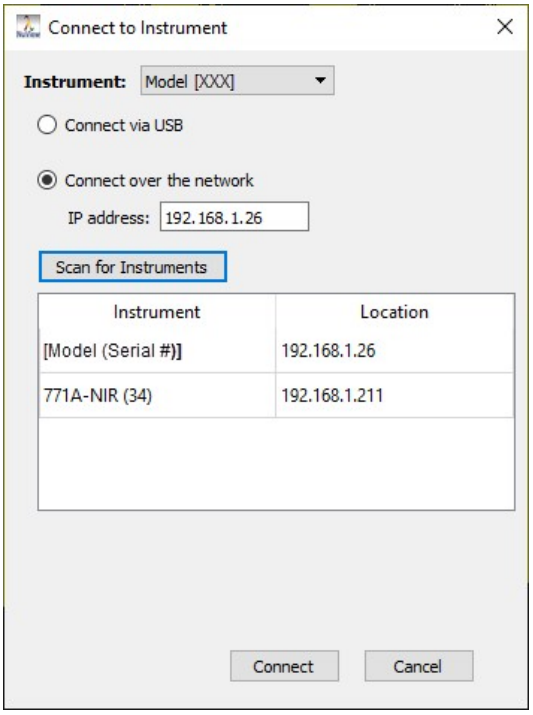
      NOTE: In other scientific publications, the units of nanometers, micrometers, and wavenumbers may refer to the values in an air, standard air, or vacuum environment. The 871 Laser Wavelength Meter provides measurements as values in a vacuum environment, and units that are dependent on environment are given a "-vac" suffix to emphasize this fact.

Instrument Menu



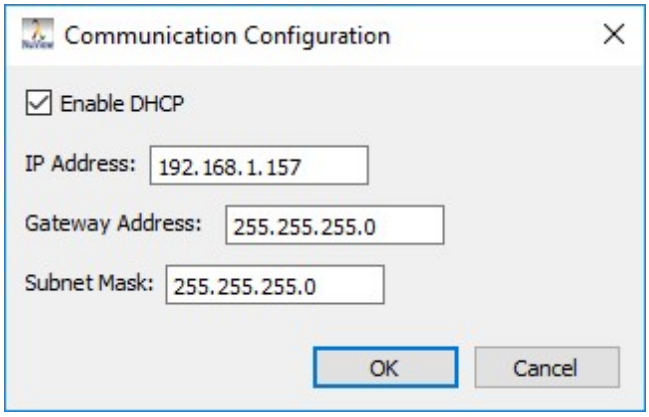
- **Connect** – The 871 system can be connected to a PC by either USB 2.0 interface or over an Ethernet network. (See graphic below.)
    1. Select **Model 871** from the drop-down menu.

2. Click on **Connect** and choose between **Connect via USB** or **Connect over the network** radio buttons.
    a. If **Connect over the network** is chosen, click on **Scan for Instruments** to search for all 871 systems connected to the network. All Bristol Instruments will appear in the format **Model (Serial #)**.
    b. Double click on the desired instrument to populate the IP address field, or manually enter the IP address using the keyboard.
3. Click on **Connect** to link to the instrument.



Connect to Instrument Screen

- **Disconnect** – Used to disconnect the 871 system from the PC.
- **Set IP Address** – Manually change the IP address for the 871 system using the keyboard. Once the IP address is changed, click **OK**, and cycle the power on the 871 system to complete the change. If DHCP is enabled, then the network will automatically assign the instrument an open IP address. **Set IP Address** only works when connected via USB. (See graphic below.)



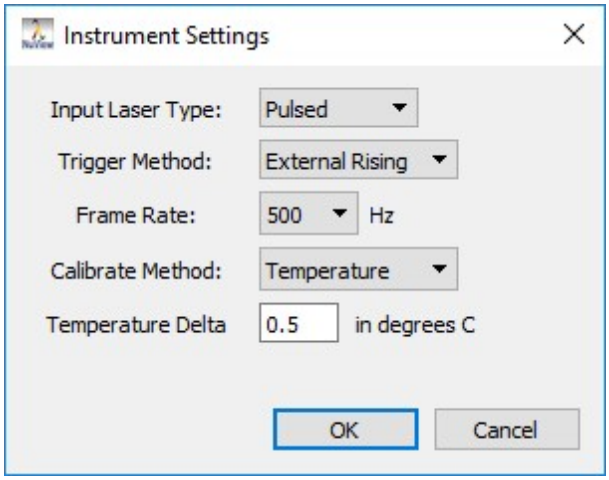
Set IP Address Screen

- **Calibrate** – Calibrates the instrument with the internal reference source. Calibration takes approximately 2 seconds to complete and temporarily interrupts any current trending or logging data. Click **Calibrate** to run.
- **Adjust Frame Rate** – Adjusts the instrument's Frame Rate to illuminate the instrument's detector for optimal signal intensity. When **Adjust Frame Rate** is selected, the *NuView* software chooses a frame rate between 12 and 1000 Hz (250 to 1500 Hz for the NIR2) to illuminate the detector at approximately 50% saturation.

  Due to the time varying incident power on the detector from a pulsed laser, Adjust Frame Rate can only be used when the **Laser Type** is set to **CW** mode. This function is disabled (grayed out) in Pulsed mode. Click **Adjust Frame Rate** to select.
- **Auto Exposure** – Adjusts the exposure time of the instrument's detector for optimal signal intensity. When **Auto Exposure** is selected, the *NuView* software chooses an exposure time that maintains the current Frame Rate setting and illuminates the detector at approximately 50-75% saturation.

  Auto Exposure can only be used when the **Laser Type** is set to **CW**. Auto Exposure is disabled (grayed out) in Pulsed mode. Click **Auto Exposure** to turn on. This places a check mark next to Auto Exposure. Click **Auto Exposure** a second time to turn off.

  NOTE: When **Auto Exposure** is turned off, the unit will hold the last set exposure time. To re-enable the maximum exposure time, enter the desired frame rate using the **Settings** dialog.
- **Settings** – This function controls the settings that the 871 system uses to capture wavelength measurements.



Instrument Settings

- **Input Laser Type** – Determines which wavelength measurements the *NuView* software reports. Select the **Input Laser Type** from the drop-down menu and click **OK**.
  - **Pulsed** – When enabled, the *NuView* software reports and records all wavelength values that reach the minimum detector intensity requirement during the measurement window. Any measurement window that does not receive sufficient intensity is discarded. This enables the *NuView* software to report the wavelength of individual pulses for low repetition lasers.

    NOTE: To ensure that the **NuView** software captures each laser pulse, the user should choose a higher Frame Rate than the repetition rate of the laser under test. The *NuView* software then reports and records wavelength values at the repetition rate of the laser, up to the maximum available Frame Rate.
  - **CW** – When enabled, the *NuView* software reports and records all wavelength measurements at the chosen frame rate, for all measurement windows, regardless of the intensity on the detector.
- **Trigger Method** – Controls the event that prompts the 871 system to start recording a measurement. The wavelength values that the *NuView* software reports and records depend on the **Input Laser Type** defined above.

  When set to **Internal** trigger mode, the number of measurements per second will correspond to the Frame Rate. When set to **External Rising** or **External Falling** trigger mode, a measurement is initiated at the rising or falling edges (respectively) of a user-defined input. The External triggers are explained in greater detail in the External Trigger 41 section.

  Once a measurement has been triggered, the *NuView* software reports and records wavelength values based on the Input Laser Type. When **Pulsed** mode is enabled, the *NuView* software reports and records all wavelength values that reach the minimum detector intensity requirement during the measurement window. Any measurement window that does not receive sufficient intensity is discarded. When **CW** mode is enabled, the *NuView* software reports and records all wavelength measurements at the triggered rate, regardless of the intensity on the detector.

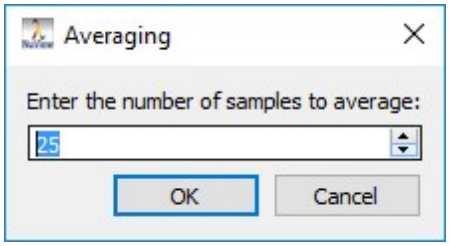
Select the desired **Trigger Method** from the drop-down menu and click **OK**.

- **Frame Rate** – Sets the measurement rate of the 871 system. When set to **Internal** trigger mode, the Frame Rate corresponds to the number of measurements per second. When set in **External** trigger mode, the Frame Rate defines the measurement time initiated by the input trigger. The relationship between Frame Rate and measurement time is explained in greater detail in Making Measurements 39 chapter. Select the desired **Frame Rate** from the drop-down menu and click **OK**.
- **Calibration Method** – Sets the event that triggers the 871 system's calibration with the internal reference source. The 871 system will calibrate periodically during the initial instrument warm-up time, even if the Calibration Method is set to Manual.
  - **Manual** – When selected, the user must initiate calibration by selecting **Calibrate** from the Instrument menu. To enable Manual calibration, select **Manual** from the drop down menu and click **OK**.
  - **Time** – When selected, the instrument calibration is initiated at a time interval specified by the Time Delta field. To enable Time calibration, select **Time** from the drop down menu, enter a **Time Delta** value in minutes, and click **OK**.
  - **Temperature** – When selected, the instrument calibration is initiated after the instrument's internal temperature rises or falls by the amount specified by the Temperature Delta field. The recommended setting is to calibrate when the ambient temperature changes by 0.5 °C.

    To enable Temperature calibration, select **Temperature** from the drop down menu, enter a **Temperature Delta** value in degrees Celsius, and click **OK**.

- **Save Instrument State** – Commits all changes to the 871 Laser Wavelength Meter's status to the internal storage of the 871 instrument. Any change to the parameters in the Data Table of the PID Controller Screen must be saved to take effect. Click **Save Instrument State** to save the changes or use the key combination **Ctrl+I**.
- **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. Each successive measurement will update the Wavelength Display or Trend Screen.
  - **Enable** – Averaging can be turned on by clicking **Enable**. This places a check mark next to Enable Averaging. Averaging is turned off by clicking **Enable** a second time.
  - **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.



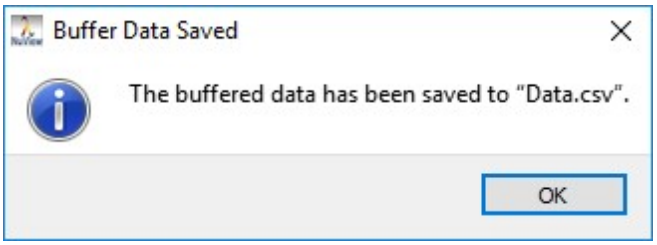
Averaging Screen

- **Buffering** – The 871 system allows the user to buffer up to 1 million wavelength measurements in the instrument's internal storage. The buffered measurements can then be downloaded and saved to the user's PC in a Comma-Separated Value (*.csv) file format. The default file name is **`Data.csv`**.

