
Picarro G2311-*f* 10Hz CO₂, CH₄, and H₂O Analyzer for Eddy Covariance Flux

User's Guide





PICARRO INC.

Picarro Analyzer User's Guide

Thank you for purchasing a Picarro product. Your Picarro Analyzer is a quality product that has been designed and manufactured to provide reliable performance.

This manual is an important part of your purchase as it will help familiarize you with the analyzer and explain the numerous features that have been designed into it. Please read this manual thoroughly before using your Picarro Analyzer.

Please contact Picarro or your authorized Picarro distributor should you have questions regarding specific applications or if you require additional information.

Contact information:

Website: www.picarro.com

Email: customersupport@picarro.com

Picarro, Inc. reserves the right to change or update the contents of this manual and to change the specifications of its products at any time without prior notification. Every effort has been made to keep the information in this document current and accurate as of the date of publication or revision. However, no guarantee is given or implied that this document is error free or that it is accurate with regard to any specification.

Picarro, Inc. has prepared this manual for use by its customers as a guide for the proper installation, operation and/or maintenance of the Picarro Analyzer.

Picarro and the Picarro Logo are trademarks of Picarro, Inc.

© 2012 Picarro, Inc. All rights reserved.
3105 Patrick Henry Dr.
Santa Clara
California, 95054
USA.

Phone 408.962.3900 • Fax 408.962.3200

PICARRO

TABLE OF CONTENTS

INTRODUCTION	4
CONVENTIONS	5
SAFETY	6
GENERAL SAFETY	6
LASER SAFETY.....	7
GETTING STARTED	8
UNPACKING	8
INSTALLATION & STARTUP PROCEDURES	9
DETAILED OPERATION INSTRUCTIONS	14
DESKTOP ICONS & FOLDERS.....	14
UNDERSTANDING THE MAIN GRAPHICAL USER INTERFACE (GUI)	17
SWITCHING BETWEEN MEASUREMENT MODES.....	22
<i>GENERAL INSTRUCTIONS ON HOW TO SWITCH BETWEEN MODES</i>	22
<i>EXPLANATION OF DIFFERENT MEASUREMENT MODES</i>	23
<i>BEFORE SWITCHING TO “HIGH PRECISION” OR “FLUX (LOW FLOW)” MODE</i>	24
DATA	25
<i>TYPES, LOCATIONS, & NAMING CONVENTIONS OF DATA:</i>	25
<i>CONFIGURING DATA ARCHIVING</i>	28
<i>REMOTE DATA ACCESS</i>	29
<i>DATA FILE VIEWER</i>	32
SETUP TOOLS	33
<i>CONFIGURING DATA FILE SAVING DETAILS</i>	33
<i>MANAGING PORTS FOR DIGITAL DATA OUTPUT/INPUT & SERIAL COMMUNICATION</i>	34
<i>SCHEDULING REMOTE DATA DELIVERY (EMAIL)</i>	35
<i>EDITING THE MAIN GUI’S PROPERTIES</i>	36
<i>SPECIFYING DIGITAL DATA OUTPUT FOR COMMAND INTERFACE</i>	37
<i>SPECIFYING DIGITAL DATA OUTPUT FOR DATA STREAMING</i>	37
<i>CUSTOMIZING ANALOG OUTPUT CHANNELS</i>	38
SHUTDOWN PROCEDURE	39
<i>IN CASE OF ELECTRICAL POWER OUTAGE</i>	40
CALIBRATING THE ANALYZER.....	41
CAVITY RING-DOWN SPECTROMETER CONTROLLER	45
HOW TO INTEGRATE AN ANEMOMETER OR A GPS TO THE ANALYZER (OPTIONAL)	46
EXTERNAL VALVE CONTROL (OPTIONAL)	51
ANALOG SIGNAL OUTPUT (OPTIONAL)	53
SPECIFICATIONS	55
ABSOLUTE MAXIMUM RATINGS	55

PICARRO

SAMPLE GAS REQUIREMENTS.....	55
PHYSICAL SPECIFICATIONS.....	56
SERVICE AND MAINTENANCE	57
REMOVING THE OLD PARTICULATE FILTER:	58
INSTALLING THE NEW FILTER:	60
TROUBLESHOOTING GUIDE.....	61
TRANSPORTATION AND STORAGE.....	64
LIMITED WARRANTY	65

PICARRO

INTRODUCTION

Picarro Analyzers use time-based, optical absorption spectroscopy of the target gases to determine concentration. They are based on wavelength-scanned cavity ring-down spectroscopy (WS-CRDS), a technology in which light re-circulates many times through the sample, creating a very long effective path length for the light to interact with the sample, thus, enabling excellent detection sensitivity in a compact and rugged instrument.

The Picarro Analyzer is comprised of two modules:

Analyzer	The analyzer contains the spectrometer, sample chamber, and a computer with a hard drive to store data. The single analyzer module controls the operation of the system and converts spectroscopic measurements into gas concentration data.
External Vacuum Pump	The diaphragm pump draws the sample gas through the instrument.

This manual contains information needed to safely install, operate, and maintain your analyzer.

This manual was designed to be easy to read and understand. If you have any questions, please let us know.

PICARRO

CONVENTIONS

Throughout the manual you will see graphic icons representing important information in the text. The purpose of these icons is to provide a visual convention to alert you of a stop in the flow of the manual, where an important note or safety hazard alert is posted.

NOTE	CAUTION	WARNING	REMINDER
			

NOTE is an important procedure of which you should be aware before proceeding.

CAUTION alerts you of a potential danger to equipment or to the user.

WARNING indicates an imminent danger to the user.

REMINDER is a helpful hint to procedures listed in the text.

SAFETY








GENERAL SAFETY

The Picarro Analyzer complies with the following safety standards:

CE

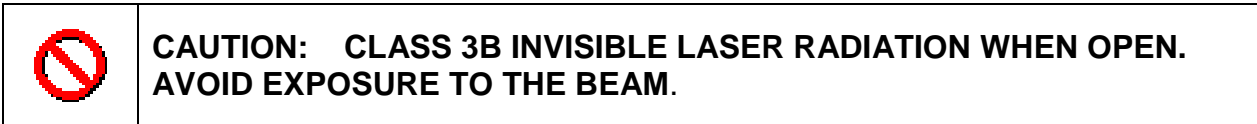
IEC EN61010-1:2001 (Safety) and EN61326-1:2006 (EMC) requirements for electrical equipment for measurement, control and laboratory use.

FDA/CDRH 21 CFR Parts 1040.10-11

	<p>WARNING: DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE! DO NOT OPERATE IN THE PRESENCE OF FLAMMABLE GASSES OR FUMES.</p>
	<p>WARNING: THE INSTRUMENT IS NOT WATER PROOF, AND IT SHOULD BE KEPT PROTECTED FROM EXPOSURE TO ALL LIQUID WATER.</p>
	<p>NOTE: The Picarro Analyzer contains no user serviceable components except the particulate filter and the vacuum pump. Do not attempt repairs; instead, report all problems to Picarro Customer Service or your local distributor. Please contact Picarro if you have any questions regarding the safe operation of this equipment. Refer to the appropriate section within this document relating to pump and filter replacement procedures.</p>
	<p>CAUTION: The inlet gas connector on the back panel of the Analyzer, and its immediate vicinity, runs hot during operation of the analyzer. Take care when connecting gas lines or working at the rear of the instrument to wear protective gloves or avoid contact with these surfaces.</p>
	<p>CAUTION: The analyzer contains HOT SURFACES and utilizes HIGH VOLTAGES inside the instrument. There are no user serviceable components except the filter within the analyzer and you should not open the analyzer except to replace the filter. Do not open any enclosures within the analyzer.</p>
	<p>NOTE: Although the analyzer components can be optionally configured for rack mounting, they require supports in the rack, such as a shelf or side L-brackets, and cannot be safely supported by the rack mount ears alone. Please refer to the section on installation for details.</p>
	<p>CAUTION: The analyzer is heavy. To avoid injury, please use proper 2-person lifting procedures when moving or installing the equipment.</p>

LASER SAFETY

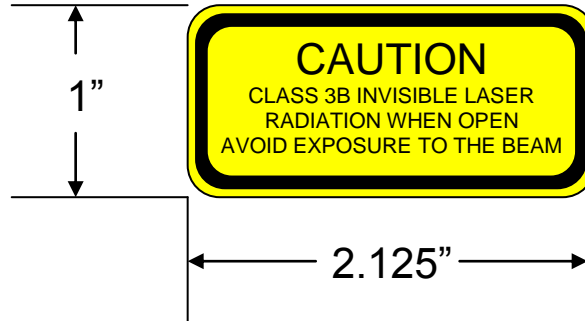
The outside of the Picarro Analyzer is classified as a Class 1 Embedded Laser Product, while the inside of the Picarro Analyzer is classified as a Class 3B Embedded Laser Product.



There are lasers used inside the analyzer, emitting a maximum of 50mW of CW light in the near-infrared. There are no user serviceable components within the analyzer enclosures and so you should not open any of these enclosures within the analyzer. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN EXPOSURE TO CLASS IIIB LASER RADIATION, which can permanently damage eyes and skin.

SAFETY LABEL

The following label is affixed to the inside of the analyzer.



PICARRO

GETTING STARTED

UNPACKING

All Picarro products are inspected and tested prior to shipment from the factory. In case there is damage to the shipping containers (holes or crushing, etc.), insist that a representative of your shipping carrier is present while you unpack the contents. Damage caused by shipping is the responsibility of the shipping carrier and all claims must be routed through their claims department.

CAREFULLY unpack the contents from the boxes. The shipment should contain the following:


1 Analyzer - includes the data acquisition, control, communications hardware and firmware to perform all gas handling, spectral collection and reporting
1 External Vacuum Pump and vacuum line
2 A/C power cables
1 Software CD
1 Certificate of compliance
1 User Manual


If an item is missing, contact Picarro for a replacement. Inspect each item to assure it is not damaged.


It is recommended that you keep the shipping packages, at least until the analyzer has been installed and verified as being fully operational.


INSTALLATION & STARTUP PROCEDURES

This section describes the setup and installation of the Picarro Analyzer. Please read and understand this section thoroughly before proceeding with the installation.

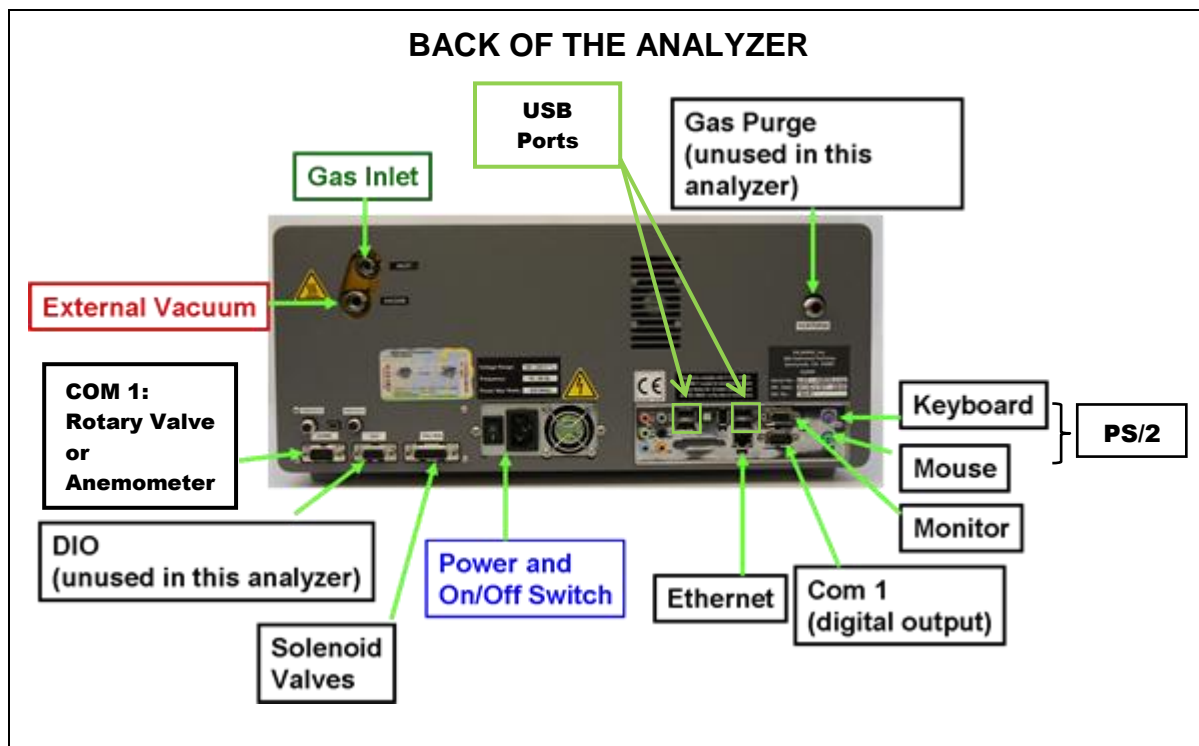
	<p>Warning: Do not attach electrical power to or start the analyzer until <u>after</u> attaching and activating the External Vacuum Pump. Do not disconnect the vacuum line while the analyzer is running. Failure to do so could result in damage to the optics.</p>
---	---

<h3>Thermal Consideration</h3>											
	<p>CAUTION: It is imperative that the analyzer have adequate ventilation and/or cooling to maintain the ambient temperature below 50°C when operating. Failure to provide adequate airflow and/or cooling to the analyzer will result in overheating of the analyzer causing a shutdown and possibly damage to the analyzer.</p>										
<table border="1"> <thead> <tr> <th>Thermal Specifications</th> <th>Min</th> <th>Max</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Ambient Operating Temperature</td> <td>5°C</td> <td>50°C</td> <td>Worst-case environmental limits (unless otherwise specified)</td> </tr> </tbody> </table>				Thermal Specifications	Min	Max	Description	Ambient Operating Temperature	5°C	50°C	Worst-case environmental limits (unless otherwise specified)
Thermal Specifications	Min	Max	Description								
Ambient Operating Temperature	5°C	50°C	Worst-case environmental limits (unless otherwise specified)								


	<p>NOTE: A fan on the front face of the analyzer draws air through the analyzer where it then exits from the rear panel. Adequate clearance must be provided at the front and rear panels of the analyzer to ensure proper airflow. Take care to ensure that this warm air is exhausted from any enclosure in which the analyzer is mounted</p>
---	--

	<p>CAUTION: Allow analyzer to equalize to room temperature before starting the installation process.</p>
---	---

PICARRO



- 1) Remove the Analyzer and the External Vacuum Pump from their shipping containers.
- 2) Place the Analyzer in a 19" rack or on a bench top. Place the External Vacuum Pump near-by or on the floor.

	Warning: The Analyzer cannot support itself using the rack mount kit alone. The instrument <i>must</i> be supported by a shelf or rails attached to the rack.
---	--

- 3) Unpack the accessories (Gas line, AC power cable, manual, certificate of compliance, and software CD).
- 4) Remove the caps from the Analyzer inlet and vacuum ports.
- 5) Remove the caps from the External Vacuum pump.
- 6) Connect the AC power cable to the External Vacuum Pump and select the appropriate voltage setting (115V or 230V).
- 7) Attach the gas line between the Analyzer vacuum port and the External Vacuum Pump (Hand tighten the nut, then make an additional 1/8th turn with an 11/16" wrench).

PICARRO



CAUTION: The back panel of the Analyzer in the vicinity of the inlet port can be very hot.

- 8) If desired, attach a tube to the External Vacuum Pump exhaust port and direct to a safe place for venting the mixture of sample and dilution gases.
- 9) It is recommended that you finish the analyzer installation and start-up procedure before attaching a gas line to the inlet port of the analyzer.



Warning: Do not connect a USB hub or other USB devices to the computer because it can interfere with the operation of the analyzer. Copying data to a USB flash drive is acceptable, however.

- 10) Attach a mouse, keyboard and display to the computer connections on the back of the Analyzer.



Note: The analyzer can be controlled and monitored using either the interactive graphical user interface (GUI) or the RS-232 command interface. A computer monitor, keyboard and mouse are required if the interactive GUI interface is desired. It is recommended that at least the initial installation be done using the GUI.

- 11) Power on the External Vacuum Pump.



