PI5310 Analyzer User Manual

for N_2O, CO, H_2O

PICARRO

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Revision History

Revision	Date	Notes
A	March 2024	First edition
B	February 2025	Operating system updated to Ubuntu 20 Linux. Text and software screenshots updated appropriately. No hardware changes. Appendix A Setup tools and Communication added.

Picarro Notices

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

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

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

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1 Introduction

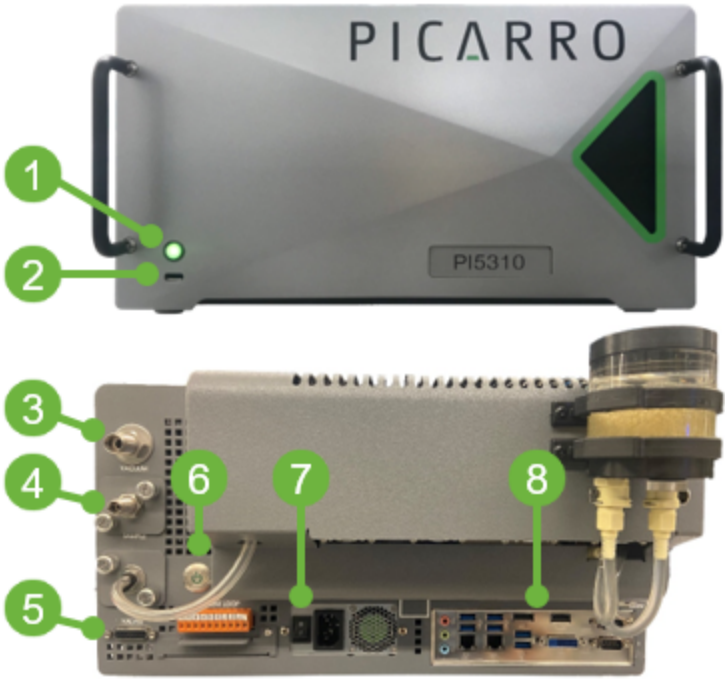
The PI5310 analyzer measures concentrations of N_2O, CO and H_2O using Picarro's patented Cavity Ring-Down Spectroscopy (CRDS). The analyzer can be deployed for air monitoring applications in a lab or in the field, allowing in-situ analysis of trace and ambient amounts of N_2O, CO and H_2O.

1.1 System Overview

This section provides an overview of the analyzer, related components, and specifications.

1.1.1 Analyzer

The following figure displays the analyzer front and back panels. More detailed information on panel features, functions, and connections are in Chapter 4, Hardware Setup.



1. LED Status Indicator
2. USB Port
3. Vacuum Ports
4. Sample Inlet
5. Valve
6. Soft Power Button
7. Main Power
8. PC Communication Ports

Figure 1 - PI5310 Front/Back Panels

1.1.2 Front Panel Operating Status

The LED indicator on the front panel shows the current operating state of the analyzer. The following figure describes the status indicator states. The status states and colors are also linked to the System Alarm Panel on the CRDS Data Viewer Screen. See Section .

Figure 2 - LED Status Indicator

1.1.3 A2000 Vacuum Pump

The A2000 vacuum pump is used to maintain cavity pressure inside the analyzer. The pump should be connected and running whenever the analyzer is in use.

Figure 3 - A2000 Vacuum Pump - Side Views

1.2 Analyzer Specifications

Table 1 - PI5310 Specifications

Parameter	Specification
Measurement Technique	Cavity Ring-Down Spectroscopy (CRDS)
Primary Gases Measured	N_2O (Nitrous Oxide), CO (Carbon Monoxide), H_2O (Water)