  The columns of the CSV file are defined by the available measurement parameters listed below. Each column is further explained in Making Measurements 43 chapter.

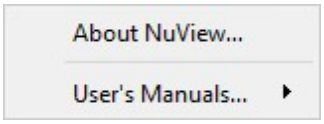
  - **Scan Index** – The scan index is an integer whose value increases by one with each measurement. The first scan index emitted by the instrument is 0, and the maximum scan index is 4294967296, after which the scan index value starts over at 0.
  - **Status** – The status word is a 32-bit-wide bitfield. The hexadecimal value of each status is listed in the Status Byte Definitions 85 section in Appendix Information.
  - **Wavelength** – The measured wavelength in the currently selected units.
  - **Power** – The relative intensity on the detector on a scale of 0 to 1.

- **Start** – Begins the buffering of wavelength data. Once clicked, the Start menu item changes to Stop. If the buffering is not ended prematurely by the user, the buffering will automatically end once the buffer is full. Click once to start buffering, and a second time to stop.
- **Clear** – Empties all of the wavelength data currently stored in the buffer.
- **Save to file** – Saves the current buffered data to a *.csv formatted file on the PC. Select the desired save location, enter a filename, and click **OK**. Once the data has been transferred from the instrument to the PC, a notification will appear to inform the user that the buffered data has been saved.



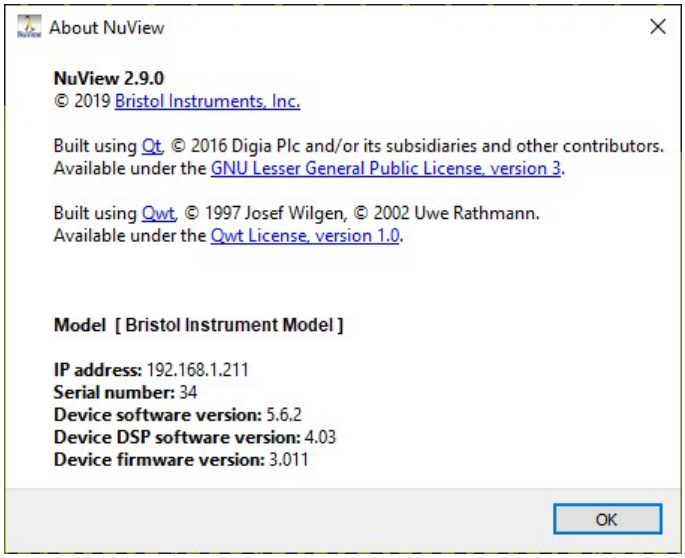
Buffering Saved Message

Help Menu



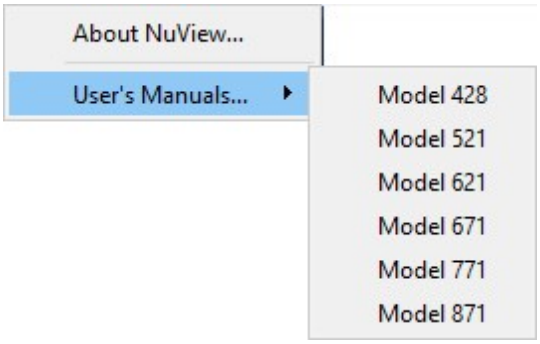
Help Menu

- **About NuView** - Displays the *NuView* software version, the embedded software versions, and information about the 871 system. The **[Bristol Instrument Model]** field will be populated with the connected instrument model.



About NuView Screen

- **User's Manuals** – Opens a list of all available User's Manuals. Clicking an instrument will bring up the appropriate PDF manual.



User Manual Access

MAKING MEASUREMENTS

System Calibration

The 871 system calibrates itself with an internal reference laser and interrupts the wavelength and power measurements for approximately 2 seconds. Calibration is initiated either manually using the **Calibrate** menu item in the *NuView* software, automatically at user-defined temperature or time intervals, or by using the corresponding SCPI command.

NOTE: The 871 system will calibrate periodically during the initial instrument warm-up time, even if the **Calibration Method** is set to **Manual**.

Setting Measurement Rate

The measurement rate of the 871 system is controlled with the **Frame Rate** setting on the *NuView* software.

- When set to **Internal Trigger** mode, the number of measurements per second will correspond to the Frame Rate.
- When set in **External Trigger** mode, the Frame Rate will define the measurement time initiated by the input trigger. The measurement time includes the exposure time and read-out time.

The equation below shows the relation between the Frame Rate and exposure time for the 871-VIS and NIR systems. The read-out time is a fixed 0.4593 milliseconds for the VIS, 0.575 milliseconds for the NIR, and 0.038 milliseconds for the NIR2.

$$Exp\ (ms) = \frac{1}{[Frame\ Rate\ (Hz)]} - [Read\ Out\ Time\ (ms)]$$

Setting the Auto Exposure

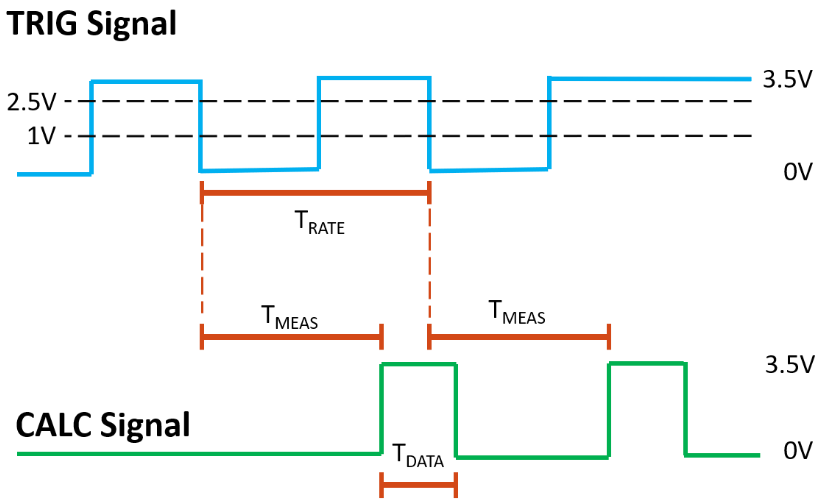
Tunable or swept lasers can result in rapid changes to the measured signal intensity. The Auto Exposure feature of the 871 system allows the instrument to compensate for changes in signal intensity that would result in low signal or saturation conditions for the instrument. When enabled, the Auto Exposure function increases or decreases the exposure time of the detector as necessary to keep the signal intensity within the dynamic range of the 871 system.

The Auto Exposure algorithm will not change the instrument Frame Rate. The maximum exposure achievable is limited by the instrument set Frame Rate. To ensure a valid measurement across the full laser scan, the 871 Frame Rate should be set to measure the laser at the lowest output intensity.

External Trigger

Trigger Logistics

The 871 system can be triggered through the monitor port for coordinating measurements with external equipment. Either a rising or falling edge TTL trigger can be specified. The graphic below illustrates the timing of the trigger signal for a falling edge trigger ($\mathbf{T_{RATE}}$). The dotted lines for 2.5V and 1V represent the necessary voltage for rising and falling TTL triggers, respectively. After being triggered, the instrument will measure for a period defined by the Frame Rate ($\mathbf{T_{MEAS}}$). Once the measurement is finished, the wavelength computation will take place ($\mathbf{T_{DATA}}$). Upon computation completion the result will be sent out the RS-422 port. To facilitate instrument handshaking, the CALC signal TTL output is available to show when a measurement cycle is complete. On the rising edge of the CALC signal, the instrument is ready to receive a trigger for the next measurement.

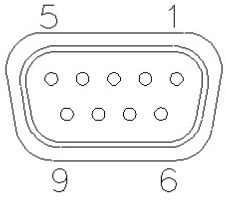


Trigger signal timing diagram

NOTE: If the instrument is triggered faster than the set Frame Rate, not all trigger signals will initiate measurements.

Monitor Port

The Monitor Port on the rear panel of the 871 Laser Wavelength Meter provides the input for a control trigger and monitoring of the data processing and output. The Monitor Port uses a 9-pin, female, D-sub style connector (shown in graphic below). The connector pinout is described in the table below.



Monitor Port

Pin Number	Signal Name	Signal Type	Description
1			N/C
2			N/C
3	TRIGGER	TTL	Input for external trigger signal.
4			N/C
5	GROUND	-	Circuit ground.
6			N/C
7			N/C
8	CALC	TTL	Monitor signal, which is set high during the processing of collected data. At the completion of data processing, results are sent out the RS-422 port.
9			N/C

High Speed Data Acquisition

This section describes the semantics and formatting of the measurement data along with the back panel pinout of the RS-422 port. The instrument ships with a RS-422-to-USB converter cable for transferring data to a computer, though any computer interface which can read an RS-422 signal can be used.

Measurement results from the 871 Laser Wavelength Meter can be retrieved through the standard SCPI messages over Ethernet or USB. The RS-422 output port must be used to achieve the highest measurement rates and most reliable timing. Every wavelength measurement computed by the 871 system, either internally or externally triggered, will be sent out the RS-422 port. The Application Software flash drive included with the 871 system contains several coding examples to demonstrate the proper method of reading the data from the RS-422 port at the maximum continuous measurement rate. If only a finite number of measurements are desired, then the internal data buffer can be used (see following section).

Communication Protocol

The communication protocol for the RS-422 port is as follows:

Baud Rate	921600
Data Bits	8
Parity	None
StopBits	1
Flow Control	None

Data Semantics

Each measurement consists of a wavelength, a relative power, a status word, and a scan index, in that order. The description of each field is as follows:

- **Wavelength** – The wavelength is given in nanometers. It is expressed as a double-precision (64-bit), floating-point number.
- **Power** – The power is given as the relative intensity on the detector. It is expressed as a single-precision (32-bit), floating-point number.
- **Status** – The status word is a 32-bit-wide bitfield. The hexadecimal value for each status word is listed in the Status Byte Definitions 85 chapter.
- **Scan Index** – The scan index is a 32-bit, unsigned integer, whose value increases by one with each measurement. The first scan index emitted by the instrument is 0, and the measurement after scan index 2^32 = 4294967296 will have scan index 0 again.

Encoding

Each measurement begins with the special byte 0x7E (the “start token”). To make it easy to identify the beginning of a measurement, the data is formatted so that this byte only ever occurs at the beginning of a measurement packet.

The encoding scheme is as follows:

- Every occurrence of 0x7E in the measurement data is replaced with the two-byte sequence 0x7D 0x5E. (The second byte is 0x7E XOR 0x20.)
- Every occurrence of 0x7D in the measurement data is replaced with the two-byte sequence 0x7D 0x5D. (The second byte is 0x7D XOR 0x20.)
- Every other byte is encoded as itself.