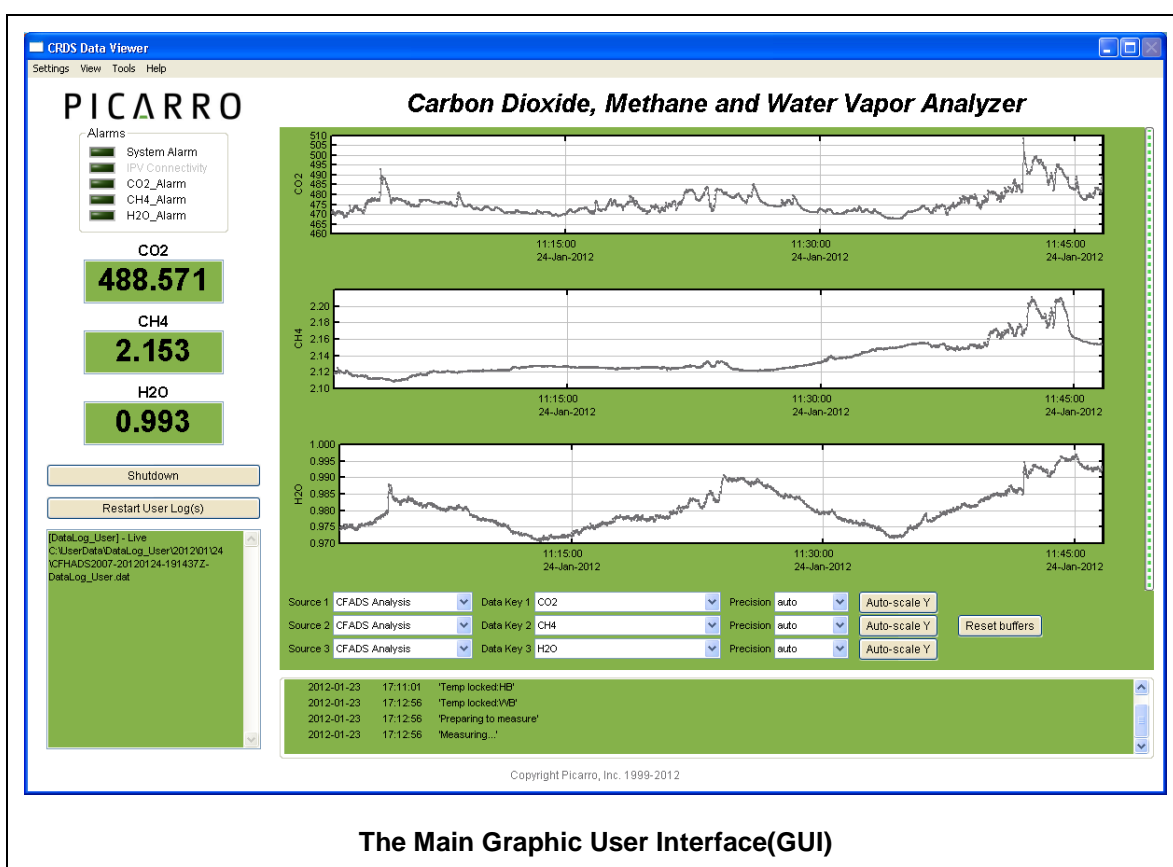
Warning: Do not attach electrical power to or start the analyzer until after attaching and activating the External Vacuum Pump. Failure to do so could result in damage to the optics.

- 12) Connect the AC power cable to the Analyzer and power on the Analyzer using the front panel button. Make sure that the power switch on the rear of the analyzer is 'ON'. For most configurations, the analyzer will start automatically a few seconds after AC power is supplied.
- 13) The software to operate the instrument will start automatically after the operating system has loaded.
- 14) The graphical user interface (GUI) will appear a few seconds after the instrument software starts.

PICARRO



Note: As the instrument is starting up, it is normal for there to be a delay in reporting data. This can take several minutes depending on how long it takes for the internal temperature to reach its operating point, and it is normal during this time for some concentration readings to be negative or constant. Additionally, the data selection pull down menus will not be populated with the appropriate items until data is actually being reported in the graph. This is typically less than 30 minutes, but depending on ambient temperature, the analyzer can take up to 1 hour to stabilize



The Main Graphic User Interface(GUI)

- 15) The status log section of the user interface describes the state of the instrument as it becomes ready to make measurements. The sequence of steps the instrument goes through are:
 - a. **Temperature Locked: WB (HB):** The system waits for the warm box (“WB” – the temperature-controlled electronics chamber) to reach operating temperature. Similarly, the temperature of the hot box (“HB” – the temperature-controlled chamber containing the analyzer’s optical

cavity and gas handling system) is stabilized. This is typically the longest step in the startup sequence. The duration of this step can range from 5 to 60 minutes, depending on the ambient temperature and how much time has elapsed since the last startup.

- b. **Entering Measuring:** Spectral scanning has started. Concentration measurements will be available in approximately 30 seconds. The instrument will continue to scan and report concentration measurements until the instrument is shutdown using the procedure below.
- c. **Pressure Stabilizing/Locked:** The valve control system begins to allow flow through the analyzer and stabilizes the pressure inside the cavity.
- d. **Measuring:** This is the normal mode of operation after startup has completed.



CAUTION: The inlet bulkhead connector can be extremely hot when the instrument is operating, or after it has been shut down. Take care when connecting gas lines or working at the rear of the instrument. Wear protective gloves or avoid contact with these surfaces. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN BURNS.

- 16) A sample gas line can now be attached to the gas inlet on the DAS. **The sample gas supplied to the instrument should be near atmospheric pressure of 14.7 ± 2 p.s.i.a. (101 ± 13 KPa absolute).** Typically, the sample gas is delivered to the instrument via a short segment of tubing attached to a tee in a higher flow gas stream. In this manner, the instrument draws the amount of flow it requires, and the delivery plumbing can be flushed at a much faster rate. The instrument is designed for atmospheric input pressure; if the delivered sample gas pressure is too high then the instrument may not be able to maintain the gas at the proper measurement pressure. If the sample gas pressure is too low then the flow rate though the instrument will be lower than needed to achieve instrument response times.



Note: The instrument measures the sample that is delivered to the gas inlet. For example, if the flow rate of gas at the input port is slow, then the measurement response will also be slow. The measurement is only as good as the sample you give it!

- 17) If you need to shut down the analyzer, please see the “Shutdown Procedure” section of this manual to shut down the analyzer correctly.


PICARRO

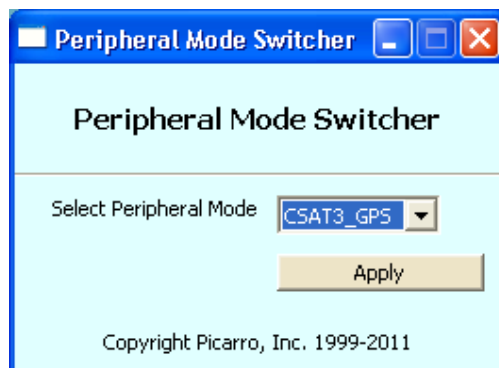
DETAILED OPERATION INSTRUCTIONS

DESKTOP ICONS & FOLDERS

On the Window's desktop, there will be the following icons & folders:

1. **Start Instrument:** When clicked, the analyzer will start measuring in the configuration that it was in when the software/analyzer was shut down.
2. **Picarro Mode Switcher:** When clicked, you will be led to a window which will allow you to switch between various measurement modes.
3. **Picarro Controller:** When clicked, you will be led to a useful diagnostic panel allowing the user to see the analyzer's internal temperatures, pressure, and spectroscopy in real time. This program has user-accessible functions, but cannot change anything related to analyzer functionality and is intended for diagnostics purposes only.
4. **Peripheral Mode Switcher:** When clicked, you will be led to a window (see below) which will allow you to switch between different peripherals. Two common peripherals to switch between for G2311- *f* are GPS and Anemometer.

	<p>The mode switcher is only used when you want to integrate data from peripheral device via RS232. If you don't see the device you wish to use in the drop-down menu of the Peripheral Mode Switcher Window(see below), please contact Picarro tech support to see if your device can be supported by your analyzer.</p>
---	---



PICARRO



5. Picarro Utilities Folder:

- **Data file Viewer:** When clicked, you will be led to a window which will allow you to convert between *.dat & H5 data files and to make various graphical representations of your data.
- **Data Recal (Flux):** When clicked, you will be led to a window which will allow you to recalibrate your Flux data based on known, certified data.
- **Data Recal (High Precision):** When clicked, you will be led to a window which will allow you to recalibrate your High Throughput data based on known, certified data.
- **Setup Tools:** When clicked, you will be led to a window which will allow you to edit various settings for your analyzer (See the “Setup Tools” section of this manual).


6. Diagnostic Folder

- **Stop Instrument:** When clicked, you will be led to a window (see below) which will allow you to turn off the analyzer in an emergency event. Upon clicking on this icon, the following window will pop up. Please see “Shutdown Procedure” section of this manual to shut down the analyzer in normal circumstances.



	CAUTION: EXCEEDING GAS INLET PRESSURE OR TEMPERATURE SPECIFICATIONS COULD RESULT IN DAMAGE TO THE INSTRUMENT. In the case of higher input pressure or flow, configuring a sampling bypass manifold system is recommended. Use a ‘tee’ at the gas inlet and either return the remainder to the main gas stream or exhaust appropriately.
	CAUTION: <u>Do not disconnect</u> the AC power to the analyzer, vacuum line or the AC power to the External Vacuum Pump while analyzer is operating. Damage may be caused by current surges if

PICARRO

	power is applied while attaching or removing cables.
	CAUTION: Analyzers which include the external valve control option are provided with a cable consisting of five electrical connections intended for controlling solenoid valves (typically 12VDC <1A max). It is important to electrically isolate the solenoid valves from the analyzer's ground to avoid electrical interference which could compromise the analyzer's accuracy.

UNDERSTANDING THE MAIN GRAPHICAL USER INTERFACE (GUI)

The Analyzer Graphical User Interface (GUI) is the primary means by which the user interacts with the Analyzer. With the GUI, the user can monitor the concentration data (as well as the anemometer or GPS data if connected), start and stop log files, set and monitor alarm levels, and shutdown the instrument. The different features of this GUI are described in the sections below.

The screenshot displays the PICARRO GUI with the following labeled components:

- Settings, view, tools, & help menus:** Located at the top left of the window.
- Alarms Panel:** Shows active alarms such as 'C12_Too_High' and 'C12_Too_Low'.
- Digital Readouts:** Displays numerical values for Delta_6min (-13.825), 12CO2 (ppmv) (469.821), and H2O (%) (1.738).
- Instrument Status:** Shows 'Warm Box Temp (C)' at 45.000 and 'Cavity Temperature (C)' at 45.000.
- Shutdown:** A button to stop the instrument.
- Stop User Log(s):** A button to manage logging.
- Data log filename and path:** Shows the current log file path: 'S:\Picarro\G2311\Log\Delta6min_20100826-130720-Delta6min_User.dat'.
- Data Source, Data Key, and Precision Pull down menus:** Located at the bottom of the data windows, allowing users to select data sources (e.g., IC02 Analysis), data keys (e.g., Delta_6min, 12CO2, H2O), and precision levels (e.g., auto).
- Axis Auto-scaling:** A button to automatically scale the y-axis of the data windows.
- Reset data buffers:** A button to clear the data buffers.
- Status log window:** A window showing a log of system events, including 'Temp unlocked VFB', 'Pressure locked', 'Missing', and 'Temp locked VFB'.
- Data Windows:** Three line graphs showing the trend of Delta_6min, 12CO2 (ppmv), and H2O (%) over time.
- Data buffer level meter:** A vertical indicator on the right side of the data windows showing the current data buffer level.

The Main Graphical User Interface(GUI)

PICARRO

Settings Menu

Change GUI mode from standard to service Enters a password protected service mode where additional operational and measurement parameters can be displayed. This list will typically include instrument temperature, gas concentrations and valve settings and is not generally available to the user.

View Menu

Lock/Unlock time axis when zoomed When locked, forces the all of the graphs to display the same time scale during zoom.

Show/hide statistics Toggles the measurement statistics display.

Show/hide instrument status Toggles the instruments status display.

Tools Menu

User Calibration Opens the user calibration window (default password is “picarro”). The password can be reset in the QuickGui.ini file in the instrument directory: “C:\Picarro\G2000\AppConfig \Config\QuickGUI\” under the section:

```
[Authorization]
UserCalPassword = Picarro
```

If this section does not exist, it can be added, the file saved, and the analyzer restarted to make the change take effect. To change the password, the analyzer must also be restarted.

The calibration slope and intercept can be entered and their effects immediately seen in the data. Please refer to the section at the end of this manual concerning calibration.

Show/Hide Valve Sequencer GUI Toggles the display of the external valve sequencer window.

Help Menu

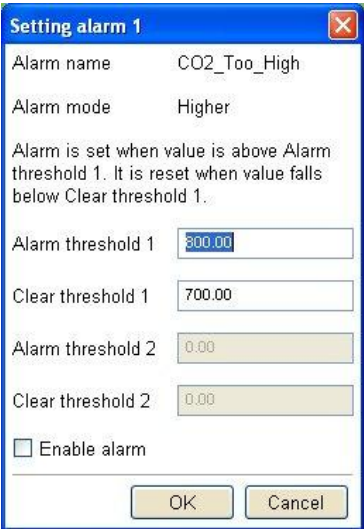
About Displays the version number of the instrument.

Shutdown Button

Use this button to shut-down the instrument. For a complete description of this procedure, see Chapter 3, Getting Started.

Start / Stop Data Log button

The Analyzer automatically records all data collected on the instrument and saves it for later analysis. These files are called Data.dat files, which are described below. In addition, the user can record a separate data log file. Press this button if you would like the instrument to start recording a separate data file. A dialog box will appear prompting you for a filename and location. Press this button again to stop recording the data file.

	<h3>Alarm Panel</h3> <p>The panel in the upper left-hand corner of the GUI is used to monitor the status of the internal instrument alarms. These indicators are gas concentration alarms, such as “CO₂ Too High/Low” depending on instrument configuration. The gas concentration alarm LED’s are off (grayed) when the respective concentrations are below a certain value, and they are illuminated when the respective concentrations are above/below a certain value. To view the alarm set point, click on the LED and a dialog box will appear indicating the alarm setting and allow the user to enable it or change the setpoint:</p> <p>Type the value you wish to set the alarm to and press the “ok” button, or press “cancel” if you do not wish to change the alarm value. If you do nothing, the dialog box will disappear and the alarm value will remain unchanged.</p>
--	---

Data Log Filename and Path

The filename and path of the active data log is displayed in this pane. The indicator is grayed-out if there is no active data log (i.e., if a new data log has not been started using the *Start /Stop New Data Log Button*). A new file will be generated at midnight, which will be saved to the same location as the original log file.

Reset Data Buffer Button

Press this button to clear the internal data buffer of the GUI. This has the effect of clearing all data in the data window. Pressing this button has no effect on any of the data log files stored by the instrument.

Data Window

The data window displays a graph of any stream of data vs. system time, with a format of hh:mm:ss. The user can select which data stream is displayed using the *Data selection pulldown menu*.

PICARRO

Digital Readouts

The latest value for the selected parameters is displayed.

Measurement Statistics

The mean, standard deviation and slope of the data in the graph is dynamically calculated and indicated below the digital concentration readout. These numbers change to reflect whatever data is in the data window.

Data Buffer Level Meter

The meter to the right of the *Data Window* indicates how much of the internal memory of the GUI is used to retain historical data collected with the instrument. There is an internal limit of a finite number of points. Once that number of data points is collected, the buffer is full, and old data is removed from the buffer as new data is collected. This buffer affects *only* the data displayed in the *data window*, not data collected in the *data –UserLlog.dat* and *–Data.dat* files. This buffer is empty upon instrument startup, and can also be emptied by pressing the *reset data buffer button* in the lower-right-hand corner of the GUI.

Graph Zooming

To zoom the graph, simply drag the magnifying glass over the section to be zoomed. To zoom back out, double click. To continue zooming out, right click. To auto-scale the y-axis of either graph, use the auto-scale buttons below the graph. To lock or unlock the time axes of each graph during zooming, select that menu item in the View menu.

Precision Pull-down Menu

Click on this icon to select the precision displayed on the y-axis, between 0 and 4 digits of precision or “auto”. The currently selected precision is displayed during operation. This does not affect the precision of the saved data in the data log files or results files.

Data Selection Pull-down Menu

Click on this icon to select the data stream that is viewed in the *data window*. Data streams available on the GUI are the gas concentrations, if either “flux sync” or “flux analysis” are selected, and if “sensors” is selected, the analyzer’s optical cavity pressure or temperature can be viewed as well as the nominal ambient temperature of the analyzer (“DAS temp”) and the temperature of the analyzer’s electronics chamber, indicated as “warm chamber temp.” The “flux sync” selector shows data that is output on equally-spaced intervals in time (at exactly 0.1s intervals) whereas the “flux analysis” shows the data as it is taken, before it has been re-sampled to be at equally-spaced time intervals.

PICARRO

Status Log Window

This window displays instrument status messages in the following form: “MM/DD/YYYY hh:mm:ss.” These messages include all messages sent to the DAS front panel display. The status log messages are all automatically logged and saved for troubleshooting purposes.