Parameter	Specification
Weight: Analyzer Weight: Pump	32.2 kg (71 lbs.) – Should be lifted by two people. A2000: 6.5 kg (14.4 lbs)
Dimensions - Analyzer	Length: 76.8 cm (30.25”) Width: 42.24 cm (16.63”) Width with Rack Mount Rails: 44.78 cm (17.63”) Height: 22.23 cm (8.75”), Height with Feet: 23.5 cm (9.25”)
Dimensions – A2000 Pump	Length: 27.9 cm (11”) Width: 10.2 cm (4”) Height: 19.1 cm (7.5”)
Clearance	Front: 15 cm (6”); Rear: 15 cm (6”)
Ambient Temperature Range	Operating: 10 °C to 35 °C (50 °F to 95 °F) Storage: -10 °C to 50 °C (14 °F to 122 °F)
Ambient Humidity Range	< 85% RH non-condensing
Sample Pressure	300 to 1000 Torr (40 to 133 kPa)
Sample Flow Rate	200 sccm
Maximum Altitude	3,048 m (10,000 ft – Operation)
Required Accessories	Included: Pump (external), Supplied by Customer: LCD monitor
Operating System	Ubuntu 20 Linux
Data Outputs	RS–232, Ethernet, USB, Data Streaming: Optional Analog 4–20 mA
Installation	Benchtop or 48.3 cm (19”) rack mount

Parameter	Specification
Power Requirements Mains Supply Voltage Fluctuation	100 – 240 VAC; 50 – 60 Hz (auto-sensing) 250 W Max 150 W (pump) ±10% of the nominal voltage
Minimum Rated Circuit Amperage	10A @ 115 VAC 5A @ 230 VAC
Liquid Ingress Protection	None

1.3 Acronyms

This manual includes various acronyms. For definitions, see below:

Table 2 - Acronyms, Formulas, Units, and Symbols

Acronym	Definition
“ (as in 1/4”)	Inches
°C	degrees Celsius
%	Percentage
±	Plus–minus sign
<	Less than
>	Greater than
≤	Less than or equal to
≥	Greater than or equal to
A	Ampere
AC	Alternating Current
bar	Metric unit of pressure. 1 bar = 100,000 pascals (Pa)
CDA	Clean Dry Air
cm	centimeters
CO_2	Carbon Dioxide

Acronym	Definition
COM	Communication Port
CRDS	Cavity Ring-Down Spectroscopy
CSV	Comma Separated Values
CPU	Central Processing Unit
DC	Direct Current
DIO	Digital Input/Output
DVI	Digital Visual Interface
°F	Degrees Fahrenheit
ft.	Length in feet;1 ft. = 12” or 12 inches (30.48 cm)
GUI	Graphical User Interface
H_2O	Water, Water Vapor
HB	Hotbox
HBr	Hydrogen Bromide
HDF	Hierarchical Data Format
Hz	Hertz
ID	Inside Diameter (i.e., .5” ID) or Identification (i.e., Slave ID)
I/O	Input/output
kg	kilograms
kPa	Kilopascal; unit of pressure; 1 kPa = 0.145 PSI
lbs	pounds
LAN	Local Area Network
m	Meters or month
mA	Milliampere
max	Maximum

Acronym	Definition
min	Minimum
mm	millimeters / millimetre
N/C	No Connection
NC	Normally Closed
NO	Normally Open
NO	Normally Open
NTP	Network Time Protocol
OD	Outside Diameter
P	Pressure
PC	Personal Computer
PDF	Portable Document Format
PFA	Perfluoroalkoxy – A chemically resistant polymer, suitable for use with sticky and aggressive gases
PN	Part Number
ppb	parts per billion
ppm	parts per million
PSI (psi)	Pounds per Square Inch
PSIG	Pounds per Square Gauge
PTFE	Polytetrafluoroethylene
Pws	Water vapor pressure
QC	Quality Control
RH	Relative Humidity
RJ-45	Registered Jack (physical network interface)
RS232	Recommended Standard 232 (serial communication protocol)
sec	Seconds

Acronym	Definition
SS/SST	Stainless Steel
TCP/IP	Transmission Control Protocol/Internet Protocol
Torr	Torricelli (unit of pressure equal to 1/760 atmosphere)
UM	User Manual
USB	Universal Serial Bus
UPS	Uninterruptible Power Supply
VA	Volt-Ampere
VAC	Volts Alternating Current
VDC	Volts Direct Current
VOC	Volatile Organic Compound
W	Watts
WB	Warmbox

1.4 Text Conventions

The following conventions are used in the manual.