The decoding process is as follows:

- If the byte 0x7E is received, then the next byte will be the first byte of the measurement packet.
- If the byte 0x7D is received, then the next byte should be XORed with 0x20 and then included in the decoded result. (The 0x7D byte should not be included in the result).
- If any other byte is received, then it should be included as-is in the decoded result.

The contents of the four measurement fields are given in little-endian order. Excluding the start token, each measurement packet is twenty (20) bytes long after decoding.

Connection Port

The RS-422 Raw Data Port on the rear panel of the 871 system provides digital signals for collecting the data steam described above. The RS-422 Raw Data Port uses a 6-pin, female, RJ11-style connector (shown below) with a pinout described in the table below.

Raw Data Port

Pin	Signal Name	Signal Type	Description
1	NC		No Connection
2	GROUND	-	Circuit ground.
3	Rx+	INPUT	Receive +
4	Rx-	INPUT	Receive -
5	Tx+	OUTPUT	Transmit +
6	Tx-	OUTPUT	Transmit -

Stored Data Buffer

The 871 system allows the user to buffer up to 1 million measurements in the instrument's internal storage. The buffer is sent as primary data in response to a SCPI command.

This section describes the semantics and formatting of the measurement data stored in the buffer along with the process for retrieving the stored data. Control of the buffering is done using the *NuView* software or through the use of the MMEMory Subsystem of SCPI commands.

Data Semantics

The binary data consists of a wavelength, a relative power, a status word, and a scan index, in that order, for each buffered measurement. The description of each field is as follows:

- **Wavelength** – The wavelength is given in nanometers. It is expressed as a double-precision (64-bit), floating-point number.
- **Power** – The power is given as the relative intensity on the detector. It is expressed as a single-precision (32-bit), floating-point number.
- **Status** – The status word is a 32-bit-wide bitfield. The meaning of each bit is described in the Status Byte Definitions 85 Appendix Information.
- **Scan Index** – The scan index is a 32-bit, unsigned integer whose value increases by one with each measurement. The first scan index emitted by the instrument is 0, and the measurement after scan index 2^32 = 4294967296 will have scan index 0 again.

Unlike the RS-422 communication, there are no escape or start characters to parse while reading this file.

Downloading Data Buffer

The data buffer is retrieved through the *NuView* software or over Telnet through USB or Ethernet SCPI commands in block data format. The data is sent in binary with the following structure:

```
#<Digits in byte total><Total bytes in Data><Data><nl>
```

As an example, if there are 10,000 bytes in the data buffer then the SCPI response would be:

```
#510000<data><nl>
```

REMOTE COMMUNICATIONS

Communications Setup

USB Interface

The USB connection to the PC uses an RNDIS driver for virtual Ethernet connection. The RNDIS driver is included with every Windows PC, but it may not be activated. If you encounter errors with connecting the PC to the instrument, this may be a result of an inactive RNDIS driver. Please see RNDIS Troubleshooting Section 75 for information describing how to activate the RNDIS driver.

Ethernet Interface

The 871 Laser Wavelength Meter is a Telnet server, using the default Telnet port 23.

NOTE: The 871 system, will only support a single Telnet session per instrument.

- **Cabling –** The Ethernet port of the model 871 can be connected to the network hub or switch using a straight-through CAT-5 Ethernet cable, since regular ports (non-uplink) on all hubs and switches are already crossed-over by default. A crossover cable is required if, and only if, Auto-MDIX is not supported.
- **IP Address Set-Up** – The IP address for the 871 system is assigned manually or automatically using the Dynamic Host Configuration Protocol (DHCP) on the **Connection Settings** screen.
    - When DHCP is enabled (**YES**), the 871 system sends a broadcast query over the network requesting necessary information from a DHCP server. Upon receipt of a valid request, the server will assign to the 871 system an IP address, a lease (length of time for which the allocation is valid), and other IP configuration parameters, such as the subnet mask. The query is initiated immediately after booting and must be completed before the 871 system can be accessed via IP-based communication with other hosts.
    - If a DHCP server is not present on the network, or if a fixed IP address is preferred, then DHCP can be disabled (NO) and the IP address can be assigned manually. Select the **Enable DHCP** button to change the DHCP status. It is important to assign an IP address that is not already in use.
    - The Subnet Mask is also entered from the **Connection Settings** screen. The Subnet Mask should match that being used by the PC, and the IP Address should fall in the same subnet. Contact the network administrator to determine the correct setting. Select the **Set Ethernet Address/Subnet Mask/Gateway** buttons, use the keypad to enter the desired addresses, and select **Enter**.

Connecting Using Telnet

A Telnet session example from a networked PC running Windows 7, 8, or 10 is given below.

1. Click on **Start/Programs/Accessories/Command Prompt**, or type **`cmd`** into the **Search** bar.
2. To start a Telnet session, type **`Telnet`** at the command prompt, followed by the 871 system's IP address displayed on the **Connection Settings** screen.

```
C:\>Telnet 192.168.1.109

MityDSP Telnet Server
```

```
Copyright 2005, Critical Link LLC

Ctrl-D - Exit
Ctrl-E _ Toggle Echo

Bristol Instruments
```

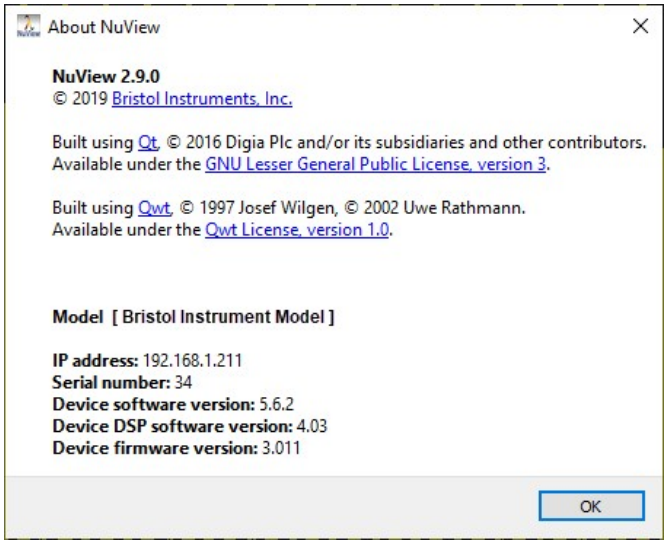
Telnet must be explicitly installed on a PC running Windows Vista, using the following instructions.

1. Go to the **Start Menu**, then click **Control Panel**.
2. Select **Programs and Features**.
3. Click **Turn Windows features on or off**, found in the left column.
4. Check the box next to **Telnet Client**, and click **OK**.

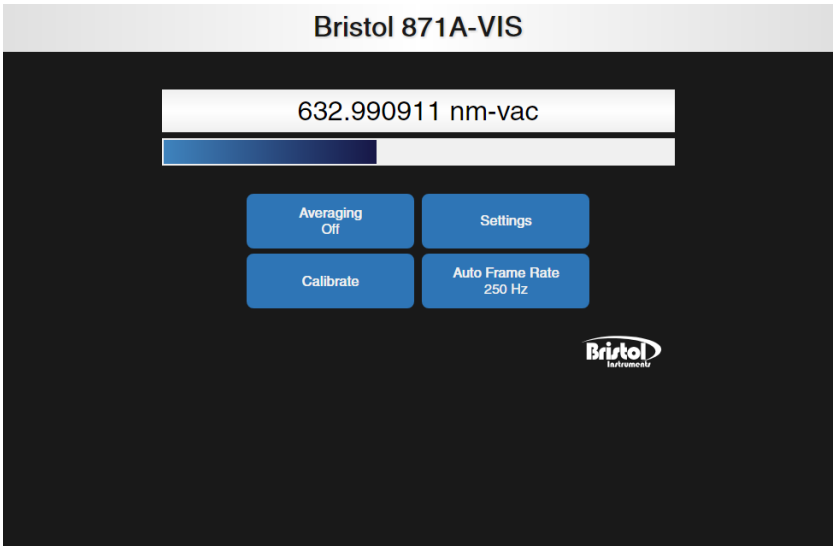
Web-based Display Application

The web-based display application allows remote connection to the 871 Laser Wavelength Meter to easily provide a portable wavelength display. A 871 with a wired connection to a network can be accessed by any computer, tablet, or smart phone connected to the same network.

1. Plug one end of an Ethernet cable into the Ethernet port on the back panel of the 871 system. Plug the other end into the wireless router.
2. Power on the 871 system and connect the *NuView* software to the instrument via USB. These steps are described in Steps 1–6 of the Operation Instructions section.
3. Identify the IP address assigned to the instrument by first selecting the **Help** menu, then selecting **About**. Note the IP address, then close the *NuView* software.

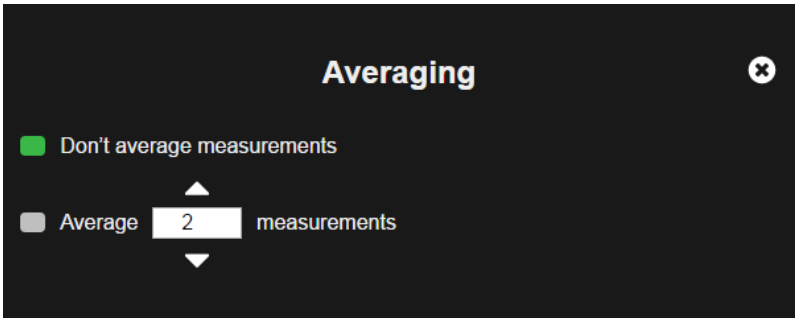


4. Connect the wireless device to the wireless network shared by the 871 system.
5. Open the wireless device's web browser and enter the 871 system's IP address. The format for the IP address shown is **`http://192.168.1.232`**.
6. Once connection is initiated, the web-based display application will immediately begin reporting wavelength and power measurements (if applicable).



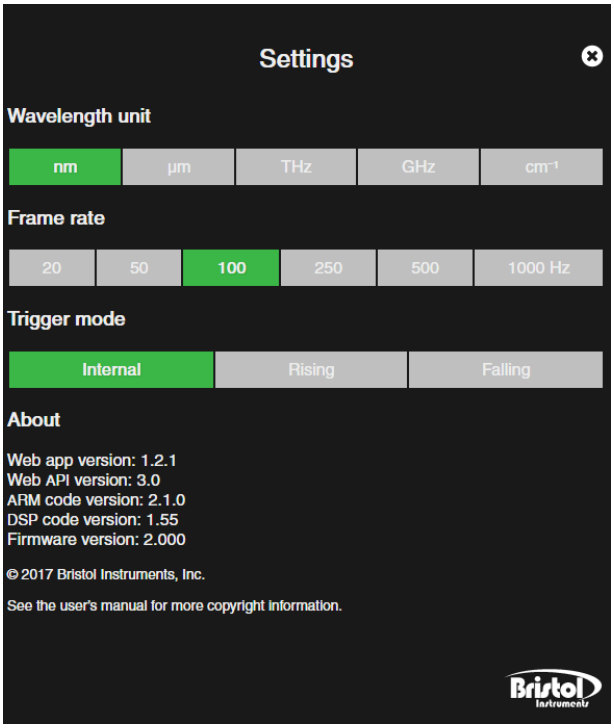
The display application shows the real-time wavelength and power measurements from the connected 871 system. The display application also offers customizable settings for displaying the measurement.