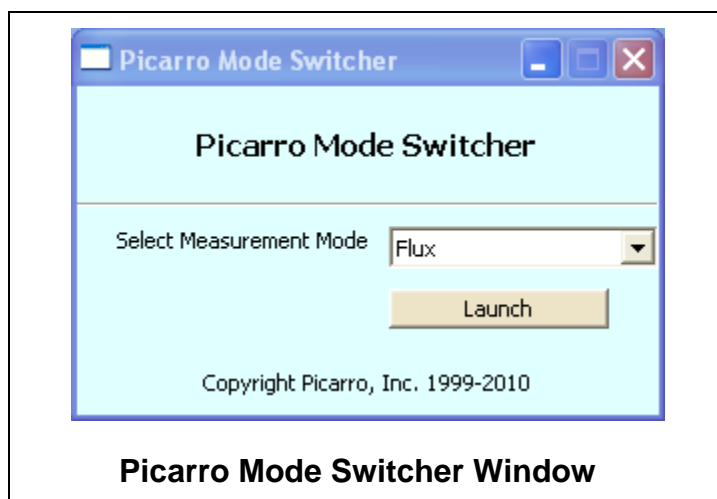
- The location of the archived Status Log messages:
 - C:\Picarro\G2000\Log\Archive\Eventlogs\Year\Month\Day
- The location of the most recent and real-time Status Log messages:
 - C:\Picarro\G2000\Log\TransientData

SWITCHING BETWEEN MEASUREMENT MODES

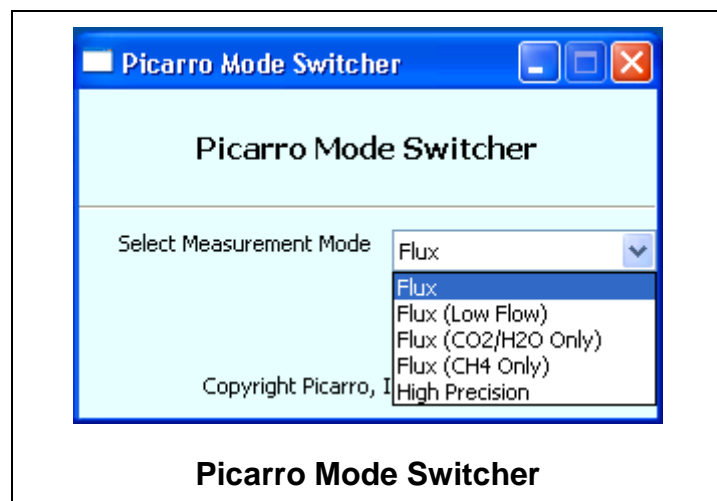
GENERAL INSTRUCTIONS ON HOW TO SWITCH BETWEEN MODES

The “Picarro Mode Switcher” allows the user to operate the analyzer in various “Flux” modes or in the “High Precision” mode. Switching between measurement modes is accomplished with a few easy steps:

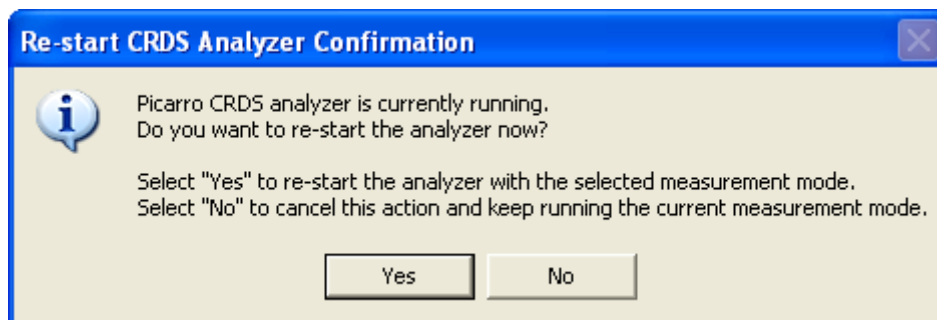
- 1) Activate the user interface by double-clicking the “Picarro Mode Switcher” icon on the analyzer’s desktop.
- 2) The following user interface will appear on the desktop:



- 3) To switch modes, click on the drop-down box menu, select the desired measurement mode, and then click the launch button:



4) Confirm your selection when prompted by the confirmation dialog box:



5) The analyzer software will then re-start in the new measurement mode. There is no need to turn the vacuum pump off during this process.

EXPLANATION OF DIFFERENT MEASUREMENT MODES

The G2301-*f* analyzer can switch between five measurement modes. The measurement modes are outlined in the table below.

G2311-*f* Measurement Modes

Measurement Mode	Measured Gas Species	Data Rate	Gas Flow Rate
Flux	CO ₂ + CH ₄ + H ₂ O	10 Hz each	5 lpm
Flux (Low Flow)	CO ₂ + CH ₄ + H ₂ O	10 Hz each	0.25 lpm with external orifice
Flux (CO ₂ /H ₂ O Only)	CO ₂ + H ₂ O	10 Hz each	5 lpm
Flux (CH ₄ Only)	CH ₄	>10 Hz each	5 lpm
High Precision	CO ₂ + CH ₄ + H ₂ O	<5 seconds each	External Orifice

PICARRO

BEFORE SWITCHING TO “HIGH PRECISION” OR “FLUX (LOW FLOW)” MODE



Operation in “High Precision” or “Flux (Low Flow)” mode requires the user to install a small, low flow adapter at the inlet of the analyzer (see figure below).



Installing the low flow adapter in any of the flux modes could damage the analyzer.

1. To install the low flow adapter, the analyzer **MUST** be **OFF** or in “**High_Precision**” mode.
2. Remove end caps from the low flow adapter.
3. Orient the adapter so that the sample gas flow is in the direction of the arrow printed on the adapter.
4. Attach and tighten the ¼” Swagelok fitting to the analyzer inlet.
5. The analyzer is now ready to operate in the High_Precision mode.



Final Note: If the user turns the system off or if a power failure causes the system to re-boot, the analyzer will re-start in the measurement mode in which it was last operating.

DATA

TYPES, LOCATIONS, & NAMING CONVENTIONS OF DATA:

HOW SPECIES ARE MEASURED: The G2311-f analyzer measures 3 species (H₂O, CH₄, & CO₂) not in parallel but sequentially at a rate of 30HZ. The “ring downs” (the time it takes for the energy to decay from the cavity) occur organically and therefore varies slightly in length. The natural speed of the instrument in flux mode will be greater than 10HZ in normal circumstances, so in order to get the data synchronized on a 10 Hz grid (which has many benefits including easy data integration with the anemometer data), the analyzer data is resampled.

HOW DATA IS STORED: During operation, the analyzer generates ASCII format text output file that is updated after each batch of concentration measurement is complete. During operation, the analyzer also creates directories to store the data, based on the date the data was acquired. After each data file has been closed, it is moved to an archive directory, and a new file is started in the original location. To keep the data files easy to manage and to limit the size of individual files and directories, please see “Setup Tools” in the “Utilities” folder on your desktop to modify various aspects of data storage.

There are two data directories – **UserData** & **Archived Data**. UserData directory contains the current and recent data. Archived Data directory contains the past data.

1. **UserData** Directory contains two types of data: DataLog_User & DataLog_User_Sync.
 - **DataLog_User:** Is the current data that is stored as measurements are made.
 - **Location:** C:\UserData\DataLog_User\Year\Month\Day:
 - **Naming Convention:** See example below.
 - CFHADS2007-20111222-000131-DataLog_User.dat
 - CFHADS: Instrument Serial Number
 - 20111222: Year, Month, date of when file was started.
 - 000131: Hour, Minute, second of when file was started (Using a 24 hour clock).
 - **DataLog_User_Sync:** Is the same data as the DataLog_User, except that data is evenly spaced in time (0.1 s interval). This type data is only available when measured in Flux mode.

PICARRO

- **Location:** C:\UserData\DataLog_User_Sync\Year\Month\Day
- **Naming Convention:** See example below.
 - CFHADS2007-20111222-000131-DataLog_User_Sync.dat
 - Explanations are as same as the above.

2. **Archived_Data** Directory contains two types of data: DataLog_User_Backup & DataLog_Private.

- **DataLog_User_Backup:** Is the archived, older data that is stored in compressed zip format.
 - **Location:**
C:\Picarro\G2000\Log\Archive\DataLog_User_Backup\Year\Month\Day
 - **Naming Convention:** See example below.
 - DataLog_User_Backup_20111107_005427.zip
 - 20111107: Year, Month, data when the file was started.
 - 005427: Hour, Minute, second of when file was started (Using a 24 hour clock).
- **DataLog_Private:** This is a complete data file which includes additional information beyond the concentration data including parameters such as instrument temperatures and pressure, set-points, and spectroscopic information. This information is generally not useful to the user, but it can be useful for diagnostic purposes. For more information, please contact Picarro.
 - **Location:**
C:\Picarro\G2000\Log\Archive\DataLog_Private\Year\Month\Day

DATA COLUMNS DESCRIPTIONS

- DATE & TIME: The date and time the sample was reported.
- FRAC_DAYS/HOURS_SINCE_JAN1: The fractional days since January 1 of the current year.
- EOPCH_TIME: The time (seconds) since midnight UTC Jan 1, 1970.
- ALARM_STATUS: 0 if there is no system alarm, 1 if a system alarm has been reported.
- species: Number corresponding to the species being measured during that time point. This will be either 10 (CO₂), 25 (CH₄), or 28 (H₂O).
- solenoid_valves: Binary number (1, 2, 4, 8, 16...) indicating which valve(s) are open.
- das_temp: The analyzer temperature in degrees C.
- CO2_CONC_SYNC: The measured CO₂ concentration in parts per million per volume.
- CH4_CONC_SYNC: The measured CH₄ concentration in parts per million per volume.
- H2O_CONC_SYNC: The measured H₂O concentration in parts per million per volume.

For more information about how to configure which columns of data appear in the DataLog files, see the “Setup Tools” in the “Utilities” Folder on your desktop.

CONFIGURING DATA ARCHIVING

The analyzer automatically compresses (zip) and archives old files. This operation is controlled by the ini file: C:\Picarro\G2000\AppConfig\Config\Archiver\Archiver.ini.

For each file type, there are various items along with some recommended default settings which may vary by file type:

- **Directory** = C:/UserData/DataLog_Sync
Optionally specifies which directory to find files to archive.
- **MaxCount** = -1
Specifies how many files to keep. A setting of -1 indicates that there is no maximum number of files. Generally -1 is used in conjunction with a maximum size limit, below.
- **MaxSize_MB** = 1500
Specifies that a maximum of 1.5GB of data is to be kept before the system begins to delete old data.
- **Compress** = True/False
Specifies if archived files are to be zipped – recommended setting is true to save hard drive space.
- **AggregationCount** = 0
If compression is set to TRUE, specifies how many files to be included in each zip archive.
- **StorageMode** = FIFO
First in first out. Specifies that old data is deleted first.
- **Quantum** = 4
Generally should not be changed. Specifies the files be sorted by year\month\day\hour in the archived directory structure.

REMOTE DATA ACCESS

Using the RemoteAccess.ini file, the analyzer can be configured to automatically:

- 1) Send data from the instrument to a list of e-mail accounts.
- 2) Measure the offset of the host computer system clock from a set of Internet timeservers and (optionally) to resynchronize the clock on the basis of this information.

The Internet connection need not be permanent, and may be a dial-up connection accessible via a user-supplied USB modem. The task of sending data and/or synchronizing the clock on the analyzer is performed using the C:\Picarro\G2000\HostExe\RemoteAccess.exe program. This program can be setup to run periodically using the Windows task scheduler at a user-configurable frequency. If a dial-up connection to the Internet is employed, it is used only on demand in order to minimize the connection time.

Each time that the RemoteAccess.exe program runs, it appends information to a log file, which keeps a record of the results of the time synchronization and of the files sent by e-mail. The RemoteAccess.exe program is configurable by means of an initialization file, which includes information such as the login credentials for the dial-up connection, the e-mail account and the list of timeservers.

The initialization file is

C:\Picarro\G2000\AppConfig\Config\RemoteAccess\RemoteAccess.ini and it should be placed in the same directory as the executable RemoteAccess.exe. The file has one required section named LOGGING and three optional sections named NTP, DIALUP and EMAIL. The logging section has a single key Logfile whose value is the path to the log file. Once this log file exceeds 64 kbytes in length, it is backed up appending a numeric extension to the file name and a new file is open. A total of ten backup log files are kept.

NTP

The NTP section controls querying the Internet time servers using the SNTP protocol (RFC4330) and the resetting of the clock on the host computer. If the section is not present, time synchronization is not carried out. The keys Server1, Server2, etc., are used to specify the URLs of the timeservers. As many of these timeservers are interrogated as possible, and the clock offset is computed on using the median of the results obtained from the available servers. If the UpdateClock key is set to true, the offset is applied to the host clock. Otherwise, the offset is recorded, but the host clock is not changed.

PICARRO

EMAIL

The EMAIL section controls the sending of the data files as e-mail attachments. If the section is not present, e-mail messages are not sent. The key Directory specifies the directory that contains the data files. When the program is run, files in this directory are sent to the specified recipients and the files are deleted. In order to avoid problems with incomplete files, programs that place files into this directory should do so using an atomic operation, such as a rename. The Server key is set to the name of an RFC2821-compliant SMTP server that actually sends the e-mail messages.

The From key is the e-mail address from which the messages are sent. Note that some SMTP servers check that the source is permitted to send mail while others allow any name in this field. The collection of e-mail addresses to which copies of the e-mail is sent is specified by the keys To1, To2, etc. The Subject key is used to fill the subject field in the e-mail header, and may be set to any string. Depending on the SMTP server, it may be necessary to use authentication before e-mails can be sent, as described in RFC2554. If such authentication is not needed, the key UseAuthentication is set to false. If this key is set to true, two additional keys Username and Password must also be specified for the e-mail account.

DIALUP

The DIALUP section is used if a dial-up connection to the Internet needs to be established when the program runs. If the section does not exist, a permanent connection is assumed to be available for carrying out the other tasks specified in the initialization file. The ConnectionName key specifies the name of the dial-up connection to use, as listed under Network Connections in the Control Panel. The values of the keys Username, Password and Number are used to make the connection.

PICARRO

Example of “RemoteAccess.ini” File

[LOGGING]

LogFile=c:/temp/RemoteAccessLog

[NTP]

Server1=time-a.nist.gov

Server2=time-b.nist.gov

Server3=time-a.timefreq.bldrdoc.gov

Server4=time-b.timefreq.bldrdoc.gov

Server5=time-c.timefreq.bldrdoc.gov

Server6=time.nist.gov

Server7=time-nw.nist.gov

UpdateClock=1

[DIALUP]

ConnectionName=Picarro Dialup Access

Username=user

Password=password

Number=14085551212

[EMAIL]

Server=smtp.servername.org

Directory=c:/picarro/mailbox

From=instrument@picarro.com

To1=recipient1@site1.com

To2=recipient2@site2.com

Subject=CRDS data from Silverstone instrument

UseAuthentication=0

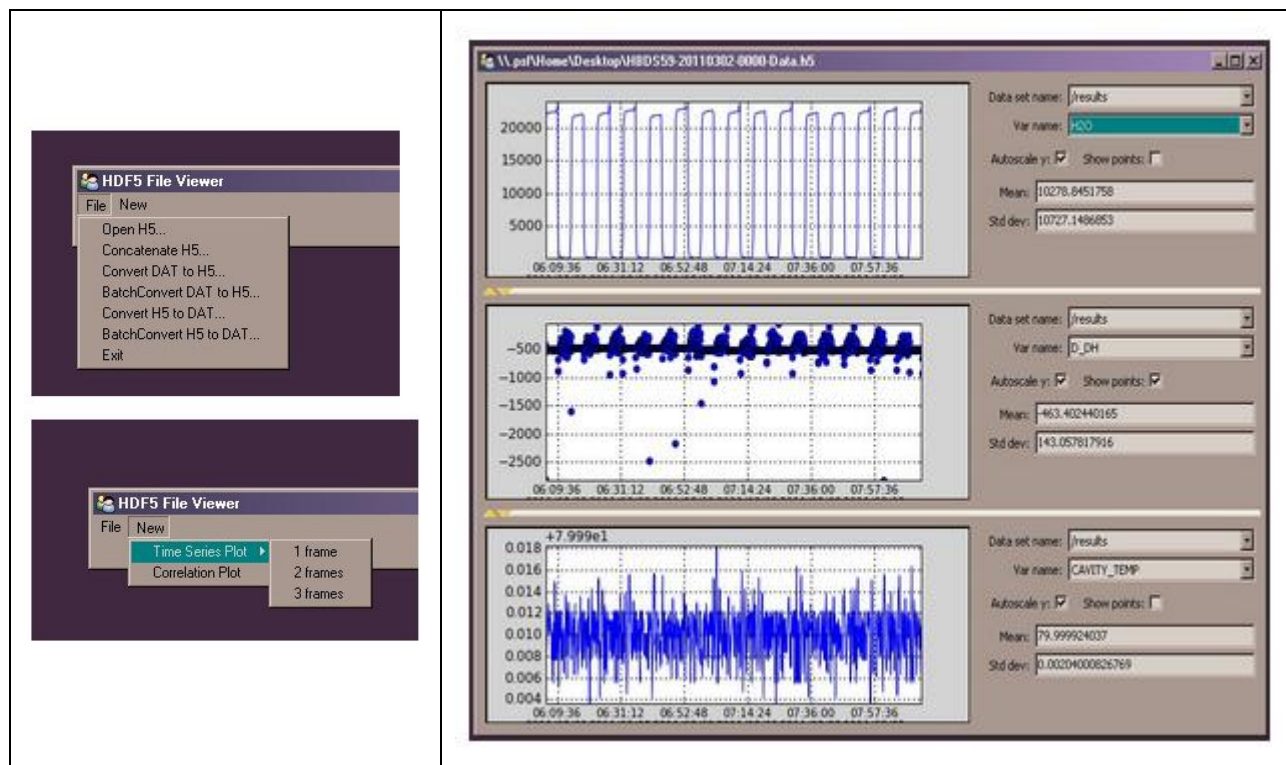
PICARRO

DATA FILE VIEWER

Picarro 2XXX-series analyzers allow users to archive data using a highly-compressed, binary “HDF5” or “h5” format.