- *Italic* text identifies screen names and to emphasize important text or certain features.
- ***Bold Italic*** text identifies section reference links.
- **Bold** text is for actions to take (such as clicking on a UI button), caution and warning statements, and text you should type or select in screens.

2 Safety

The following chapter provides an overview of warning symbols used in this document, general safety guidelines for using the analyzer, and acquired certifications.

2.1 Warning Symbols

The purpose of these icons is to provide a visual convention to alert you of important information. They indicate dangers to either the operator or to the product, and other important information. The following symbols are used in this manual.

DANGER

DANGER indicates an imminently hazardous situation that, if not avoided, will result in death or severe injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or severe injury.

WARNING

HAZARDOUS VOLTAGE alerts user to areas that may expose a user to electrical energy that is high enough to cause injury or death.

WARNING

LASER WARNING alerts user of a laser danger.

CAUTION

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

HOT SURFACE

HOT SURFACE alerts user to potential injury from hot surfaces.

NOTE

The NOTE is important information that you should be aware of before proceeding.

REMINDER

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

2.2 General Safety

This section describes the CDRH and CE certifications for class 1 lasers and regulatory conformity for the European Union.

2.2.1 CDRH Certification

This Picarro analyzer complies with 21 CFR Chapter 1, sub-chapter J, and is classified as a Class 1 laser system when all panels and covers are on.

2.2.2 CE Certification

This Picarro analyzer complies with the European standards and the instrument is affixed with a CE label. This CE label is located on the rear of the instrument.

WARNING

Using this analyzer in a manner not specified by Picarro may result in damage to the analyzer and render it unsafe to operate

WARNING

This analyzer is for indoor use only and has an ingress protection rating of IPx-0. Analyzer is NOT protected against exposure to water including dripping, spraying, splashing or immersion

WARNING

Do not operate in an explosive atmosphere! Do not operate in the presence of flammable gases or fumes

⚠ CAUTION

The analyzer contains no user serviceable components except the particulate filter, CPU fan, and A2000 vacuum pump diaphragms and valves. To order user-replaceable parts and access video replacement instructions, see section Chapter 11, Maintenance.

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

⚠ CAUTION

Do not replace the mains supply power cord with an inadequately rated cord.

⚠ WARNING

If mounting in a 19” rack, this analyzer cannot support itself using a front rack mount kit alone. It must be supported by a shelf, or by user-provided “L” type support brackets.

⚠ CAUTION

Equipment Damage: 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 exhaust the remainder of the gas stream appropriately.

⚠ HOT SURFACE

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.

CAUTION

Equipment Damage: Do not disconnect 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 power is applied while attaching or removing cables.

WARNING

This analyzer weighs 71 lbs. (32.2 kg). Use the technique described below when lifting the analyzer.

1. Before lifting, inspect the unit for slippery substances or sharp edges.
2. Lift with two people, one on each side of the analyzer.
3. Crouch down and stay close to the unit. Always keep your back as straight as possible.
4. Position your feet for sturdy balance. Lift with your legs, not your back.
5. Do not twist the back while carrying the unit. Rotate direction with hip joints.
6. Lower the unit by bending at the knees.

2.3 Laser Safety

WARNING

This equipment is classified as a Class 1 laser product with an embedded 3B laser in accordance with EN 60825-1:2014. Do not to open the enclosure where this label is placed; there are no user serviceable parts inside.

The following laser safety Label is affixed to the outer cover of the analyzer.

Figure 4 - Laser Safety Label – Affixed to Outside Cover of Analyzer

WARNING

The laser is a Class3B when exposed.
Only operate or service this device in accordance with the instructions in this guide, and only open the device in an approved laser safe service area using appropriate laser-safety glasses.

The following laser safety label is affixed to the inside of the analyzer:

Figure 5 - Laser Safety Label – Affixed to Inside of Analyzer

WARNING

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

WARNING

Any light emitted from the front panel status indicator, regardless of color or state, indicates one or more lasers are on.

3 Unpacking

3.1 Inspect the Shipping Containers

Picarro products are inspected and tested before leaving the factory. Their packing containers have been designed to keep the equipment safe from damage during transit.