- **Averaging** – This function automatically calculates a running average of as many as 128 measurements. When averaging is selected, the wavelength display will display a single measurement after the chosen number of measurements is collected and averaged. The wavelength display will then be updated with each successive measurement. (See graphic below.)
  - **Don't average measurements** – Clicking this button disables averaging.
  - **Average…measurements** – Clicking this button enables averaging and allows the user to enter a number of averages between 2 and 128. 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 or number-pad.



- **Calibrate** – Calibrates the instrument with the internal reference source. Calibration takes approximately 2 seconds to complete and temporarily interrupts the displayed wavelength. A caution message is displayed while calibration is in progress.

- **Settings** – Allows the user to select the measurement units for the wavelength display, instrument frame rate, and trigger mode. The Settings screen also displays relevant information about the web-based display application and embedded software versions.
    - **Wavelength Unit** – Displays the wavelength in units of **nm**, **µm**, **GHz**, **THz**, or **cm^{-1}**. The green colored unit is currently displayed, while gray colored units are inactive. Click to select desired unit.
    - **Frame Rate** – Click to select the rate of measurements in number per second when using the internal trigger mode. For external trigger, the Frame Rate is related to the sensor exposure time. The green colored rate is currently displayed, while gray colored units are inactive.
    - **Trigger Mode** – Click to change the trigger mode between **Internal**, external rising edge (**Rising**), and internal falling edge (**Falling**). The green colored trigger mode represents the currently enabled method, while gray colored settings are inactive.
    - **About** – Lists the display application version and the embedded software versions.



- **Auto Frame Rate** – Adjusts the instrument's Frame Rate to illuminate the instrument's detector for optimal signal intensity. When Adjust Frame Rate is selected, the Display Application chooses a frame rate to illuminate the detector at approximately 50% saturation. Due to the time varying incident power on the detector from a pulsed laser, the Adjust Frame Rate can only be used when the Laser Type is set to CW mode. This function is always disabled (off) in Pulsed mode.

SCPI Command Summary

The following table is a summary of all the available SCPI commands for the 871 Laser Wavelength Meter.

NOTE: "[…]" brackets indicate an optional argument, and "{… | … | …}" brackets indicate a choice from a set of arguments.

Common Commands	
*CLS	Clears all event registers and the error queue.
*ESE{ ? | <integer> }	Sets/Queries the bits in the standard event status enable register.
*ESR?	Queries the value of the standard event status register.
*IDN?	Queries instrument model number, serial number and firmware version.
*OPC?	Queries the operation complete bit of the standard-event status register.
*RCL	Restores instrument settings.
*RST	Resets instrument to default settings.
*SAV	Saves instrument settings.
*STB?	Queries the value of the status byte.

Measurement Instructions	
{:FETCh | :MEASure | :READ} :ALL?	Queries the scan index, status, wavelength, and power.
{:FETCh | :MEASure | :READ} :ENVironment?	Queries the unit temperature and pressure.
{:FETCh | :MEASure | :READ} :FREQuency?	Queries the measured frequency.
{:FETCh | :MEASure | :READ} :POWer?	Queries the measured power.
{:FETCh | :MEASure | :READ} :WAVelength?	Queries the measured wavelength.
{:FETCh | :MEASure | :READ} :WNUMber?	Queries the measured wavenumber.

CALCulate Subsystem	
:CALCulate:DATA? {POWer | FREQuency | WAVelength | WNUMber }	Queries the data resulting from delta and drift measurements.
:CALCulate:DRIFt[:STATe]{ ? | OFF | ON}	Sets/Queries if DRIFt is to be calculated.
:CALCulate:DRIFt:METHod{? | STARt | MAXMin }	Sets/Queries the method used for DRIFt calculation.
:CALCulate:RESet	Resets the CALCulate subsystem.
:CALCulate:TIMe[:ELAPsed]?	Returns the time since last power on or reset.

SENSe Subsystem	
:SENSe:AVERage:COUNt {? | { 2 | 3 | ... | 128 }}	Sets\Queries the number of readings to be averaged.
:SENSe:AVERage:DATA? { :POWer | :FREQuency | :WAVelength | :WNUMber }	Queries averaged data.
:SENSe:AVERage:STATe {? | { OFF | ON }}	Sets\Queries state of averaging.
:SENSe:CALIbrate	Initiates a calibration.
:SENSe:CALIbrate:METHod {? | { OFF | TIME | TEMPerature }}	Sets\Queries the automatic calibration method.
:SENSe:CALIbrate:TEMPerature {? | { 1 | 2 | 3 ... | 50 }}	Sets\Queries the calibration temperature interval.
:SENSe:CALIbrate:TIMer {? | { 5 | 6 | 7 ... | 1440 }}	Sets\Queries the calibration time interval.
:SENSe:DETector:FUNCtion {? | { CW | PULSe }}	Sets\Queries type of laser under test.
:SENSe:EXPosure:AUTO {? | { OFF | ON }}	Sets\Queries the state of auto exposure.
:SENSe:PID:ERRor?	Queries the PID error.
:SENSe:PID:FUNCtion?	Queries if instrument has PID functionality.
:SENSe:PID:LCONstants:DERivative { ? | < real> }	Sets\Queries derivative constant of the PID calculation.
:SENSe:PID:LCONstants:INTegral { ? | < real> }	Sets\Queries integral constant for the PID calculation.
:SENSe:PID:LCONstants:PROPortional { ? | < real> }	Sets\Queries proportional constant for the PID calculation.
:SENSe:PID:OUTput?	Queries the voltage output of the PID.
:SENSe:PID:SPOint { ? | < real> }	Sets\Queries PID setpoint.
:SENSe:PID:STATe {? | { OFF | ON }}	Sets\Queries the state of the PID computation.
:SENSe:PID:VOLTage:DEFault { ? | < real> }	Sets\Queries the default PID voltage.
:SENSe:PID:VOLTage:MAXimum { ? | < real> }	Sets\Queries the maximum PID voltage.
:SENSe:PID:VOLTage:MINimum { ? | < real> }	Sets\Queries the minimum PID voltage.
:SENSe:PID:VOLTage:OFFSet { ? | < real> }	Sets\Queries the PID voltage offset.
:SENSe:PID:VOLTage:SCALe { ? | < real> }	Sets\Queries the PID voltage gain scale.

STATus Subsystem	
:STATus:QUEStionable:CONDition?	This command queries the SCPI Questionable Status register.
:STATus:QUEStionable:ENABle{? | <integer>}	Sets\ Queries the Questionable Enable register.

SYSTem Subsystem	
:SYSTem:ERRor?	Queries error strings from the Error Queue.
:SYSTem:HELP:HEADers?	Query a list of all commands/queries supported by the instrument.

TRIGer Subsystem	
:TRIGger:SEQuence:METHod{ ? | { INT | RISE | FALL }}	Set\Queries the method for triggering a new measurement.
:TRIGger:SEQuence:RATE{ ? | { 20 | 50 | 100 | 250 | 500 | 750 | 1000 | 1250 | 1500 }}	Sets\Queries the instrument measurement rate.
:TRIGger:SEQuence:RATE:ADJust[?]	Issues an automatic measurement rate adjustment.

SCPI Command Detail

This section describes the communication scheme of the 871 Laser Wavelength Meter. It follows the Standard Commands for Programmable Instruments (SCPI) Syntax and Style Guidelines. The sections detail the available commands by subsystem. "[…]" brackets indicate an optional argument, and "{… | … | …}" brackets indicate a choice from a set of arguments.

Measurement Instructions

The measurement instructions are used to return a reading to the computer. The three basic measurement instructions are MEASure, READ, and FETCh. The :FETCh command will return a reading based on the last complete scan of the instrument's interferometer. Using :FETCh, it is possible to collect new measurements at the instrument's specified measurement rate. However, if :FETCh queries are made faster than the instrument's measurement rate, it is possible to get the same reading twice. Old readings are indicated by a bit in the questionable status register.

The :MEASure command will return a reading based on the next scan cycle of the instrument's interferometer. The :READ command will return a reading based on the current scan of the instrument's interferometer. The :MEASure and :READ commands guarantee that each reading returned is a new one. However, because :MEASure waits until after the end of the current measurement cycle before returning a reading, measurement rates can be as slow as half the instrument's scan rate. To get multiple measurement types from a single scan (such as, WAVelength, POWer, etc.), use :READ followed by one or more :FETCh queries.

{ :MEASure | :READ | :FETCh } :ALL?

Description	Returns the scan index, the instrument status, an input laser reading, and a power reading for the tallest measured peak.
Query Response	A comma separated list of 4 numeric values (e.g., 1509773, 4, 1510.01797, -10.23). These denote the scan index, instrument status, wavelength, and power.
Examples	:FETC:ALL? :MEAS:ALL?

{ :MEASure | :READ | :FETCh } :ENVironment?

Description	Returns the instrument's internal temperature in degrees Celsius (ºC) and pressure in millimeters of mercury (mm Hg).
Query Response	Two numerical values with units separated by a comma (e.g., 28.5 C, 740 MMHG).
Examples	:READ:ENV? :FETC:SCAL:ENV?

{ :MEASure | :READ | :FETCh } :FREQuency?

Description	Returns an input laser reading in units of THz.
Query Response	A single numerical value (e.g., 193.67357).
Examples	:READ:FREQ? :FETC:SCAL:FREQ?

{ :MEASure | :READ | :FETCh } :POWer?

Description	Queries a power reading in either mW (milliwatts) or dBm as specified by the :UNIT:POWer function.
Query Response	Power measured in dB or mW for instruments with an internal power meter. Otherwise a relative power measurement is reported.
Examples	:READ:POW? :FETC:SCAL:POW?

{ :MEASure | :READ | :FETCh } :WAVelength?

Description	Returns an input laser wavelength value in units of nm.
Query Response	A single numerical value (e.g., 1531.5877).
Examples	:READ:WAV? :FETC:SCAL:WAV?

{ :MEASure | :READ | :FETCh } :WNUMber?

Description	Returns an input laser reading in units of cm^{-1}.
Query Response	A single numerical value (e.g., 6643.2891).
Examples	:READ:WNUM? :FETC:SCAL:WNUM?