Screenshots below show the Data File Viewer program, which can be found in the “Picarro Utilities” Folder on the analyzer’s desktop. This programs allows you to open h5 files, convert h5 files to *.dat files (also convert *.dat to h5), as well as to do batch conversions. Through this program, multiple h5 files can be joined, and then viewed as graphs. In the graph window, you can select any of the data columns in the file, autoscale, zoom, hide/show points, and calculate statistics of data within the graph window.

If you have any questions, please contact Picarro or refer to Picarro Community for more information. <http://www.picarro.com/community/>

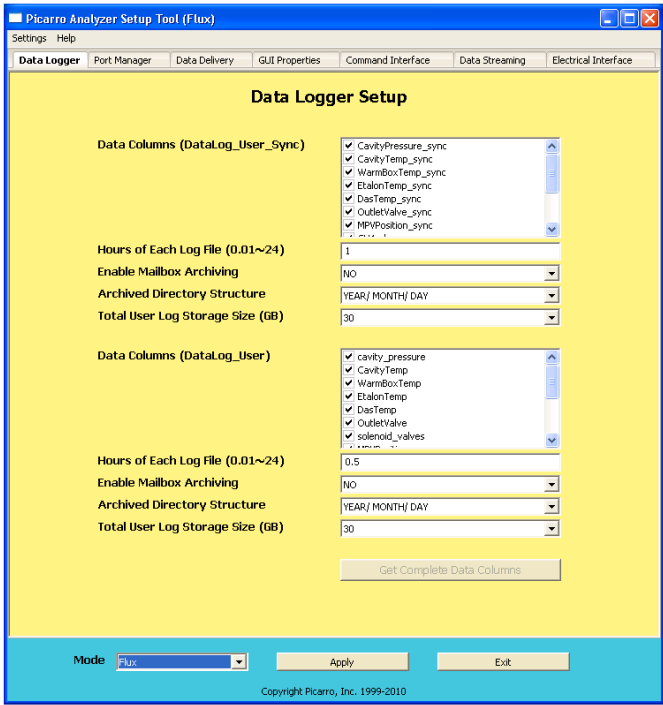


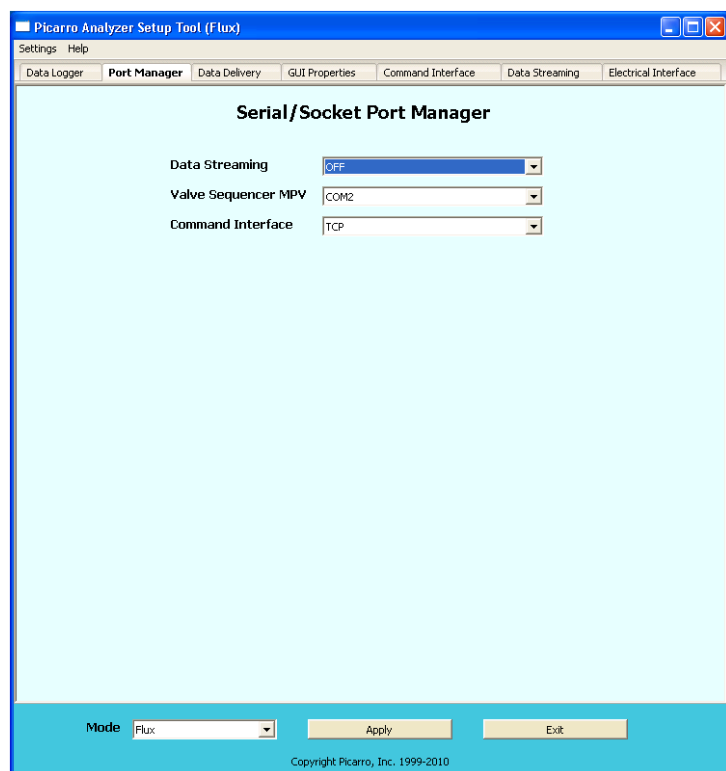
PICARRO

SETUP TOOLS

In the desktop folder called Picarro Utilities, the Setup Tool can be launched by double clicking on its icon. The tool allows the user to configure data file saving details, including which data elements are written to data files, digital data output (via serial port or TCP/IP), remote data delivery (via email), and general GUI properties. .

Seven tabs of the Setup Tool Window are explained in the next pages. If you have any questions about the Setup tool, please contact Picarro or refer to Picarro Community for further details. - <http://www.picarro.com/community/>

	<h3>CONFIGURING DATA FILE SAVING DETAILS</h3>
	<p>The DATA LOGGER tab allows the user to configure various data file saving details, including which data elements are written to data files.</p> <p>Data Columns: Controls which data elements are written to data files.</p> <p>Hours of Each Log File: Controls the size of each data document.</p> <p>Enable Mailbox Archiving: Enables archiving of data in the mailbox folder – C:\Picarro\G2000\Log\Archive\DataLog_Mailbox</p> <p>Archived Directory Structure: Specifies part of naming convention for data documents.</p> <p>Total User Log Storage Size (GB): Specifies the size of storage allowed for User Data (Recent Data).</p> <p>After making the appropriate edits, click “Apply” to put changes into effect and then “Exit” to close the window.</p>



MANAGING PORTS FOR DIGITAL DATA OUTPUT/INPUT & SERIAL COMMUNICATION

The **PORT MANAGER** tab allows you to control digital data output/Input via serial port or TCP/IP.

On this window, specify the port you want your data to stream through (COM1/COM2/ Off), the port you want to connect your Valve Sequencer to (COM1/COM2/Off), and/or your desired Command Interface (COM1/COM2/ TCP/Off).

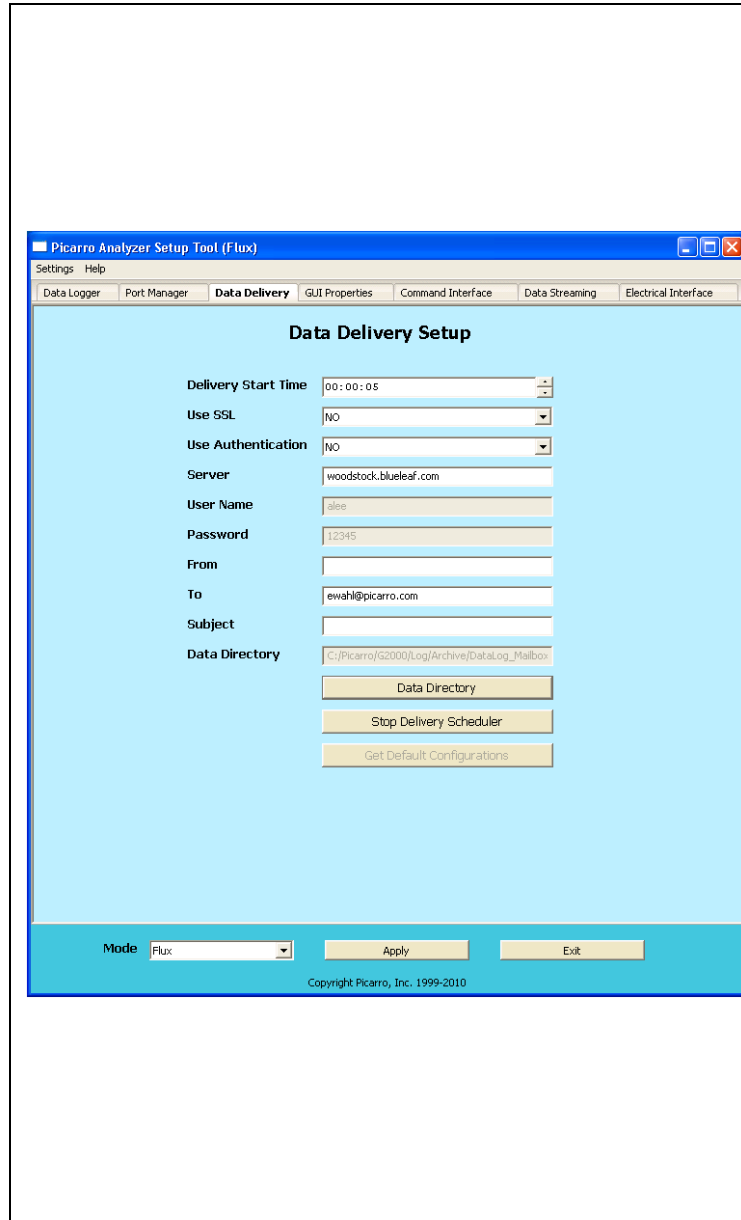
Make sure there are no COM port conflicts before clicking “Apply.”

After making the appropriate edits, click “Apply” to put changes into effect and then “Exit” to close the window.

See below to learn more about Serial Communication in Picarro Analyzer, and also see “Control Valve Sequencer” section of this manual to learn more about valve sequencer.

SERIAL COMMUNICATION:

The analyzer supports an RS-232 physical command interface, which can be used to control the instrument and to retrieve concentration data. Not all features of the instrument are available on the serial interface. For details on how to use the serial command interface, please see the Programming Guide (included in pdf format on the installation CD). This command set may also be used across a TCP/IP interface through an Ethernet connection.



SCHEDULING REMOTE DATA DELIVERY (EMAIL)

The **DATA DELIVERY** tab allows the user to schedule remote data delivery (email).

Delivery Start Time: Time of the day when data will be sent.

SSL: Depending on the sender's email server, the sender can activate the Secure Sockets Layer (SSL).

Use Authentication: Turning this on will require the receiver to provide a password and a username to access data. Set up the **password & Username** from this window.

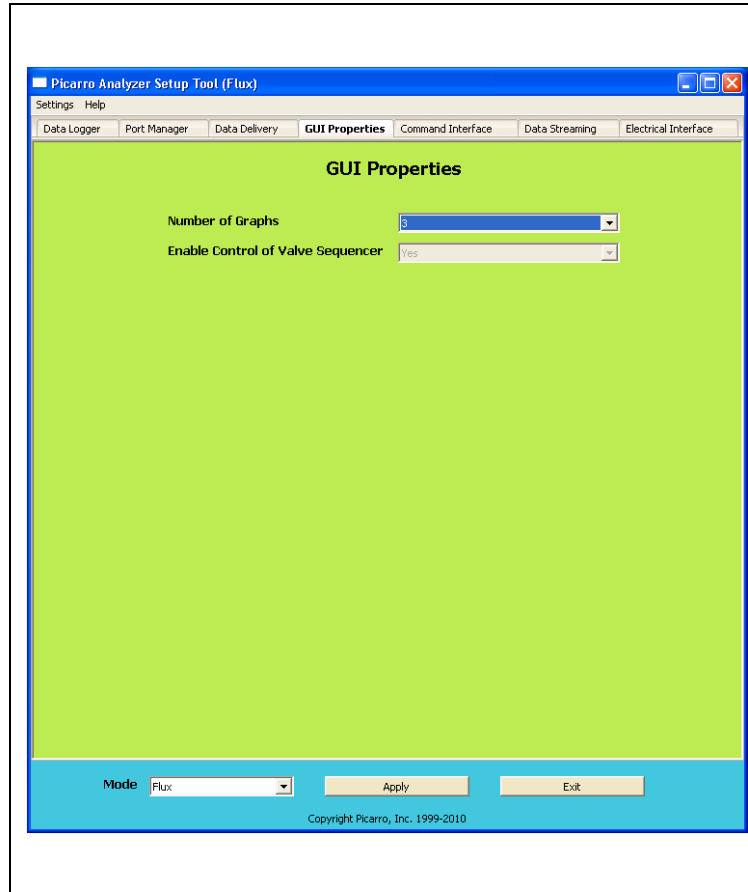
From: Sender's email

To: Receiver's email.

Subject: subject line of the email.

Data Directory: Location of the data you want email.

After making the appropriate edits, click "Apply" to put changes into effect and then "Exit" to close the window.

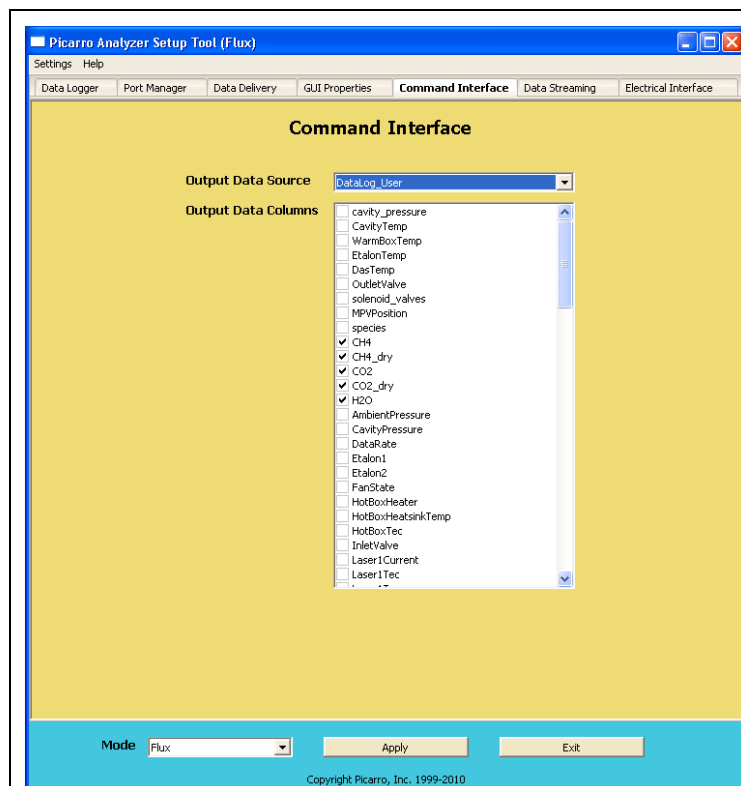


EDITING THE MAIN GUI'S PROPERTIES

The **GUI PROPERTIES** tab allows you to set the number of line graphs visible on the main GUI. It also allows you to enable the control of Valve Sequencer from the main GUI.

To make the Valve Sequencer menu item visible under the “Tools” menu of the main GUI:

1. Click on “Settings” of the “Setup Tool” window, and then “Switch to Service” mode.
2. Choose “Yes” next to “Enable Control Valve Sequencer” drop down menu on the “GUI Properties” tab.
3. Click “Apply” to put changes into effect and then “Exit” to close the window.
4. You should now be able to access the “Show/Hide Valve Sequencer GUI” menu from the main GUI under “Tools”

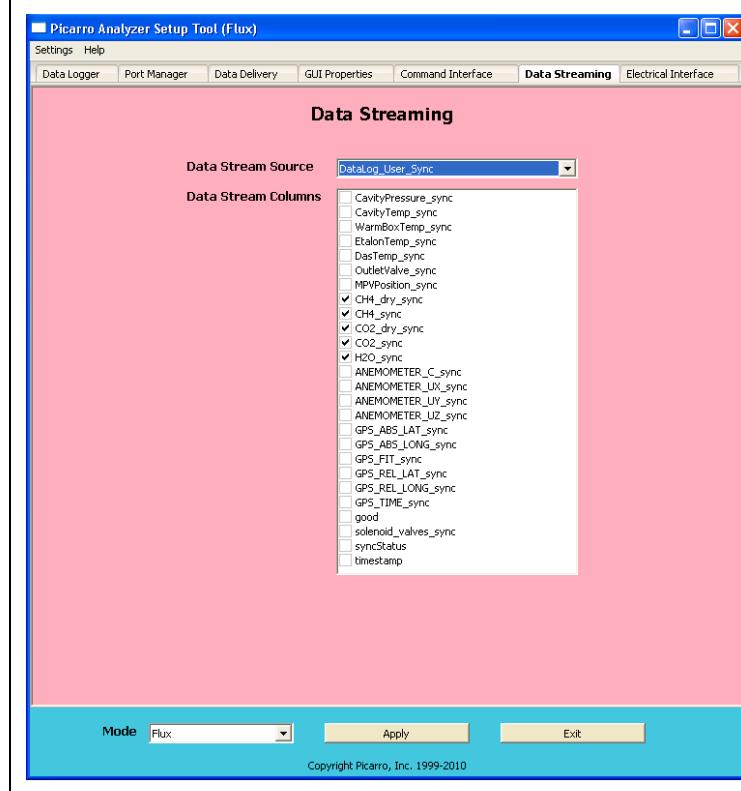


SPECIFYING DIGITAL DATA OUTPUT FOR COMMAND INTERFACE

The **COMMAND INTERFACE** tab allows you to specify the data elements that are sent via COM port/TCP (specified in the PORT MANAGER tab). Two types of data can be specified here: Datalog_User & DataLog_User_Sync.