Common Commands

*CLS

Description	Clears the event status register and the error queue.
Examples	*CLS

*ESE { ? | <1...256>}

Description	Sets/Queries the bits in the event status enable register. The *ESE (event status enable) command sets the bits in the event status enable register and enables the corresponding events in the event status register. For each bit that is set (equal to 1), the corresponding bit is enabled in the event status register (ESR). <integer> is an integer value which is the sum of all of the bit values for those bits that are set.
Query Response	<1...256>
Examples	*ESE 256 *ESE? => 256

Event Status Enable Register

BIT	BIT VALUE	ENABLES
7	128	Power On (PON)
6	64	Not Used
5	32	Command Error (CME)
4	16	Execution Error (EXE)
3	8	Device Dependent Error (DDE)
2	4	Query Error (QYE)
1	2	Not Used
0	1	Operation Complete (OPC)

*ESR?

Description	Returns a value which encodes the bits in the event status register that are set. If any bits are set in the ESR, then the ESR summary bit will be set in the STB. See table above for the explanation of the bit values.
Query Response	<1...256>
Examples	*ESE? => 12

*IDN?

Description	Returns a string value which contains the instrument type, serial number, and firmware version. The third value is the instrument serial number. The last value is the software version and will reflect the actual version number.
Query Response	Returns comma separated values depending on the instrument connected: BRISTOL WAVELENGTH METER, Model, Serial Number, Software Version
Examples	*IDN? => BRISTOL WAVELENGTH METER, 871A-NIR, 1135, 1.03

*OPC?

Description	Query returns a one (1) when all pending device operations are complete.
Query Response	{0 | 1}
Examples	*OPC? => 1

*RCL

Description	Restores instrument settings saved using the *SAV command.
Examples	*RCL

*RST

Description	Command returns SCPI settings to a default state. See individual commands for their reset values.
Examples	*RST

*SAV

Description	Saves the current instrument settings which can be restored later by using the *RCL command.
Examples	*SAV

*STB?

Description	Query to return the current value of the instrument's status byte.
Query Response	Returns an integer that is the sum of all the set bit values in the instrument Status Byte table below.
Examples	*STB? => 8

Instrument Status Byte

BIT	BIT VALUE	CONDITION
5	32	A bit is set in the questionable register (see STATus subsystem)
3	8	The errors in the error queue (see SYSTem subsystem)
2	4	A bit is set in the event status register

CALCulate Subsystem

The CALCulate subsystem is used to read and control the instrument's calculated values. The instrument continuously updates delta values based on the specified method desired. To retrieve CALCulate subsystem data, first choose a calculate data type, and then perform a calculate query. For example, to read the delta power, issue the following commands:

:CALC:DELT:METH MAXM Set up to read maximum-minimum.
:CALC:DATA? POW Read the maximum-minimum power.

:CALCulate:DATA? { POWer | FREQuency | WAVelength | WNUMber }

Description	Returns a calculated value based on the based on the :DELTa:METHod setting.
Query Response	A numerical value in fixed or scientific notation, depending on the units (see measurement of power, above).
Examples	:CALC:DATA? POW :CALC:DATA? WAV

:CALCulate:DELTa:METHod{ ? | { STARt | MAXMin }}

Description	Sets the state of the method of the delta calculation to either STARt or MAXMin. The STARt method calculates the value difference between the first measurement after a :CALCulate:RESet command and the current measurement value. The MAXMin method calculates the difference between the maximum and minimum values found since the last :CALCulate:RESet command.
Query Response	{ STARt | MAXMin}
***RST Value**	STARt
Examples	:CALC:DELT:METH STARt :CALC:DELT:METH? => STARt

:CALCulate:RESet

Description	Resets the minimum, maximum, and start values to the current reading. Resets the deltas and drifts to zero, and sets the elapsed time to 00:00:00.
Examples	:CALC:RES

:CALCulate:TIMe[:ELAPsed]?

Description	Queries the elapsed time since the instrument was turned on or was reset using the CALC:RES command.
Query Response	Time in HH:MM:SS format.
Examples	:CALC:TIM? :CALC:TIM:ELAP?

MMEMory Subsystem

The MMEMory subsystem controls the instruments buffer. As many as 1 million measurements can be internally stored and retrieved.

:MMEMory:CLOSe

Description	Stops writing measured data to the buffer.
Examples	: MMEM:CLOS

:MMEMory:DATA?

Description	Sends buffered data in a block format as defined in the Making Measurements chapter.
Examples	: MMEM:DATA?

:MMEMory:INITialize

Description	Clears all measurements in the buffer and closes if it is open.
Examples	: MMEM:INIT

:MMEMory:OPEN

Description	Starts writing measured data to the buffer.
Examples	: MMEM:OPEN

SENSe Subsystem

The SENSe subsystem allows changes in parameters that affect how the instrument makes measurements.

:SENSe:AVERage:COUNt {? | { 2 | 3 | ... | 128 }}

Description	Sets/Queries the number of readings to be averaged.
Query Response	{2 | 3 | 4 …128}
***RST Value**	2
Examples	:SENS:AVER:COUN 8 :SENS:AVER:COUN? => 8

:SENSe:AVERage:DATA? { :POWer | :FREQuency | :WAVelength | :WNUMber }

Description	Returns averaged wavelength or power data for the last N number of measurements. The value of N is set by :AVERage: COUNt command. If averaging is not turned on then the most recent data is returned.
Query Response	Averaged power, frequency, wavelength or wave number.
Examples	:SENS:AVER:DATA? POW :SENS:AVER:DATA? WAV 8

:SENSe:AVERage:STATe {? | { OFF | ON }}

Description	Sets/Queries if data is currently being averaged.
Query Response	{ OFF | ON }
***RST Value**	OFF
Examples	:SENS:AVER:STAT OFF :SENS:AVER:STAT? => OFF

:SENSe:CALIbrate

Description	Initiates a calibration of the instrument.
Examples	:SENS:CALI

:SENSe:CALIbrate:METHod {? | { OFF | TIME | TEMPerature }}

Description	Sets/Queries the method of automatic calibration for the instrument to be OFF or on a specified TIME or TEMPerature interval. The time interval between automatic calibrations is set with the :SENSe:CALIbrate:TIME command and the temperature interval is set with the :SENSe:CALIbrate:TEMPerature command.
Query Response	{ OFF | TIME | TEMPerature }
***RST Value**	TEMPerature
Examples	:SENS:CALI:METH TIME :SENS:CALI:METH? => TIME

:SENSe:CALIbrate:TEMPerature {? | { 1 | 2 | 3 ... | 50 }}

Description	Sets/Queries the minimum change in internal temperature that will trigger a calibration of the instrument. The change is specified in $1/10^{th}$ °C increments so a value of 10 corresonds to a 1 °C change.
Query Response	{ 1 | 2 | 3 | ... | 49 | 50 }
***RST Value**	5
Examples	:SENS:CALI:TEMP 25 :SENS:CALI:TEMP? => 25

:SENSe:CALIbrate:TIMer {? | { 5 | 6 | 7 ... | 1440 }}

Description	Sets/Queries the time between automatic calibrations of the instrument. The time is specified in minutes.
Query Response	{ 5 | 6 | 7 | ... | 1439 | 1440 }
***RST Value**	30
Examples	:SENS:CALI:TIM 100 :SENS:CALI:TIM? => 100

:SENSe:DETector:FUNCtion {? | { CW | PULSe }}

Description	Sets/Queries whether the instrument is detecting a continuous wave (CW) or pulsed laser source. For a pulsed laser source, measurements without sufficient intensity on the detector are not reported.
Query Response	{ CW | PULSe }
***RST Value**	CW
Examples	:SENS:DET:FUNC CW :SENS:DET:FUNC? => CW

:SENSe:EXPosure:AUTO {? | { OFF | ON }}

Description	Sets/Queries the state of the Auto Exposure function. When Auto Exposure is turned on the instrument modifies the exposure time dynamically to maintain the optimal detector signal.
Query Response	{ OFF | ON }
***RST Value**	ON
Examples	:SENS:EXP:AUTO OFF :SENS:EXP:AUTO? => OFF

:SENSe:PID:ERRor?

Description	Queries the last PID output error, expressed in nanometers.
Query Response	<real> Value in nanometers
Examples	:SENS:PID:ERR? => 0.123

:SENSe:PID:FUNCtion?

Description	Queries if the instrument has PID functionality.
Query Response	{ 0 | 1 }
Examples	:SENS:PID:FUNC? => 1

:SENSe:PID:LCONstants:DERivative { ? | < real> }

Description	Sets/Queries the derivative constant (K_D) for the PID calculation, expressed in seconds.
Query Response	<real> in range {0.0 … 50.0}
***RST Value**	0.0
Examples	:SENS:PID:LCON:DER 30.0 :SENS:PID:LCON:DER? => 30.0

:SENSe:PID:LCONstants:INTegral { ? | < real> }

Description	Sets/Queries the integral constant (K_I) for the PID calculation, expressed in Hz.
Query Response	<real> in range {0.0 … 50.0}
***RST Value**	0.0
Examples	:SENS:PID:LCON:INT 20.0 :SENS:PID:LCON:INT? => 20.0

:SENSe:PID:LCONstants:PROPortional { ? | < real> }

Description	Sets/Queries the proportional constant (K_P) for the PID calculation, expressed as a unit-less constant.
Query Response	<real> in range {0.0 ... 50.0}
***RST Value**	1.0
Examples	:SENS:PID:LCON:PROP 30.0 :SENS:PID:LCON:PROP? => 30.0

:SENSe:PID:OUTput?

Description	Queries the last PID output voltage, expressed in volts.
Query Response	<real> Value in volts
Examples	:SENS:PID:OUT? => -0.45

:SENSe:PID:SPOint { ? | < real> }

Description	Sets/Queries the target wavelength of the PID calculation. All values expressed in nanometers.
Query Response	<real> in range {350 ... 14000}
***RST Value**	1000
Examples	:SENS:PID:SPO 500 :SENS:PID:SPO? => 500

:SENSe:PID:STATe {? | { OFF | ON }}

Description	Sets/Queries whether the PID calculation is enabled. If set to OFF the PID output voltage will be set to the default value defined by the SENSe:PID:VOLTage:DEFault command.
Query Response	{ OFF | ON }
***RST Value**	OFF
Examples	:SENS:PID:STAT OFF :SENS:PID:STAT? => OFF

:SENSe:PID:VOLTage:DEFault { ? | < real> }

Description	Sets/Queries the voltage output when the PID calculation is disabled, expressed in volts.
Query Response	<real> in range { -5.0…5.0 }
***RST Value**	-5.0
Examples	:SENS:PID:VOLT:DEF 1.2 :SENS:PID:VOLT:DEF? => 1.2

:SENSe:PID:VOLTage:MAXimum { ? | < real> }

Description	Sets/Queries the maximum output voltage for the PID calculation, expressed in volts. The instrument automatically limits this voltage to a maximum of 5.0 volts.
Query Response	<real> in range { 0.1 … 5.0 }
***RST Value**	5.0
Examples	:SENS:PID:VOLT:MAX 1.5 :SENS:PID:VOLT:MAX? => 1.5

:SENSe:PID:VOLTage:MINimum { ? | < real> }

Description	Sets/Queries the minimum output voltage for the PID calculation, expressed in volts. The instrument automatically limits this voltage to a minimum of -5.0 volts.
Query Response	<real> in range { -5.0 … 0.0 }
***RST Value**	-5.0
Examples	:SENS:PID:VOLT:MIN -2.5 :SENS:PID:VOLT:MIN? => 2.5

:SENSe:PID:VOLTage:OFFSet { ? | < real> }

Description	Sets/Queries the voltage offset (centering position) for the PID calculation, expressed in volts. The instrument automatically limits this voltage to ± 5.0 volts.
Query Response	<real> in range { -5.0 … 5.0 }
***RST Value**	0.0
Examples	:SENSE:PID:VOLT:OFFS 2.0 :SENS:PID:VOLT:OFFS? => 2.0

:SENSe:PID:VOLTage:SCALe { ? | < real> }

Description	Sets/Queries the voltage/gain scale for the PID calculation, expressed in volts per nanometer.
Query Response	<real> in range { -500.0 … 500.0 }
***RST Value**	1.0
Examples	:SENSE:PID:VOLT:SCAL 20.0 :SENS:PID:VOLT:SCAL? => 20.0

STATus Subsystem

The STATus subsystem is used to retrieve status information from the instrument and to mask or screen what status can be retrieved. Status registers give information about the instrument and the latest measurement. Status enable registers allow some status information to be ignored. Status information disabled though the status enable registers will not show up in the status registers.

STATus:QUEStionable:CONDition?

Description	Queries the SCPI Questionable Status Register which contains bits that indicate that one or more measurement types are of questionable accuracy. The bits in the register are described in the table below.
Query Response	<0...2047> An integer which is the sum of the bit values for all bits in the register that are set.
Examples	:STAT:QUES:COND?

Questionable Status Register

BIT	BIT VALUE	DESCRIPTION
0	1	The wavelength has already been read for the current scan.
1	2	(not used)
2	4	(not used)
3	8	The power value is outside the valid range of the instrument.
4	16	The temperature value is outside the valid range of the instrument.
5	32	The wavelength value is outside the valid range of the instrument.
6	64	(not used)
7	128	(not used)
8	256	(not used)
9	512	The pressure value is outside the valid range of the instrument.
10	1024	Indicates that the reference laser has not stabilized.

STATus:QUEStionable:ENABle {? | {1 ... 2047}}

Description	Used to set and clear bits in the SCPI Questionable Enable Register. This register contains bits that are used to mask one or more conditions indicated in the Questionable Status Register. Clearing a bit (setting it to zero) causes that condition to be masked so that, even if the condition is true, its associated bit will not get set in the Questionable Status Register. The Questionable Enable Register has the same format as the Questionable Status Register. See table above.
Query Response	<0...2047> An integer which is the sum of the bit values for all bits in the register that are enabled.
Examples	:STAT:QUES:ENAB 1024 (enables “reference laser not stable” bit) :STAT:QUES:ENAB 2047 (enables all bits) :STAT:QUES:ENAB?

SYSTem Subsystem

The SYSTem subsystem supplies information and status about the SCPI command parser.

:SYSTem:ERRor?

Description	Reads error strings from the SCPI Error Queue. If the Error Queue has any entries, the Error Queue bit is set in the Status Byte. The instrument has a 30 entry, first-in, first-out queue. Repeatedly sending the query :SYST:ERR? returns the error numbers and descriptions in the order in which they occurred until the queue is empty. Any further queries return 0, "No error" until another error occurs. A table of possible errors is shown below.
Query Response	<integer>, <string> (e.g., –104, “Data type error”)
Examples	:SYST:ERR?

SCPI Errors

ERROR NUMBER	DESCRIPTION
0	No error
-101	Invalid character
-102	Syntax error
-103	Invalid separator
-104	Data type error
-220	Parameter error
-221	Settings conflict
-222	Data out of range
-230	Data corrupt or stale

:SYSTem:HELP:HEADers?

Description	Reads a list of all commands and queries supported by the instrument. Each line of the response is terminated by a linefeed. The first line indicates the number of bytes of help data that follow. The remaining lines are strings of help data. All lines of data must be read before continuing normal operations.
Query Response	#<integer> <string> <string> <string> ... <string>
Examples	:SYST:HELP:HEAD?

TRIGger Subsystem

The TRIGger subsystem is used to define the length of a measurement and how a measurement is initiated. The values for the TRIGger subsystem are INTernal, external FALL, or external RISE.

:TRIGger:SEQuence:METHod{ ? | { INT | RISE | FALL }}

Description	Sets/Queries the trigger method being used for data collection.
Query Response	{ INT | FALL | RISE }
***RST Value**	INT
Examples	:TRIG:SEQ:METH FALL :TRIG:SEQ:METH? => FALL

:TRIGger:SEQuence:RATE{ ? | { 20 | 50 | 100 | 250 | 500 | 750 | 1000 | 1250 | 1500 }}

Description	Sets the measurement rate of the internal trigger used for data collection. The INTernal TRIGger is specified as the number of measurements per second. The integration time set by the measurement rate will be used for external triggering. The available rates will depend on the instrument model as defined below. VIS \ NIR Model: { 20 | 50 | 100 | 250 | 500 | 1000} NIR2 Model: { 250 | 500 | 750 | 1000 | 1250 | 1500}
Query Response	VIS \ NIR Model: { 20 | 50 | 100 | 250 | 500 | 1000} NIR2 Model: { 250 | 500 | 750 | 1000 | 1250 | 1500}
***RST Value**	500
Examples	:TRIG:SEQ:RATE 250 :TRIG:SEQ:RATE? => 250

:TRIGger:SEQuence:RATE:ADJust[?]

Description	Sets the measurement rate of the internal trigger used for data collection. The INTernal TRIGger is specified as the number of measurements per second. The integration time set by the measurement rate will be used for external triggering. The available rates will depend on the instrument model as defined below.
Query Response	<int> The adjusted measurement rate in value of Hz.
Examples	:TRIG:SEQ:RATE:ADJ :TRIG:SEQ:RATE:ADJ? => 275

APPENDIX INFORMATION

Warranty and Service

The 871 Laser Wavelength Meter is warranted against defects in material and workmanship for a period of one year from 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.

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.

There are no user serviceable parts inside the 871 Laser Wavelength Meter. All service and repair work for the instrument is to be done at Bristol Instruments. 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.

If you have any questions about the operation of your 871 system or need to have your 871 system serviced, please call Bristol Instruments at (585) 924-2620. Or, you can contact us at service@bristol-inst.com.

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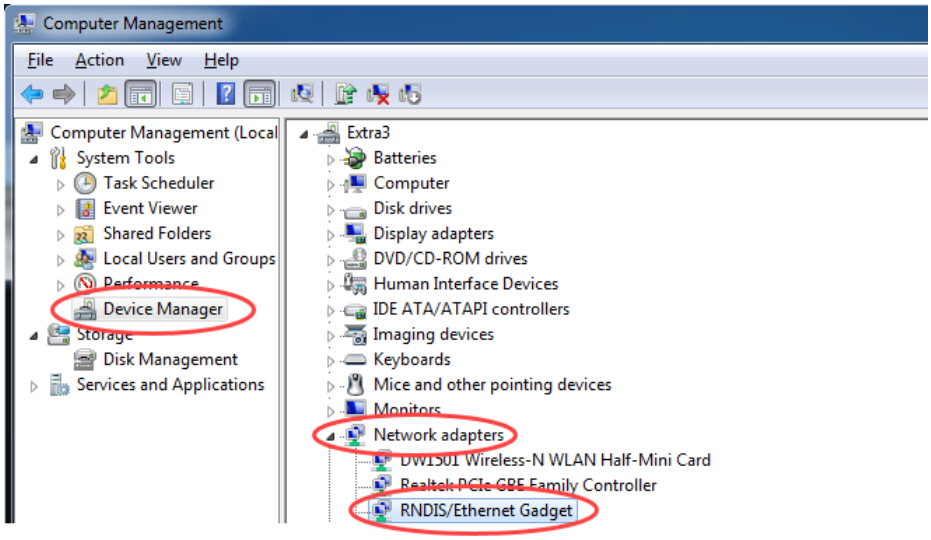
RNDIS Troubleshooting

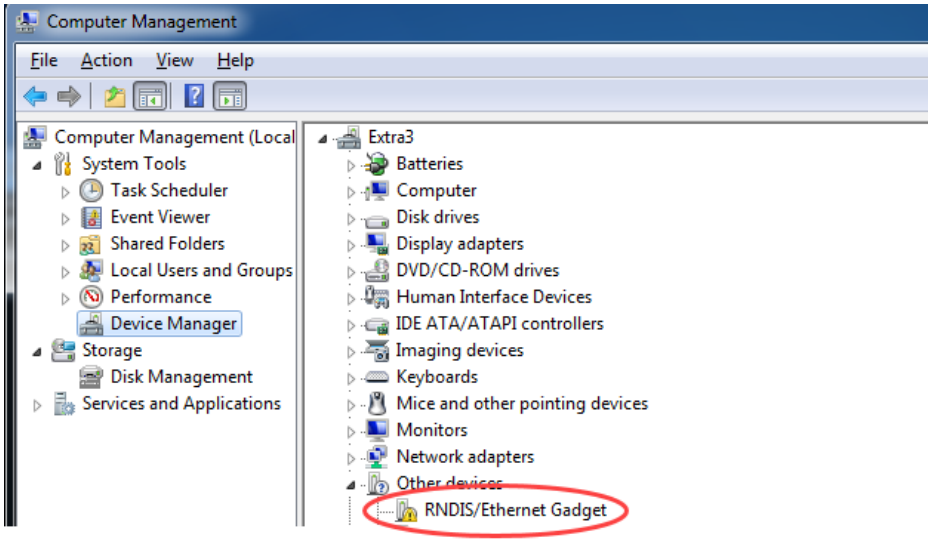
The 871 Laser Wavelength Meter communicates over USB interface with a virtual Ethernet connection. This connection uses the Remote Network Driver Interface Specification (RNDIS). Typically, the RNDIS system is automatically activated or installed when the instrument is first connected to the PC. However, there are several situations where the driver may not activate correctly. The following sections describe solutions to the most common RNDIS problems encountered with Windows 7 and 10 operating systems.

Windows 7

Most Windows versions (Windows 7 or newer) are shipped with the RNDIS driver. However, sometimes with Windows 7, it is necessary to manually enable the RNDIS driver if the computer does not recognize the 871 system. After connecting the 871 system to the PC via USB interface and powering up the 871 system, a successful connection will show up in the **Device Manager** (**`Control Panel`**> **`Device Manager`**) under **Network Adapters** as **RNDIS/Ethernet Gadget**.