To output data, the Command Interface needs to be sent commands to.

After making the appropriate edits, click “Apply” to put changes into effect and then “Exit” to close the window.

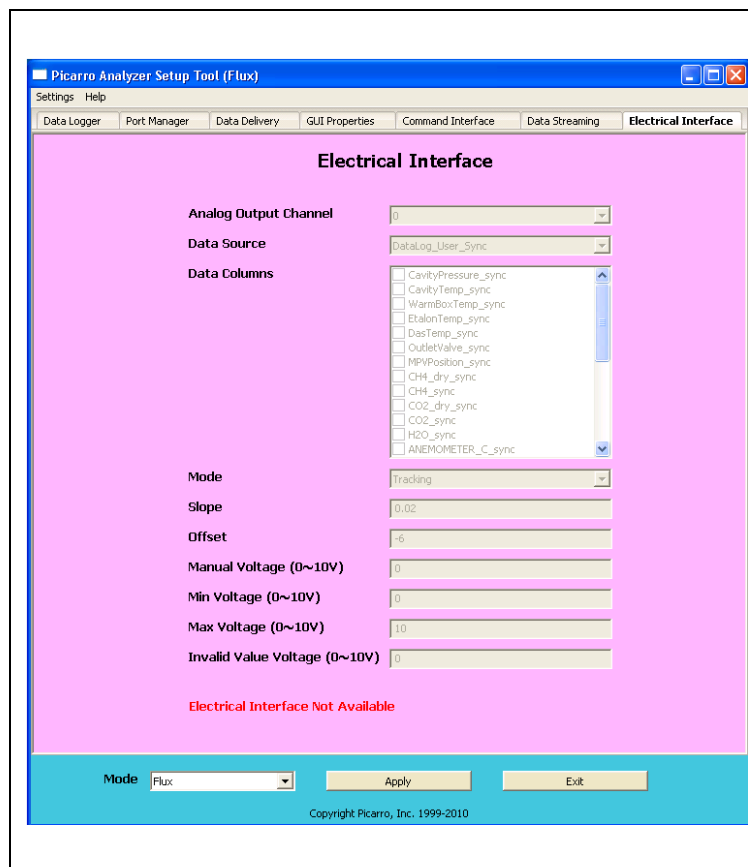


SPECIFYING DIGITAL DATA OUTPUT FOR DATA STREAMING

The **DATA STREAMING** tab allows you to specify the data elements that you want to send via COM port (specified from the PORT MANAGER tab). Two types of data can be specified here: Datalog_User & DataLog_User_Sync.

Data Streaming outputs data continuously, whereas the Command Interface needs commands to output data.

After making the appropriate edits, click “Apply” to put changes into effect and then “Exit” to close the window.



CUSTOMIZING ANALOG OUTPUT CHANNELS


The Picarro analyzer may be optionally configured with an Electrical Interface Card (EIC) that provides up to 8 analog signals available to the user for monitoring various measurements results and analyzer parameters.

The **ELECTRICAL INTERFACE** tab allows you to customize each analog output channel.

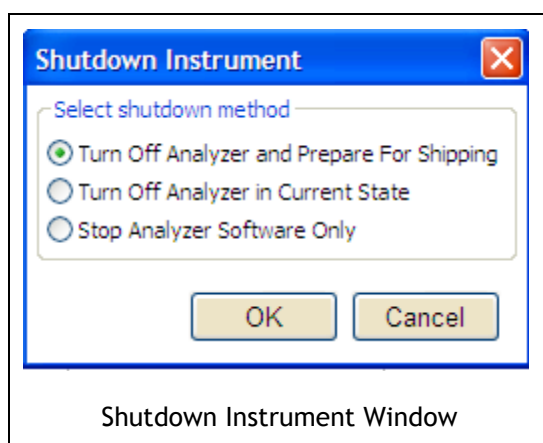
After making the appropriate edits, click “Apply” to put changes into effect and then “Exit” to close the window.

This tab will be disabled if your analyzer was not configured to work with an analog peripheral.

SHUTDOWN PROCEDURE

	<p>CAUTION: A flow of clean, relatively dry gas should always be directed through the instrument for several minutes prior to shut down. Trapping a high-moisture content gas sample in the cavity can cause condensation damage to the mirrors as the instrument cools from its operating temperature.</p>
---	--

Clicking the Shutdown button on the GUI of the Analyzer Software opens a window that offers different shutdown states for the Analyzer.



Stop Analyzer Software Only: This mode of turn off is used to perform updates and to set up configuration changes. This does not turn off the analyzer, however it does turn off the software. To learn how to turn the analyzer software back on, refer to the “Turning the Analyzer Software Back On” section in this chapter of the manual.

Turn Off Analyzer in Current State: Used when the analyzer will be off for a few hours or overnight and will not be moved. The analyzer gas cell is stored at sub-atmospheric pressure. *If the analyzer is moved in this mode it is possible to damage the gas cell!*

Turn Off Analyzer and Prepare for Shipping: Used for when the analyzer undergoes long storage or transport. This mode pre-fills the cavity to ambient pressure with a gas prior to shut down. This gas should be clean and dry to prevent condensation inside the system as it cools down. Five minutes of flow is sufficient. If the instrument is likely to experience low storage temperatures, the gas should be dry enough so as not to cause condensation (<1000 ppmv water concentration, for example, is sufficiently dry). If the instrument will be stored at typical room temperatures, however, the gas need not be particularly dry and the analyzer can be shut down safely after it has been purged for a few minutes with normal room air.

PICARRO

IN CASE OF AN ELECTRICAL POWER OUTAGE

If power to the analyzer is cut-off for any reason the analyzer will cease operation. However, when the power is reapplied, the analyzer will restart automatically, the Picarro software tools will properly close out previous files and open new files for data collection so that previously collected data, instrument diagnostics and other parameters recorded up to the time of power outage are retained.

If short power outages will be a routine operating environment, Picarro recommends use of a power conditioning and/or uninterruptible power supply that will work to prevent the more damaging operating system and software corruption problems that can occur with repeated crashes.

CALIBRATING THE ANALYZER

You can use either of the methods below to calibrate your analyzer. **Method 1** requires you to make a graph (known standards versus measured standards) to calibrate the analyzer. **Method 2** does not require you to make any graph, however the effect of its calibration is harder to reverse in comparison to Method 1.

METHOD 1: USING THE MAIN GRAPHICS USER INTERFACE (GUI) TO CALIBRATE THE ANALYZER

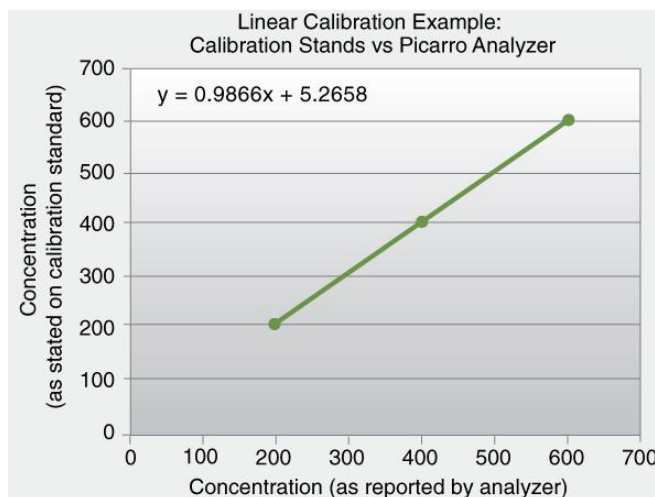
Since the Picarro Analyzer is extremely linear, it is only necessary to use three calibration standards to calibrate each gas or isotopic species (two points define the calibration line and a third intermediate point is used for verification). The exact value of each calibration standard is not of particular importance as long as they span a representative range of values over which the analyzer will typically be operated. It is reasonable to use a concentration of zero for the low calibration value, for example. Although it is not necessary to use more than three standards, additional standards can be used to further constrain the linear calibration coefficients.

To perform a calibration or verification of calibration, the user simply introduces the first calibration standard into the analyzer for an interval long enough for the analyzer to yield a stable measurement of that sample. The stated concentration of the calibration sample (a calibrated gas bottle, for example) and the value the analyzer reads for that sample are recorded for each calibration standard used. These values can then be plotted, as shown below, in a spreadsheet, for example, to determine the linear relationship between the known calibration values and the analyzer's reported values. A linear best-fit equation can be calculated from the data. It is important to plot the analyzer's reported concentration on the horizontal axis and the gas standards' stated concentrations on the vertical axis. The slope and intercept of the best-fit line through these points are the two values that are used to calibrate the analyzer. By determining what the linear relationship is between the known calibration values and the analyzer's reported concentration values in this way, a calibration offset (slope and intercept) can be calculated so as to add a correction term to the analyzer's factory or previous calibration.

Changing the analyzer's calibration is intended to be done infrequently. Instead of recalibrating frequently to increase the accuracy of the data, users often just verify the calibration by measuring three or more gas standards and use the same regression procedure described here to calculate an offset by which to correct their data offline. Using the equation in the graph below, this would be accomplished point-by-point by calculating the corrected data "y" by using the analyzer's data "x" so that: $\text{Data}_{\text{corrected}} = 0.9866 \cdot \text{Data}_{\text{raw}} + 5.268$.

PICARRO

	Value Given by Analyzer	Value of Calibration Standard
Calibration Point #1	200.1	202.7
Calibration Point #2	600.3	597.6
Calibration Point #3	400.0	400.0



Calibration values are input into the software by selecting the “User Calibration” from the “Tools” button in the Main Graphics User Interface (pg. 12). The window below will pop up. Enter the slope and intercept for each species in the window. This is a password-protected function with the default password of “Picarro.” After the calibration is entered, it will take effect immediately after clicking “ok.”

User Calibration

ch4_conc slope: 1.0

ch4_conc offset: 0.0

co2_conc slope: 1.0

co2_conc offset: 0.0

h2o_conc slope: 1.0

h2o_conc offset: 0.0

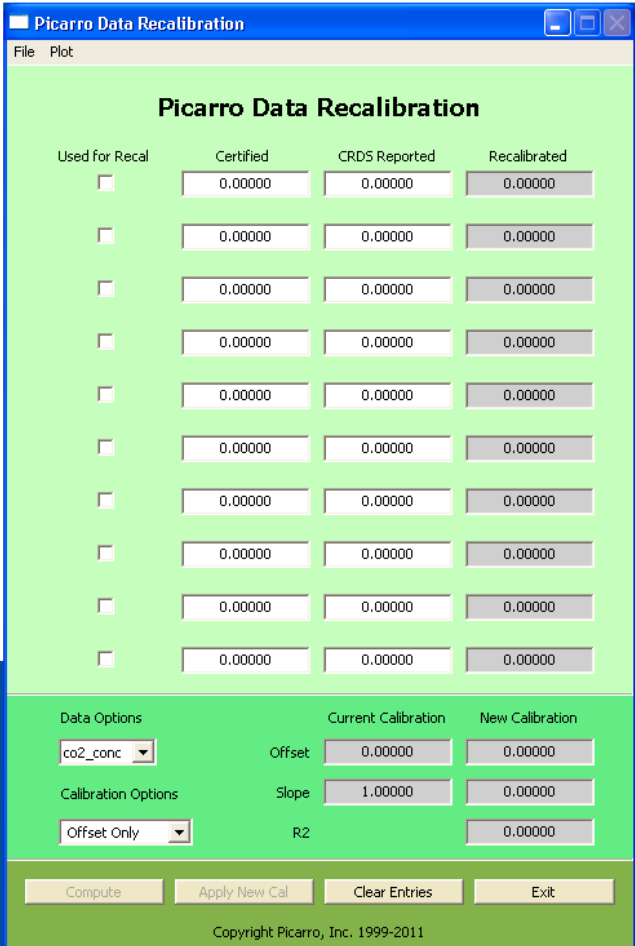
OK Cancel

PICARRO

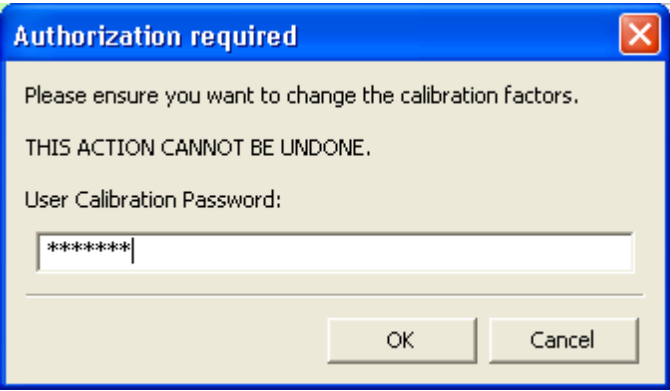
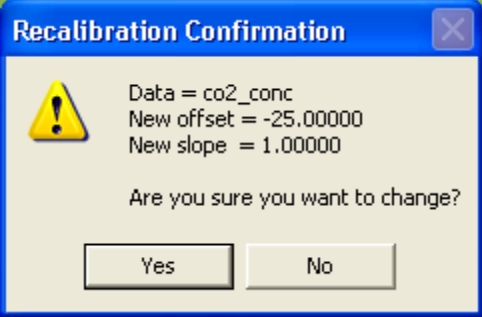
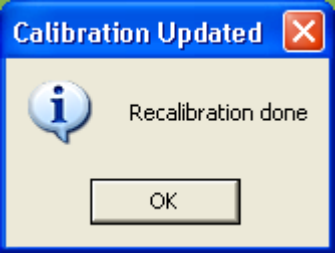
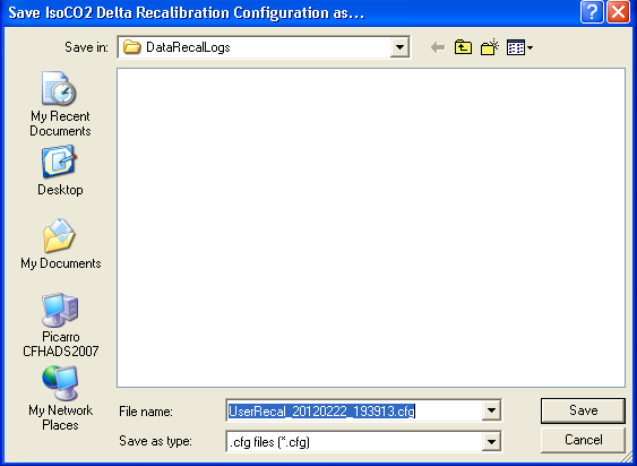
To return to the factory calibration, simply set the slope to 1 and the intercept to 0 for each species.

METHOD 2: USING THE “PICARRO DATA RECALIBRATION TOOL” TO CALIBRATE THE ANALYZER

This tool can be used after you have performed the calibration measurements of standards with your Picarro analyzer.

	<p>The Picarro Data Recalibration (“Data Recal”) software can be found in the “Picarro Utilities” folder in the desktop, and it can be used to recalibrate the data analyzed by Picarro analyzers.</p>
	<p>In the screen shot on the left, “Certified” is the expected ppm measurement, “CRDS Reported” is the ppm measured by a Picarro analyzer, “Recalibrated” is the ppm recalculated by the software. This recalculation is based on which horizontal row/s of data you choose to check in the “Used for Recal” column.</p>
	<p>Direction: Step 1: Open the window on the left, and click on “Clear Entries” to reset the values in the “Picarro Data Recalibration” window.</p>
	<p>Step 2: type in the “Certified” and the “CRDS Reported” data values. Check the row/s (in the “Used for Recal” column) that you want the software to use to recalibrate your “CRDS Reported” data values. Click the “Compute” button. The recalibrated values will appear in the right most column. Click “Apply New Cal” if you want to apply the calibration to your future measurements.</p>

PICARRO

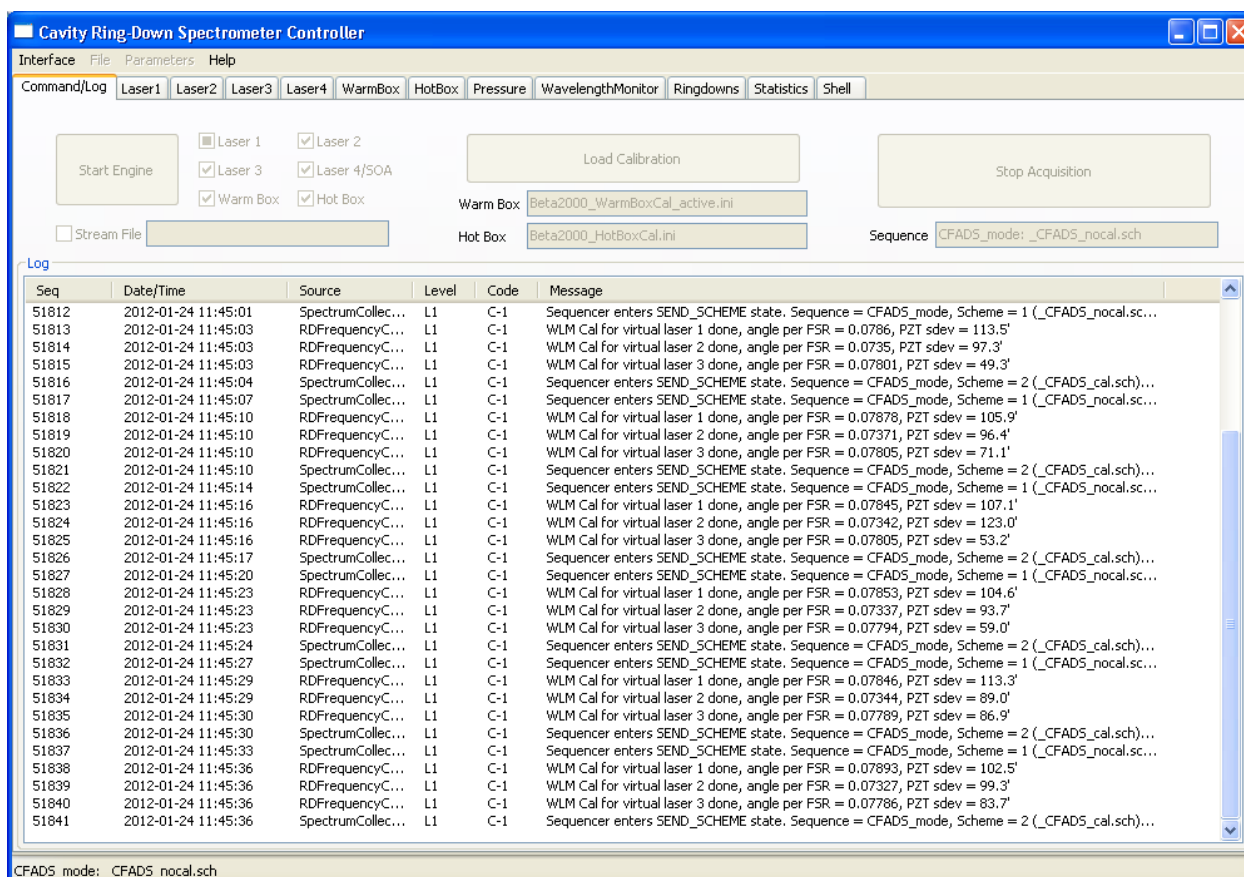
	<p>After clicking on “Apply New Cal” in the previous window, the window on the left will pop up. The default user Calibration Password is “Picarro.” Click “OK” to continue. Take note that this action cannot be undone from the “Picarro Data Recalibration Window,” but it CAN be undone from the “User Calibration” window from METHOD1 (pg48).</p>
	<p>Upon clicking “OK” in the previous window, the window on the left will pop up. Review the values in the window, and click “YES” to confirm.</p>
	<p>Upon clicking “YES” in the previous window, the following window will pop up. Click “OK” to continue.</p>
	<p>Upon clicking “OK,” you will be given an option to save your calibration setting. Click “Cancel” if you don’t want to save your new calibration setting.</p> <p>You have now calibrated your analyzer. The next time you do any sample measurement, the measurements will be based on the new calibration setting.</p>

PICARRO

CAVITY RING-DOWN SPECTROMETER CONTROLLER

On your desktop, there is an icon labeled “Picarro Controller.” Clicking on this icon will open up a useful diagnostics panel (see image below), allowing the user to see the analyzer’s internal temperatures, pressure, and spectroscopy in real time. This program has user-accessible functions, but cannot change anything related to analyzer functionality and is intended for diagnostics purposes only.

If you have any questions, please contact Picarro or refer to Picarro Community for more information. <http://www.picarro.com/community/>



PICARRO

HOW TO INTEGRATE AN ANEMOMETER OR A GPS TO THE ANALYZER (OPTIONAL)

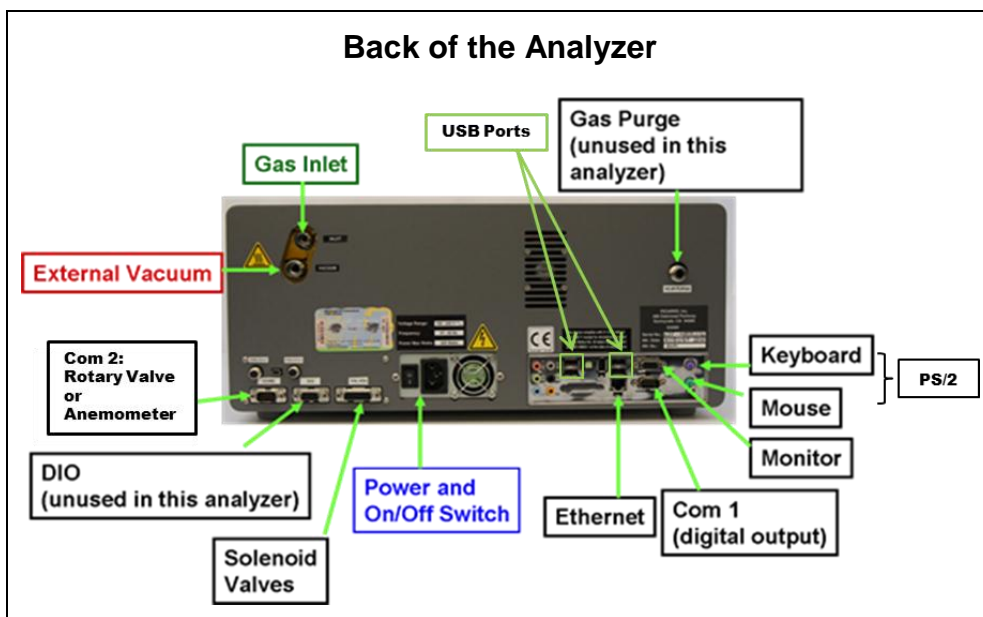
INSTRUCTIONS:

1. Two peripherals you can integrate to the analyzer are the GPS and the Anemometer.

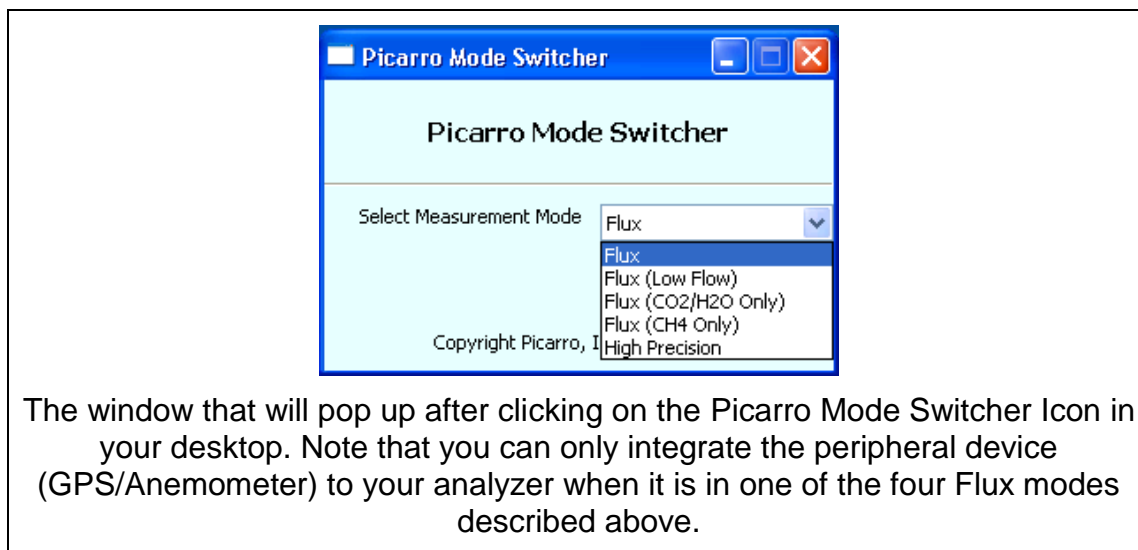
If you want to integrate the **GPS** to the analyzer, please connect it to the **COM1** port on the back of the analyzer (see diagram below).

If you want to integrate the **Anemometer** to the analyzer, please connect it to the **COM2** port on the back of the analyzer (see diagram below).

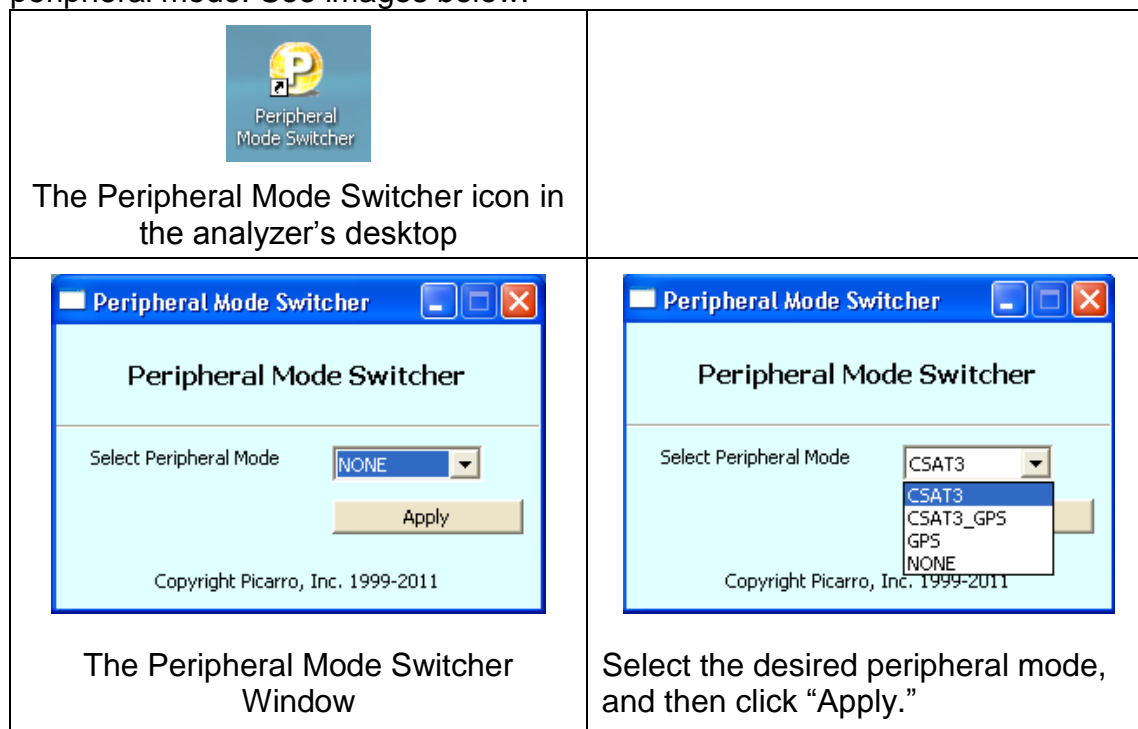
You can plug in the Anemometer or the GPS to the analyzer while the analyzer is turned on, turned off, or making measurements.




2. You can only integrate the peripheral (GPS/Anemometer) to the analyzer while the analyzer is in one of the Flux modes. To switch to one of the Flux modes, click on the "Mode Switcher" icon in your desktop to switch between modes (see the section on "Switching Between measurement Modes" in this manual). See image below for more information.



- After plugging the Anemometer/GPS into the analyzer and making sure your analyzer is in one of the Flux modes, click on the “Peripheral Mode Switcher” icon in the desktop and choose the desired peripheral mode in the drop down menu of the window that will pop up. CSAT3 stands for Anemometer while GPS stands for Global Positioning System. Click “Apply” to apply the chosen peripheral mode. See images below.

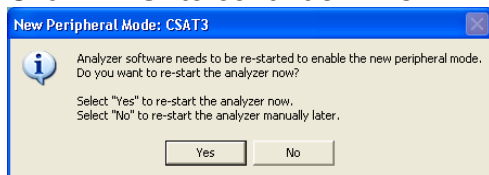


PICARRO

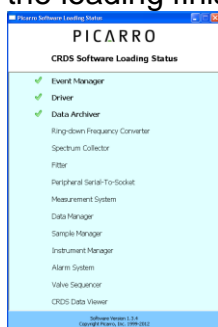


Please plug in the peripheral device before applying the new peripheral mode from the “Peripheral Mode Switcher” window, for GPS/Anemometer measuring will start automatically soon after the application of a new peripheral mode.

1. Upon clicking “apply” in the previous window, the following window will pop up. Click “YES” to continue. This will re-start the analyzer.



2. Upon clicking “YES,” the following loading status window will pop up. Wait until the loading finishes.



3. Once the loading becomes complete, the main GUI will pop up. Wait until the word “measuring” shows up in the status window of the main GUI before looking for the real-time data from your GPS. Once the word “measuring” shows up, you can select the data of your peripheral device that you want to visualize in your main GUI from the “Data Key” drop down menus. See images below for more information.

CRDS Data Viewer
Settings View Tools Help

PICARRO Carbon Dioxide, Methane and Water Vapor Analyzer

Alarms

- System Alarm
- IPV Connectivity
- CO2
- CH4
- H2O

CO2 (ppm)
524.844

CH4 (ppm)
2.616

H2O (%)
1.062

Shutdown
Restart User Log(s)

[DataLog_User] - Live
C:\UserData\DataLog_User\2012\02\22
CFHADS2007-2012\0222-195433Z-
DataLog_User.dat

[DataLog_User_Sync] - Live
C:\UserData\DataLog_User_Sync\2012\02
22\CFHADS2007-2012\0222-195434Z-
DataLog_User_Sync.dat

"Data Key" drop down menu.

Data Key 1: CO2 Precision: auto Auto-scale Y
Data Key 2: CH4 Precision: auto Auto-scale Y
Data Key 3: CH4, CH4_dry, CO2, CO2_dry, DataRate Precision: auto Auto-scale Y

You can select the data of your peripheral device you want to visualize in your main GUI from the "Data Key" drop down menus.

How to visualize the data of your peripheral device in your GUI

CRDS Data Viewer
Settings View Tools Help

PICARRO Carbon Dioxide, Methane and Water Vapor Analyzer

Alarms

- System Alarm
- IPV Connectivity
- CO2
- CH4
- H2O

CO2 (ppm)
525.030

GPS_ABS_LAT
37.396

H2O (%)
1.061

Shutdown
Restart User Log(s)

[DataLog_User] - Live
C:\UserData\DataLog_User\2012\02\22
CFHADS2007-2012\0222-195433Z-
DataLog_User.dat

[DataLog_User_Sync] - Live
C:\UserData\DataLog_User_Sync\2012\02
22\CFHADS2007-2012\0222-195434Z-
DataLog_User_Sync.dat

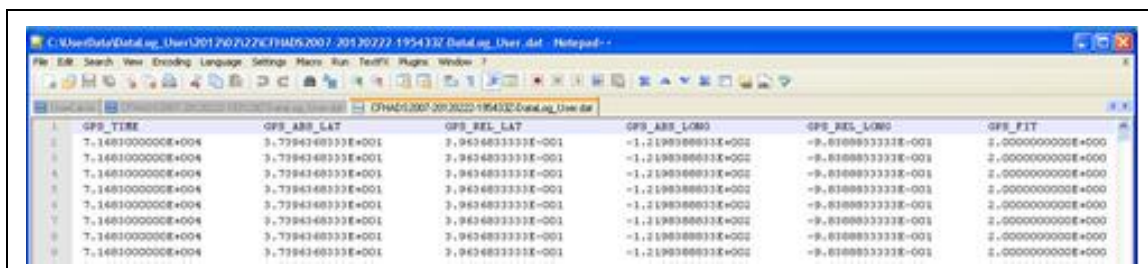
An example of how the data of your peripheral device will appear in your main GUI.

Source 1 Flux Data Key 1: CO2 Precision: auto Auto-scale Y
Source 2 Flux Data Key 2: GPS_ABS_LAT Precision: auto Auto-scale Y
Source 3 Flux Data Key 3: H2O Precision: auto Auto-scale Y

An example of how the real-time data of your peripheral device will appear in your main GUI

PICARRO

- The data of your peripheral device will be stored in the Archived_Data and the UserData Directory as part of the normal data documents that contain species (H2O, CH4, CO2) measurements. Below is an example of new columns that may appear in your data document with the integration of a peripheral device (in this case, a GPS).