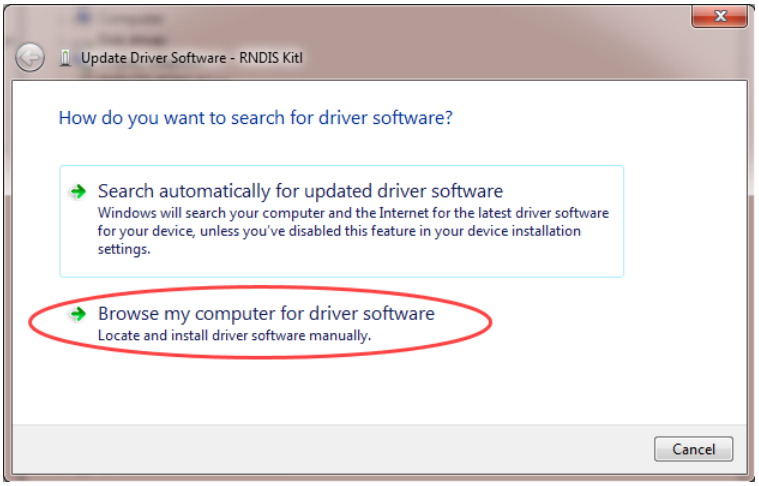


- If the RNDIS driver is not enabled, the Device Manager will show a yellow exclamation point for **RNDIS/Ethernet Gadget**.

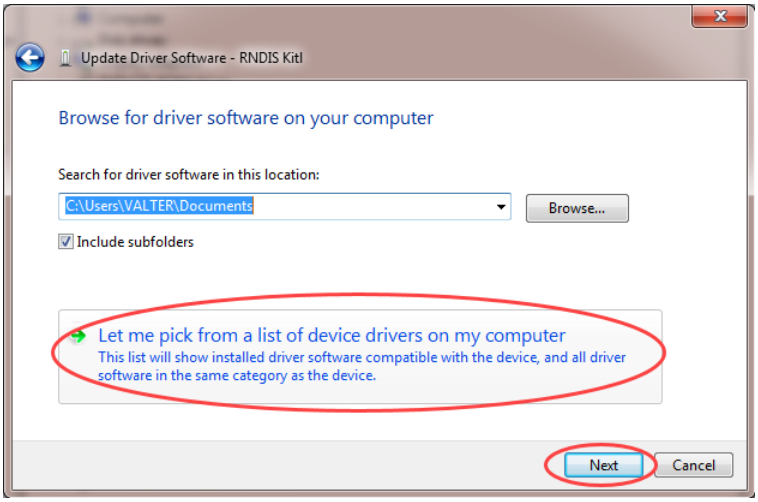


- If disabled, use the following instructions to enable the RNDIS driver.

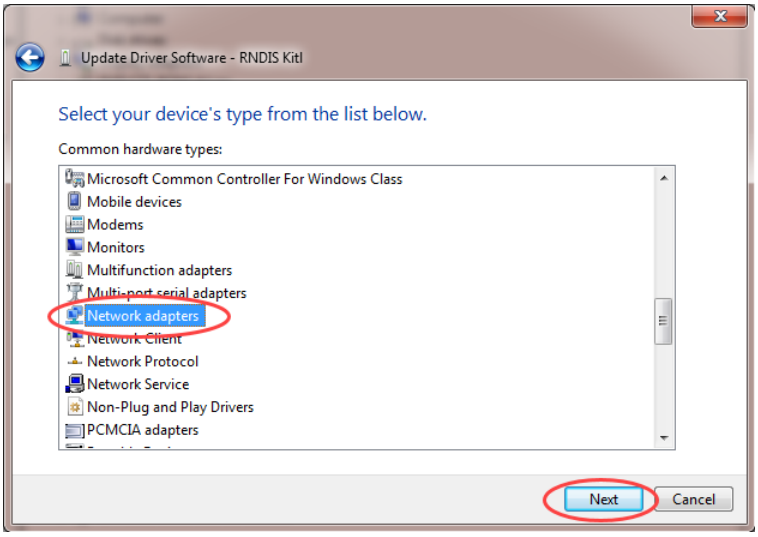
1. Right click on **RNDIS/Ethernet Gadget** and select **Update Driver Software**. The driver selection wizard prompt for how to search displays as shown below.
2. Select **Browse my computer for driver software**. The driver selection dialog displays.



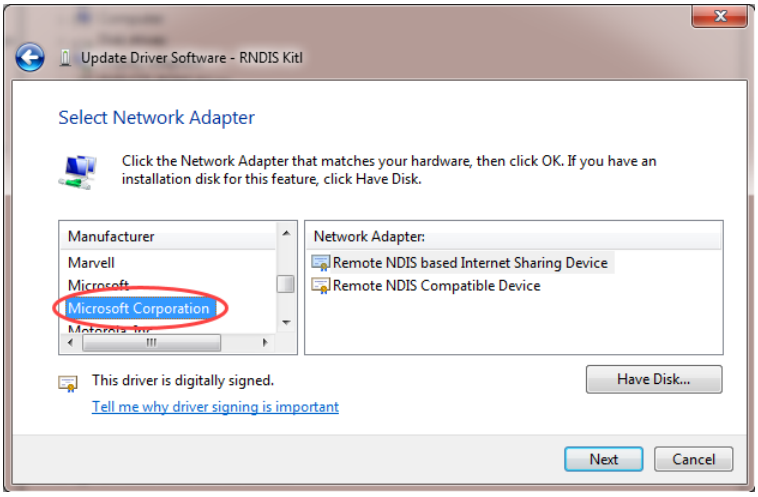
3. Select **Let me pick from a list of device drivers on my computer** and click **Next**.



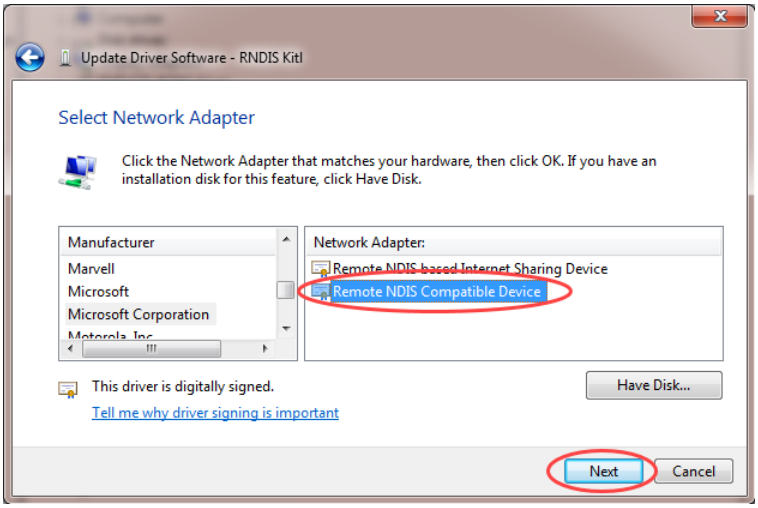
4. Select **Network adapters** for the device type (RNDIS emulates a network connection) and click **Next**.



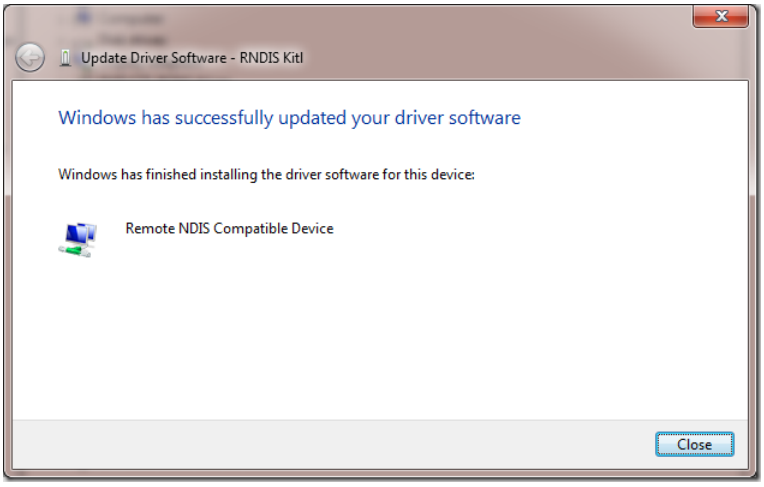
5. Select **Microsoft Corporation** as the network adapter manufacturer as shown below. (Do <u>not</u> click **Next** yet.)



6. Select **Remote NDIS Compatible Device** as the network adapter as shown below and click **Next**.



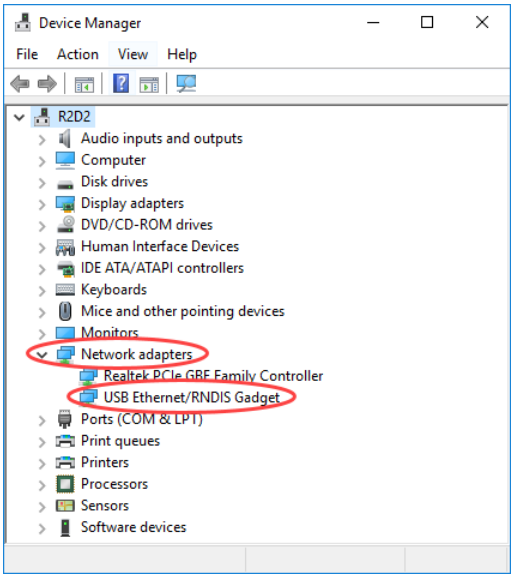
7. When completed, you should see the following dialog indicating the driver is enabled.



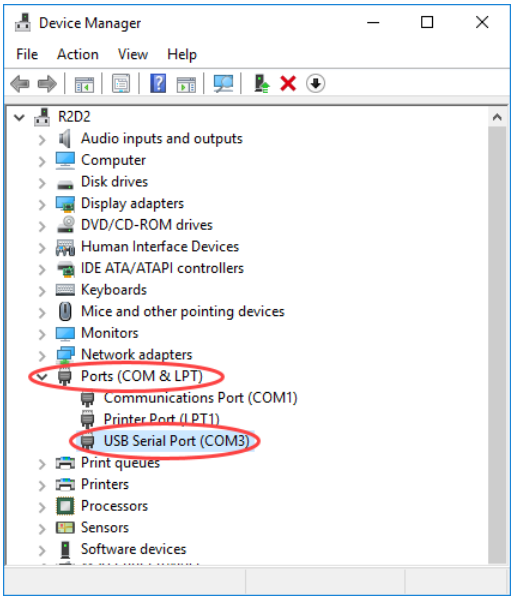
NOTE: If you need to connect to a RNDIS device from a virtual machine, it is easier to set up the RNDIS driver on your "real" machine and then share it with the virtual machine as you do with other network connections.

Windows 10

When a RNDIS enabled device is connected to a Windows 10 PC for the first time, the PC occasionally recognizes the instrument as a COM port device instead of an Ethernet Gadget/RNDIS. To fix this, update the driver associated with the instrument. Updating the driver causes the PC to reassign the COM port device as an Ethernet Gadget/RNDIS. After connecting the 871 system to the PC via USB interface and powering up the 871 system, a successful connection will show up in the **Device Manager** (**`Control Panel>Device Manager`**) under **Network Adapters** as **USB RNDIS/Ethernet Gadget**.



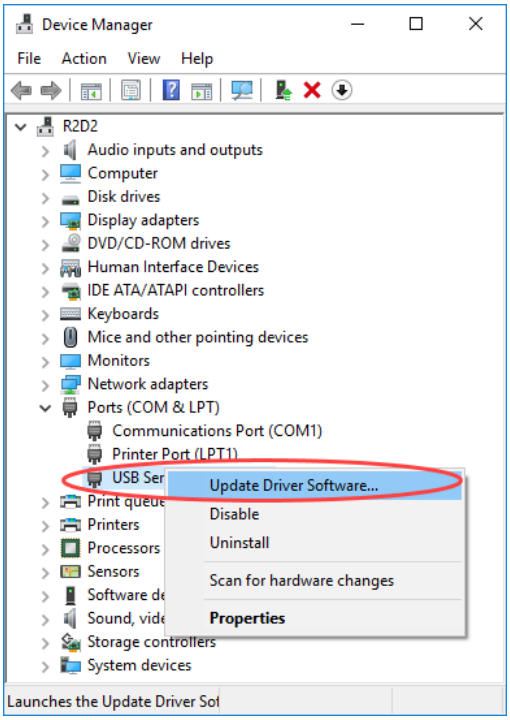
An unsuccessful USB connection with a RNDIS device will appear under **Ports (COM & LPT)** as a COM device.



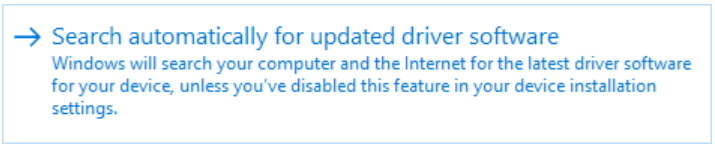
NOTE: This is incorrect for a USB connection only. The RS-422 to USB cable provided by Bristol Instruments appears as a COM device when correctly connected.

Use the following instructions to update the RNDIS driver:

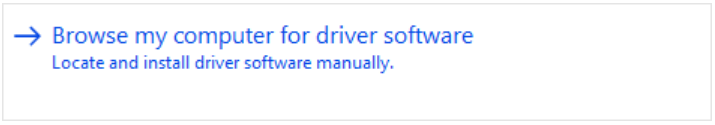
1. Right click on **USB Serial Port** and select **Update Driver Software** as shown below.



2. If an internet connection is available, select **Search automatically for updated driver software** to retrieve the latest driver from the internet.



3. If no internet connection is available, select **Browse my computer for driver software** and locate the **RNDIS Driver** zip file on the customer CD supplied with the instrument. Unzip the files, and choose the 32-bit or 64-bit file according to the Windows operating system of the PC.



NOTE: If you need to connect to a RNDIS device from a virtual machine, it is usually easier to set up the RNDIS driver on your "real" machine and then share it with the virtual machine as you do with other network connections.

Fiber-Optic Cleaning Instructions

To ensure that all fiber-optic connectors are clean and dry the 871 Laser Wavelength Meter is shipped with a fiber-optic cleaning kit consisting of a package of connector cleaning sticks and clean wipes. It is assumed that isopropyl alcohol or another solvent is available for cleaning.

Sticklers CleanWipes

1. Hold wipe in hand.
2. Apply cleaning solvent to the wipe.
3. Rub fiber against the wipe until clean.
4. Discard the wipe.

Sticklers CLEANSTIXX Connector Cleaning Sticks

1. Moisten with cleaning solvent. Be careful not saturate the stick.
2. Insert stick into the connector.
3. To clean the fiber-optic input connector, rotate the stick 10 times.
4. Discard the stick.

Software Copyright Acknowledgement

The Model 871 makes use of copyrighted software, the use of which is hereby acknowledged.

Font Awesome by Dave Gandy

Go-Json-Rest

Knockout

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
Laser Not Stable	This indicates that the internal reference laser has not stabilized yet.
Reference laser stabilizing!	The reference laser is performing its self-test. Once the self-test is complete, the instrument is ready for calibration.
Calibrating	The instrument is currently calibrating.
Calibration failed	The previous requested calibration failed. Measurements will be discontinued until a valid calibration is acquired.
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.
Detector signal saturated	The input light has saturated the detector signal. If automatic attenuation is on, reduce the input laser intensity.
Detector signal low	The intensity on the detector is low. Measurements will continue to be reported but with potential for increased noise. Consider increasing laser power or decreasing frame rate.
No signal detected	No interference signal detected. Verify laser parameters meet instrument specifications.
Wavelength accuracy is reduced	The instrument has encountered an error with the interference fringes from the final etalon, and the instrument will not meet its stated accuracy specification. Ensure that the input signal is single mode with bandwidth less than 1 GHz and that the power is not near the upper or lower bounds of the instrument.

Status Byte Definitions

The 871 Laser Wavelength Meter reports the instrument status for each acquired measurement. The status is a 32-bit number with each bit indicating a different piece of information. Depending on the method for retrieving this status, it can be displayed as a hexadecimal or decimal value. The status messages for relevant bits are listed in the table below. For additional information about the status messages, please contact Bristol Instruments.

BIT VALUE	DECIMAL VALUE	HEX VALUE	STATUS MESSAGE
2	4	0x00000004	Reference laser locked
3	8	0x00000008	Etalon fringe error
4	16	0x00000010	Etalon saturation error
7	128	0x00000080	Calibration failure
8	256	0x00000100	Input power too high
9	512	0x00000200	Input power too low
10	1024	0x00000400	Reference laser temp high
11	2048	0x00000800	Reference laser not stable
12	4096	0x00001000	Reference laser out of range
13	8192	0x00002000	Instrument temperature high
14	16384	0x00004000	Instrument temperature low
15	32768	0x00008000	Instrument pressure high
16	65536	0x00010000	Instrument pressure low
17	131072	0x00020000	Wavelength Out of Bounds
18	256144	0x00040000	Reference fringes low
19	524288	0x00080000	Etalon fringe error
20	1048576	0x00100000	Etalon saturation error
21	2097152	0x00200000	Calibration in progress
22	4194304	0x00400000	Etalon fringe error
23	8388608	0x00800000	Etalon saturation error
24	16777216	0x01000000	Etalon fringe error
25	33554432	0x02000000	Etalon saturation error
26	134217728	0x08000000	Wavelength accuracy reduced
28	536870912	0x20000000	Low detector signal
29	1073741824	0x40000000	Fringe frequency error

DECLARATION OF CONFORMITY

Manufacturer's Name: Bristol Instruments, Inc.

Manufacturer's Address: 770 Canning Parkway
Victor, NY 14564 USA

declares this product:

Product Name: Wavelength Meters

Model Number(s): 871-VIS, 871-NIR, 871-NIR2

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	**±4 KV Air & Contact**
	EN61000-4-3: 2006	**3 V/m 80 MHz-2.7GHz**
	EN61000-4-4: 1995	**±1 KV**
	EN61000-4-5: 1995	**±1 KV(L-G) ±0.5 KV(L-L)**
	EN61000-4-6: 1996	**3 V 0.15-80 MHz**
	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 1834 – 91018 Evry cedex - France

Date of Issue: February 2, 2016

CE

Signed:

John Theodorsen

Vice President of Operations

INSTRUMENT SPECIFICATIONS

MODEL	871A	871B
LASER TYPE	Pulsed and CW	
WAVELENGTH		
Range	**VIS:** 375 – 1100 nm **NIR:** 630 – 1700 nm	**VIS:** 375 – 1100 nm **NIR:** 630 – 1700 nm **NIR2:** 1000 – 2500 nm
Absolute Accuracy [1, 2]	± 0.2 ppm (single-mode fiber)	± 0.75 ppm (single-mode fiber) ± 1 ppm (multi-mode fiber ≤ 62.5 µm diameter)
Repeatability [3, 4]	± 0.0075 ppm	± 0.0125 ppm
Calibration [5]	Automatic with built-in wavelength standard	
Display Resolution	9 digits	8 digits
Units [6]	nm, µm, cm^{-1}, GHz, THz	
OPTICAL INPUT SIGNAL		
Maximum Bandwidth (FWHM)	1 GHz	10 GHz
Minimum Input [7, 8, 9, 10]	**VIS:** 3 – 300 nJ **NIR:** 50 – 600 nJ	**VIS:** 3 – 300 nJ **NIR:** 30 – 600 nJ **NIR2:** 50 – 600 nJ
MEASUREMENT RATE	1 kHz	
INPUTS/OUTPUTS		
Optical Input [11]	Pre-aligned FC/PC fiber connector (optional free beam-to-fiber coupler)	
Instrument Interface	USB and Ethernet interface with Bristol's Windows-based display program Streaming via RS-422 (internal or external TTL trigger) PID controller (± 5 V output)	
COMPUTER REQUIREMENTS	PC running Windows 7, 8, or 10, 1 GB available RAM, USB 2.0 (or later) port, monitor, pointing device	
ENVIRONMENTAL [7]		
Warm-Up Time	< 15 minutes	
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)	3.5 in. x 17.0 in. x 15.0 in. (89 mm x 432 mm x 381 mm)	
Weight	17 lb (7.65 kg)	
POWER REQUIREMENTS	90 - 264 VAC, 47 - 63 Hz, 50 VA max	

(1) Defined as measurement uncertainty, or maximum wavelength error, using a coverage factor of 3 providing a confidence level of ≥ 99.7%.
(2) Traceable to accepted physical standards.
(3) Standard deviation for a 1-minute measurement period after the instrument has reached thermal equilibrium. Standard deviation for a 10-minute period is about twice the 1-minute specification.
(4) Wavelength resolution is approximately two times repeatability.
(5) For VIS version, stabilized single-frequency HeNe laser. For NIR version, laser diode locked to acetylene absorption (NIST Special Publication 260-133).
(6) Data in units of nm, µm, and cm-1 are given as vacuum values.
(7) Characteristic performance, but non-warranted.
(8) Required minimum energy from a single laser pulse. Greater sensitivity is achieved by increasing the length of the measurement window to allow for the integration of a greater number of laser pulses.
(9) Required minimum power is approximated by multiplying the required minimum energy by the selected measurement rate.
(10) Sensitivity at specific wavelengths can be determined from graphs that are provided in the 871 Series Product Details brochure.
(11) Visual inspection and optimization of the interference fringe pattern is not required.

BRISTOL
INSTRUMENTS

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