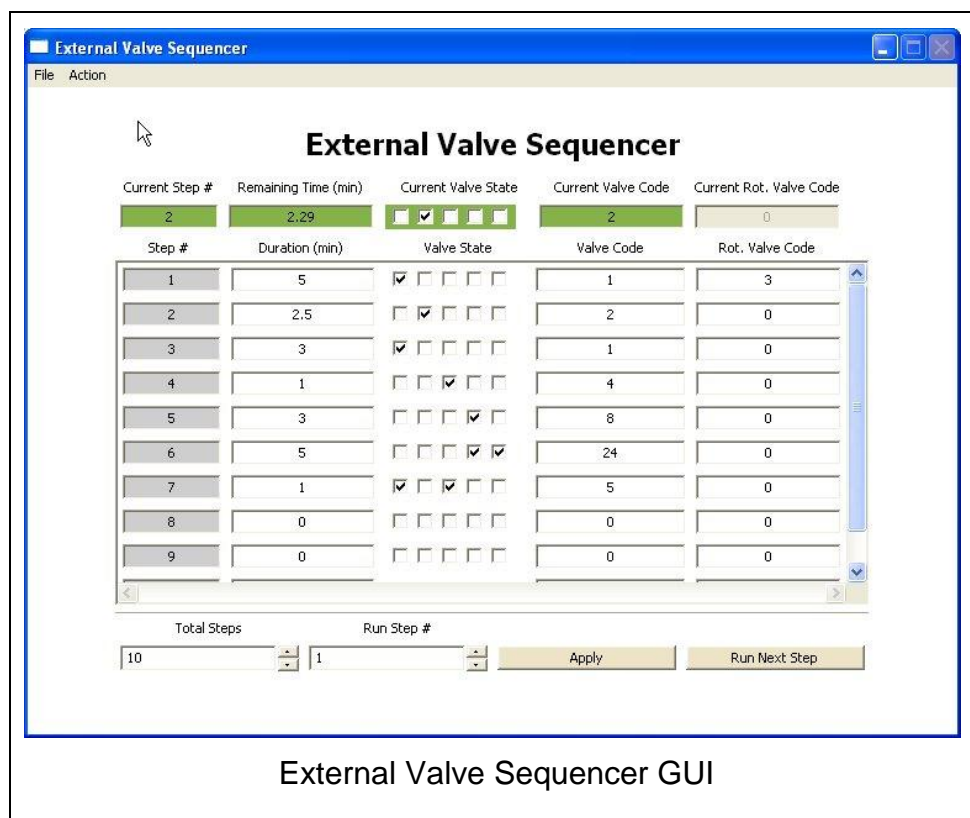


The screenshot shows a Notepad++ window with a file named 'DataLog_User.dat'. The file contains a table with seven columns: GPS_TIME, GPS_ABS_LAT, GPS_REL_LAT, GPS_ABS_LONG, GPS_REL_LONG, and GPS_FIT. Each row contains numerical values in scientific notation. The GPS_TIME column has values like 7.146810000000E+004. The GPS_ABS_LAT column has values like 3.73943480333E+001. The GPS_REL_LAT column has values like 3.94348033333E-001. The GPS_ABS_LONG column has values like -1.21983880333E+002. The GPS_REL_LONG column has values like -9.81088533333E-001. The GPS_FIT column has values like 2.00000000000E+000.

An example of new data columns that will appear in the normal data documents with the integration of a peripheral device.

EXTERNAL VALVE CONTROL (OPTIONAL)

The analyzer has been equipped with a cable for control of external solenoid valves. It may be necessary to contact Picarro for additional information on how to configure the analyzer to utilize this feature. Analyzers are provided with a cable consisting of five electrical connections intended for controlling solenoid valves (typically 12VDC <1A max). It is important to **electrically isolate the solenoid valves from the analyzer's ground** to avoid electrical interference that can compromise the analyzer's accuracy. There is also a serial (COM) port for controlling a multi-position (typically rotary) valve via serial commands. Currently, it supports the standard commands of Valco (VICI) rotary valves, and the Valco controller can simply be plugged into the rotary valve port and will be recognized upon instrument startup. Contact Picarro for additional details on this feature.



External Valve Sequencer GUI

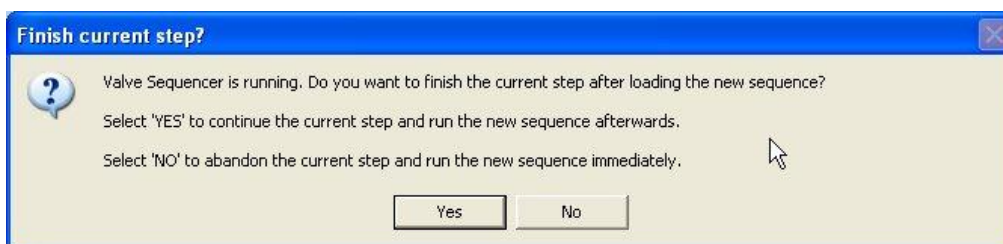
PICARRO

When the “Show Valve Sequencer GUI” is selected under “Tools” in the software, the screen above will appear. This allows the user to manually open or close different valves or to program in a sequence which can be executed later. The valve sequencer operates as a state machine, iterating through a series of steps, dwelling at each step for a certain period of time, and repeating the sequence of steps indefinitely or until the sequencer is stopped. The steps can manually be changed before their specified duration has elapsed by clicking “Run Next Step.”

At each step, multiple valves can be activated and a rotary valve can be used in conjunction with up to five solenoid valves. The check mark in the “valve state” boxes indicate a valve is open. The “duration” window shows how long that set of valve(s) is open. The “current step” field indicates (if the sequencer is running) which step is being executed in the list. The Current Valve Code (binary number) and Current Rotary Valve Code (if enabled) are shown for the set valve combination. A grayed-out value of “0” in the rotary valve code window indicates a valve has not been found on the COM port.

Multiple sequences can be loaded and/or saved in files and selected later with the appropriate menu item under the “file” menu. Under the “Action” menu the sequences can be started or stopped, reset to the first step, or all valves set to “0” by selecting the appropriate menu item. A running sequence can be incremented by pressing Run Next Step. The valve sequence currently shown on the panel can be saved, or a previously saved sequence can be loaded with the Save/Load Valve Sequence File buttons.

To increase the number of sequence items, increment the “total steps” control. If a sequence has been started, the window can be hidden (and the sequence will continue to run) by selecting “Hide Sequencer Interface.” If a new sequence is loaded while the sequencer is running, the dialog box below will appear asking if the current step should be completed. Both solenoid and rotary valve codes are written into columns in the data files indicating the active valve configuration at each point in time when data is taken. These can be used as event timing flags, for example, if no solenoid valves are present as the codes will be recorded regardless of whether a valve is connected or not. The rotary valve codes are saved as a column in the DataLog_Private file described earlier.



PICARRO

ANALOG SIGNAL OUTPUT (OPTIONAL)

Overview: The Picarro analyzer may be optionally configured with an Electrical Interface Card (EIC) that provides up to 8 analog signals available to the user for monitoring various measurements results and analyzer parameters.

Two circular connectors, labeled 'ANALOG 0-3' and 'ANALOG 4-7' are present on the back face of the analyzer in (see Fig 1). The pinout for each connector is listed below. The mating connector is P/N HR25-7TP-8P (72), manufactured by Hirose Electric Group.

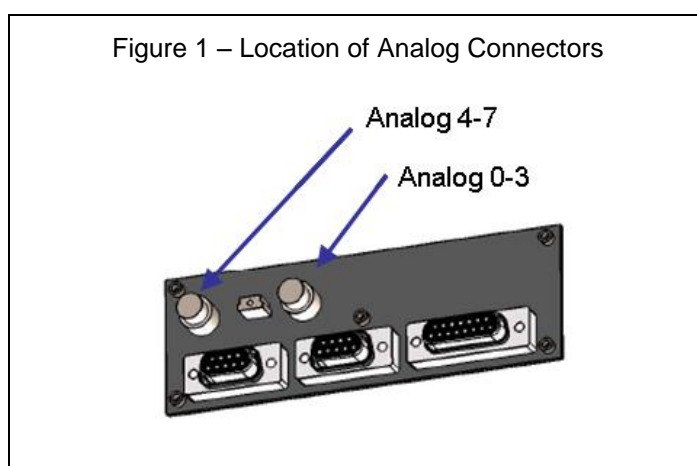


Table 1 – Analog Signal Pin Mapping

'ANALOG 0-3'		'ANALOG 4-7'	
Pin	Function	Pin	Function
1	GND 0	1	GND 4
2	CHANNEL 0	2	CHANNEL 4
3	GND 1	3	GND 5
4	CHANNEL 1	4	CHANNEL 5
5	GND 2	5	GND 6
6	CHANNEL 2	6	CHANNEL 6
7	GND 3	7	GND 7
8	CHANNEL 3	8	CHANNEL 7

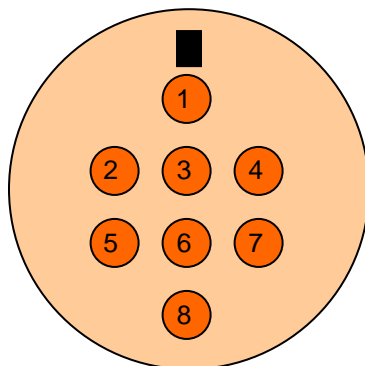


Figure 2 – Pin Numbering

Configuration

The default configuration is set at the factory and is listed in the table below. It can be modified by editing the ElectricalInterface.ini file located in the C:\Picarro\G2000\AppConfig\Config\ElectricalInterface directory.

Table 2 – Default Parameter Configuration

Channel	Parameter	Scale	Range
0	CO2 Concentration	0-10V	300 – 800 ppm
1	CH4 Concentration	0-10V	1.5 – 3.5 ppm
2	H2O Concentration	0-10V	0 – 4 %
3	Cavity Pressure	0-10V	130 – 150 Torr
4	None	NA	NA
5	None	NA	NA
6	None	NA	NA
7	None	NA	NA

PICARRO

SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

The following limits are the absolute maximum ratings. Operation beyond any of these limits may result in permanent damage to the analyzer (unless otherwise specified for custom or OEM systems).

Parameter	Min	Max	Units
Storage Temperature	-10	+50	°C
Storage Relative Humidity (non-condensing)	0	90	%
Ambient Operating Temperature	5	50	°C
Operating Relative Humidity (non-condensing)	0	99	%
Warm-Up Time from OFF (at 15 °C)		1	hour
Ambient Temperature Change		5	°C/hr
Total Power Dissipation (steady state w/o pump)		470	W
Total Power Dissipation (maximum w/o pump)		600	W

SAMPLE GAS REQUIREMENTS

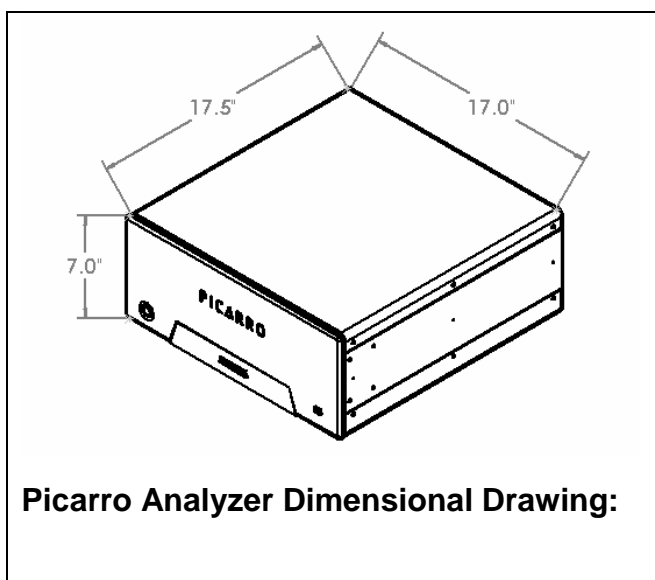
Parameter	Value	Comment
Inlet gas temperature	5-50 °C	
Inlet gas pressure	500 – 1000 Torr	
Inlet gas flow rate	0.4 -7 slm at 760 Torr	In bypass manifold configuration. Depends on the Measurement Mode.
Gas type	Oil free Non-corrosive Non-flammable Non-condensing	Samples with condensing levels of H ₂ O content may damage the analyzer.
Particle free	< 0.1 µm	

PICARRO

Please consult the Compliance Certification for analyzer performance and performance specifications. Size specifications below are listed for standard instruments only and may differ for customized or OEM systems.

PHYSICAL SPECIFICATIONS

Parameter	Value
Inlet gas connector	1/4" stainless steel Swagelok
Outlet gas connector	3/8" stainless steel Swagelok
W x H x D	17" x 7.5" x 17"
AC power	100/110 VAC @ 50/60 Hz 220VAC @ 50 Hz



SERVICE AND MAINTENANCE

The advanced, rugged design of the Picarro Analyzers provides stable, long-term operation with minimal service or maintenance. With the exception of the particulate filter, the analyzer is not user serviceable. Should it appear to malfunction, please refer to the Troubleshooting Guide or contact Picarro.

PARTICULATE FILTER:

There are two in-line, sub-micron particulate filters before the measurement cavity. The first is user-replaceable and replacement filters can be purchased from Picarro and installed by the user. **It is important to NEVER remove the filter that is directly attached to the cavity. Only change the filter immediately following the inlet at the back of the analyzer. Refer to the filter replacement procedure in this document for further details.** The symptoms of a clogged filter can be analyzer reporting “pressure low” or there being no flow into the instrument, causing unusual measurements. Filters can become clogged after years of use in dirty environments. If liquid water is accidentally sucked into the inlet line, it will clog the filter and impede the flow (usually for a few days) until it evaporates. If this occurs, it is important to NOT turn off the analyzer or replace the filter until it is dry. The reason for this is that the increased humidity due to liquid water in the filter can cause condensation on the optics if the analyzer is allowed to cool from its operating temperature. Often, after the filter dries, the analyzer will begin functioning normally, and a filter replacement is not necessary.

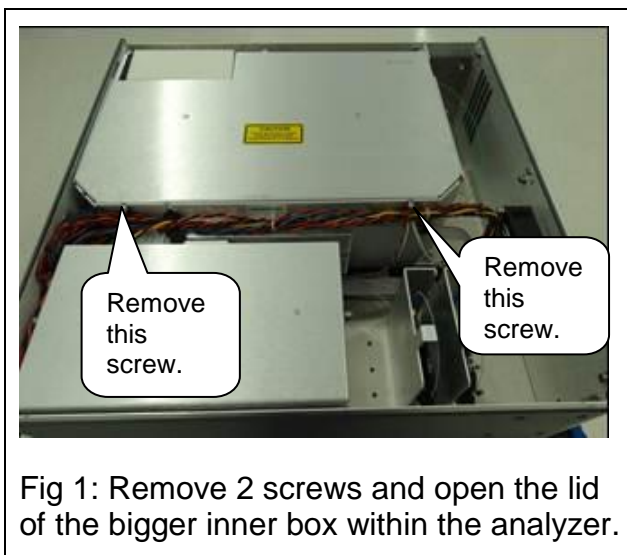
Picarro Analyzer Replacement Procedure for User-Serviceable Particulate Filter

Tools Required:

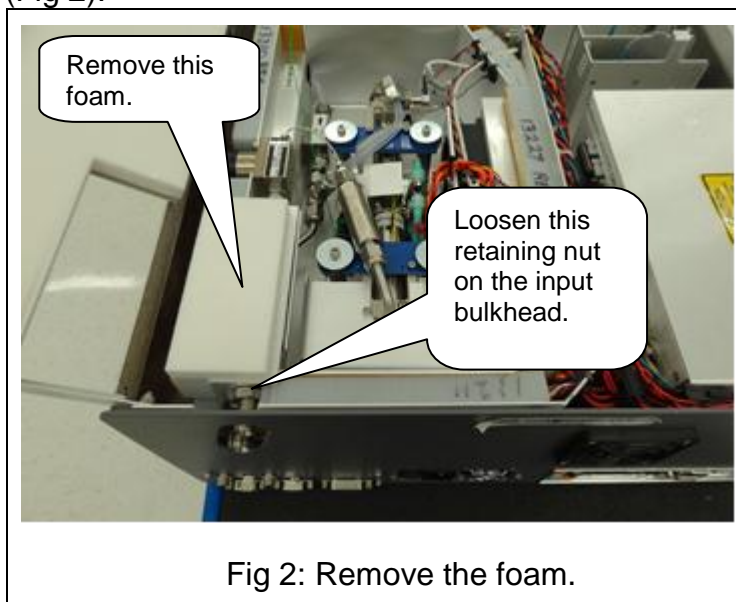
- 1.5mm hex driver
- 9/16” open-end wrench
- 5/8” open-end wrench
- 11/16” open-end wrench

REMOVING THE OLD PARTICULATE FILTER:

1. Move the analyzer to a clean work environment.
2. Using a 2 mm hex driver, remove the top lid of the analyzer by removing six M3 x 6mm socket flathead screws.
3. Loosen and remove the 2 screws on the inner long side of the bigger box. Open the lid (Fig 1).



4. Using a 5/8" wrench, loosen the retaining nut on the input bulkhead (about 1 full turn should be enough) (Fig 2).
5. Slide the foam towards left side of the analyzer (from the back of the analyzer) to remove it (Fig 2).



PICARRO

- Using the 9/16" and 11/16" wrenches, loosen two nuts that are connecting the filter to the analyzer (Fig 3, 4, 5).
- Slide the filter slightly towards the back of the analyzer and lift it out (Fig 6).

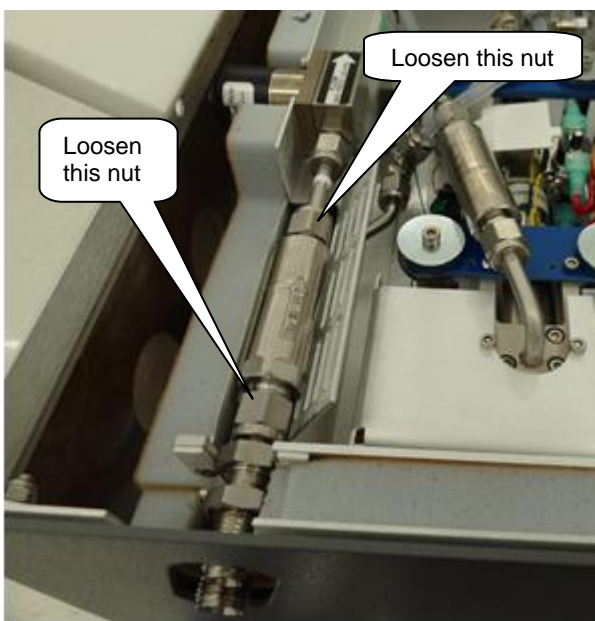


Fig 3: Loosen 2 nuts to remove the filter

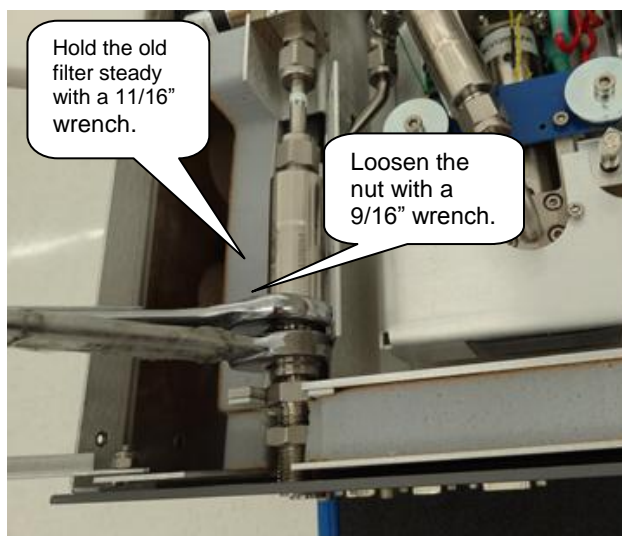


Fig 4: Loosen the First Nut

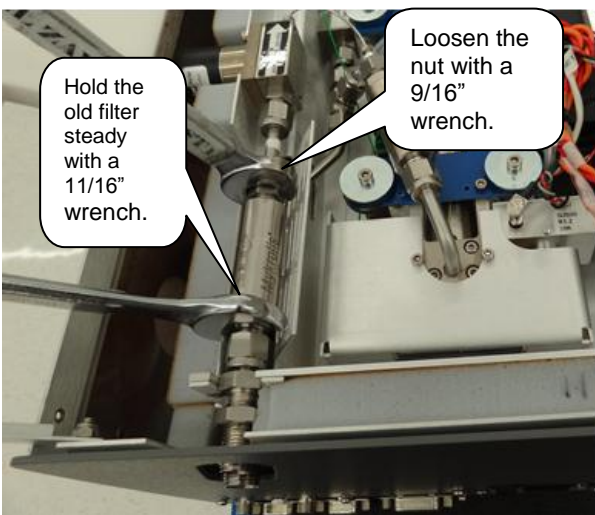


Fig 5: Loosen the 2nd nut

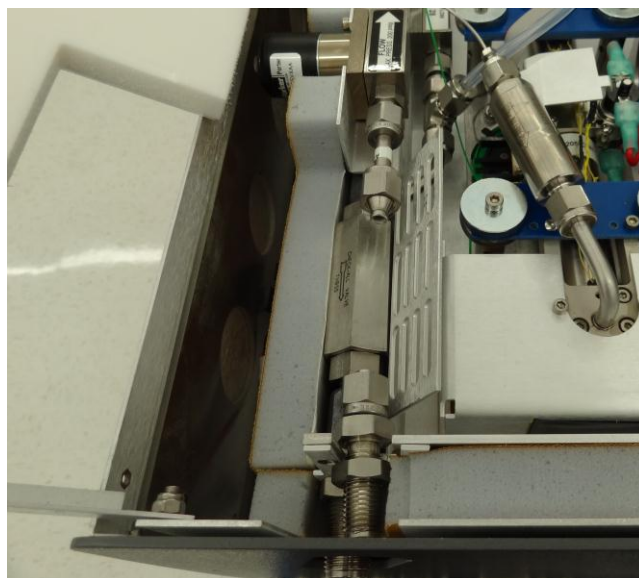


Fig 6: Remove the old filter

PICARRO

INSTALLING THE NEW FILTER:



Note: When re-attaching 1/4" Swagelok fittings, the nut should be hand-tightened and then turned an additional 1/8 of a turn using a wrench.

1. Remove the filter from its packaging.
2. Using the 9/16" and 11/16" wrenches, attach it to the two nuts. The arrow on the filter needs to point away from the back of the analyzer.

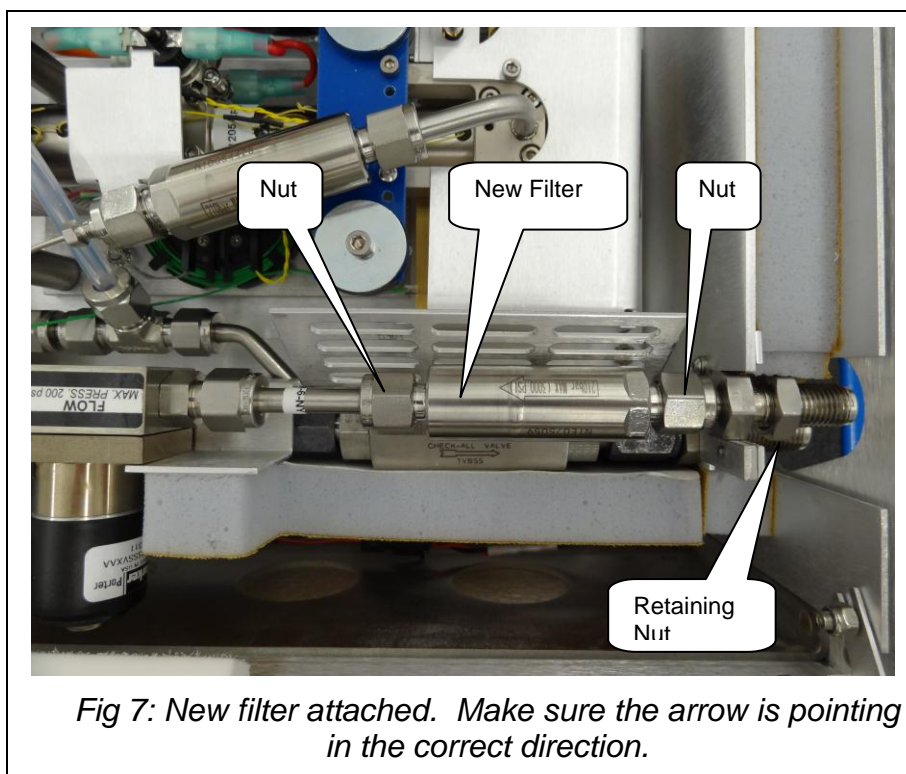


Fig 7: New filter attached. Make sure the arrow is pointing in the correct direction.

3. Using a 5/8" wrench, reposition the filter foam cover and tighten the retaining nut on the bulkhead fitting. The metal edge of the filter cover should be under the foam.
4. With a 2 mm hex driver, reattach the analyzer's top with 6 screws.

PICARRO

TROUBLESHOOTING GUIDE

The following section lists problems that may be encountered during installation and operation of the analyzer. The corresponding step-by-step procedures provide resolution in most cases. If, after attempting these procedures, the problem remains unresolved, please contact Picarro (Customer Service at (408) 962-3900) or refer to Picarro Community (<http://www.picarro.com/community>).

1. Power LED on analyzer does not illuminate

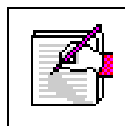
Context: Turning on the analyzer by momentarily depressing its front panel power switch should apply power. The green power LED is illuminated when it detects the correct power levels.

- (a) Check that the AC power cord is attached and plugged into a working outlet.
- (b) Check that the rear on-off switch near the AC power cord is in the on position.
- (c) Press and hold the front panel power switch for at least 5 seconds as the analyzer may take several seconds to respond.

2. User interface program does not start

Context: The computer may be configured to start the instrument and the associated user interface program automatically after it completes its boot-up sequence, or the program may be launched using the “Start instrument” icon on the desktop. During this process, the computer establishes communications with the analyzer via the USB interface, starts a number of background programs, and finally runs the user interface program.

(a) Communications problems with the analyzer may occur if the analyzer fails to initialize correctly on power up. Should the analyzer initialization process not complete correctly, shut down the instrument by shutting down the Windows operating system on the control computer: use the Start menu, select the red Shut down button and select “Shut down” in the drop-down box under “What do you want the computer to do?”. Wait for the shutdown to complete normally and for the computer and analyzer to turn off completely. After a few seconds, restart the computer by momentarily depressing the power button.



NOTE: Do not simply restart Windows, since this does not cycle the power to the analyzer.

3. Sample pressure cannot be controlled to the appropriate value for concentration measurements

Context: Under normal operation, the cavity pressure is automatically locked to the correct value by means of electronically controlled inlet and outlet valves. The message “Pressure Locked” on the front panel display and the user interface indicates that the cavity pressure is at the appropriate value. Should either of the messages “Pressure high” or “Pressure low” be displayed, the cavity pressure is out of its correct operating range.

- (a) The “Pressure low” message indicates that there is insufficient gas available at the inlet of the analyzer. Check the inlet plumbing to the analyzer and ensure that the pressure at the inlet is within the specifications.
- (b) The “Pressure high” message indicates that gas cannot be removed from the analyzer at a sufficient rate. Check the vacuum line between the analyzer and the power vacuum unit for leaks. Failure of the vacuum pump, injecting dilution gas at excessive pressure, or excessive pressure at the inlet can also cause this problem.

4. User interface program “freezes” and does not update graphs as data are collected

Context: The computer may become unresponsive causing the programs that control the analyzer to stop functioning. The computer and analyzer should be shut down and restarted.

PICARRO

- (a) Re-setting the computer and the instrument requires that the computer be shut down and restarted. If the computer responds to the mouse, a normal Windows shutdown may be carried out: use the Start menu, select the red Shut down button and select "Shut down" in the drop-down box under "What do you want the computer to do?" Wait for the shutdown to complete normally and for the computer and analyzer to turn off completely. After a few seconds, restart the computer by momentarily depressing the power button.
- (b) If the computer does not respond to the mouse, hold down the power switch on the front panel for a few seconds until the computer and the instrument turn off. After another few seconds, restart the analyzer by momentarily depressing the power button.

TRANSPORTATION AND STORAGE

In the event that the instrument will be transported or stored, the following procedure can be used to prepare the instrument and repack it into the original carton.

Packing the Analyzer

- 1) Shutdown the instrument using the shutdown button, using the “prepare for shipment” option. Clean dry gas should be attached to the instrument prior to shutting down. This prevents condensation inside the system during storage or shipment.
- 2) Disconnect the all tubing and electrical connections from the analyzer.
- 3) To prevent contamination and possible damage to the connector threads, place caps on all gas connections.
- 4) Place the analyzer in a plastic bag with a package of desiccant. Seal the bags with tape.
- 5) Pack the analyzer in the original shipping container ensuring that all of the foam pieces are in place to protect the analyzer during shipping.




CAUTION: WHEN SHIPPING OR RELOCATING THE ANALYZER, IT IS IMPORTANT TO PROTECT IT FROM MECHANICAL SHOCKS. FAILURE TO DO SO CAN COMPROMIZE ITS PERFORMANCE. WHEN SHIPPING THE ANALYZER, USE ITS ORIGINAL PACKAGING ONLY.

PICARRO

LIMITED WARRANTY

Picarro, Inc. warrants its Products to be free from defects in material and workmanship and to perform in the manner and under the conditions specified in the Product specifications for twelve (12) months from shipment.

This warranty is the only warranty made by Picarro with respect to its Products and no person is authorized to bind Picarro for any obligations or liabilities beyond this warranty in connection with its Products. This warranty is made to the original Purchaser only, is nontransferable and may only be modified or amended by a written instrument signed by a duly authorized officer of Picarro. Sub-systems manufactured by other firms, but integrated into Picarro Products, are covered by the original manufacturer's warranty and Picarro makes no warranty, express or implied, regarding such sub-systems. Products or parts thereof which are replaced or repaired under this warranty are warranted only for the remaining, un-expired portion of the original warranty period applicable to the specific Product replaced or repaired.

	<p>NOTE: DISCLAIMER</p> <p>THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL OR IMPLIED, AND SHALL BE THE PURCHASER'S SOLE REMEDY AND PICARRO'S SOLE LIABILITY IN CONTRACT OR OTHERWISE FOR THE PRODUCT. PICARRO EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.</p>
---	---

The Purchaser's exclusive remedy with respect to any defective Product shall be to have Picarro repair or replace such defective Product or credit the Purchaser's account, whichever Picarro may elect in its sole discretion. If it is found that any Product has been returned which is not defective, the Purchaser will be notified and such Product returned at the Purchaser's expense. In addition, a charge for testing and examination may, at Picarro's sole discretion, be made on any Product so returned.

These remedies are available only if: i) Picarro is notified in writing by the Purchaser promptly upon discovery of a Product defect, and in any event within the warranty period; ii) Picarro's examination of such Product discloses to Picarro's satisfaction that such defects actually exist and the Product has not been repaired, worked on, altered by persons not authorized by Picarro, subject to misuse, negligence or accident, or connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by Picarro.

PICARRO

The following warranty conditions shall apply to all Picarro, Inc. products unless amended by a written instrument signed by a duly authorized officer of Picarro:

ADJUSTMENT – No electrical, mechanical or optical adjustments to the product(s) are permitted.

PARTS AND LABOR - New or factory-built replacements for defective parts will be supplied for twelve (12) months from date of shipment of the product. Replacement parts are warranted for the remaining portion of the original warranty period. There will be no charge for repair of products under warranty where the repair work is done by Picarro, Inc. Shipping and transportation charges shall be the sole responsibility of the customer.

NOT COVERED BY THE WARRANTY – Damage to any optical surface from improper handling or cleaning procedures. This applies specifically to those items subjected to excess laser radiation, contaminated environments, extreme temperature or abrasive cleaning. Damage due to ESD, abuse, misuse, improper installation or application, alteration, accident, negligence in use, improper storage, transportation or handling. No warranty shall apply where the original equipment identifications have been removed, defaced, altered or where there is any evidence of alterations, adjustments, removal of protective outer enclosure, any attempt to repair the product by unauthorized personnel or with parts other than those provided by Picarro, Inc.

DAMAGE IN SHIPMENT - Your analyzer should be inspected and tested as soon as it is received. The product is packaged for safe delivery. If the product is damaged in any way, you should immediately file a claim with the carrier or, if insured separately, with the insurance company. Picarro, Inc. will not be responsible for damage sustained in shipment. All Picarro products are F.O.B. origin, shipped from the Picarro factory or Picarro distributor. The price of all Products, unless otherwise specifically stated, is Ex-Works, Sunnyvale, CA as defined by Incoterms, 2001. The cost of normal packaging for shipment is included in the invoiced price. Where Buyer specifies special packaging, a charge will be made to cover any extra expense.

CLAIMS ASSISTANCE - Call Picarro, Inc. Customer Service or your local distributor for assistance. Give our representative the full details of the problem. Helpful information or shipping instructions will be provided. If requested, estimates of the charges for non-warranty or other service work will be supplied before work begins.

RETURN PROCEDURE - Customers must obtain a Return Merchandise Authorization Number from Picarro, Inc. prior to returning units. Products being returned for repair must be shipped in their original shipping cartons to avoid damage.