Picarro shipping containers consist of:

- A wooden crate with metal clamps
- Layers of protective foam

Figure 6 - Shipping Container with Clamps Installed/Removed

1. To open the crate, use a claw hammer to remove the metal shipping clamps.
2. Inspect the condition of the crate and packing materials upon arrival. The crate houses the analyzer and the external pump. Even if the crate shows some external damage, it will protect the instrument under most circumstances.

   If the equipment inside the container does appear to be damaged, photograph all the evidence of damage and contact Picarro, sending the photographs as soon as possible.
3. Keep all packing materials so the instrument can easily be returned Picarro if necessary.

3.2 Unpack Components

While unpacking each shipping box:

- Inspect each item to ensure it is not damaged.
- If items are missing, contact Picarro.
- Keep the shipping materials to reuse when transporting the analyzer.
- Contact Picarro for options on transporting systems to remote labs.

WARNING

This analyzer weighs 71 lbs. (32.2 kg). Use the technique described below when lifting the analyzer.

1. Before lifting, inspect the unit for slippery substances or sharp edges.
2. Lift with two people, one on each side of the analyzer.
3. Crouch down and stay close to the unit. Always keep your back as straight as possible.
4. Position your feet for sturdy balance. Lift with your legs, not your back.
5. Do not twist the back while carrying the unit. Rotate direction with hip joints.
6. Lower the unit by bending at the knees.

3.3 Contents

NOTE

The following shipping contents may arrive in one or more shipping containers.

Table 3 - Shipping Contents

Part (qty)	Description
 Analyzer (1)	Includes all the data acquisition, control, and communications hardware and firmware to perform all gas handling, spectral collection, and analysis.
 AC Power Cables (1)	A power cable with connectors appropriate to your country is provided. **Note:** The analyzer automatically adjusts to local voltage.

Part (qty)	Description
 Control Cable Kit (1)	For external solenoid valves.
 Nut (1) and Ferrules (2)	For connecting input line to analyzer gas input.
 Vacuum Hose (1)	Hose to connect the pump to the analyzer.
 Rails (1 set)	Mounting rails for cabinet installation.
 Keyboard and Mouse (1)	Monitor is not included.

Part (qty)	Description
 Document Packet (1)	Includes this user manual and certificate of compliance (not shown).
 Coolant (1)	1 bottle of Koolance 702 liquid coolant.
 A2000 Vacuum Pump (1)	Provides vacuum required for sample gas sequencing into and out of the analyzer.
 AC Power Cable (1)	A power cable with connectors appropriate to your country is provided. **Note:** The vacuum pump voltage must be selected. See in section .
 Pump Manual (1)	Detailed instructions for pump.

4 Hardware Setup

Read this entire section before proceeding. Refer to Figure 16 in the following section for installation.

4.1 Required Components and Tools

- 9/16" open end wrench
- 11/16" open end wrench
- 5/8" open end wrench
- Phillips head screwdriver (for rack mounting)
- 2.5 mm Allen wrench (for rack mounting)
- Pump
- Power Cord for analyzer and pump
- Coolant for chiller

4.2 Installation Safety

WARNING

Two-person lift required: The analyzer weighs 32.2 kg (71 lbs). When lifting the analyzer, use the technique described section 1.1, General Safety (or follow your local regulations).

CAUTION

When the analyzer is being integrated to an external system, the safety of that system is the responsibility of the assembler of that system.

WARNING

Equipment Damage: Do not attach electrical power to or start the analyzer until after attaching and turning on 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.

⚠ WARNING

Picarro sells certain USB enabled devices, such as GPS, which are approved for use. Do not connect USB hubs or unauthorized USB devices (except flash drives, mice, and keyboards) to the USB ports. Unauthorized USB devices may interfere with the normal functioning of the analyzer.

⚠ WARNING

When using compressed gases, follow all appropriate safety conventions, including use of eye protection, physical restraint of cylinders, etc.

⚠ WARNING

Lines connected to the 1/4" Swagelok sample inlet connector must not exceed 15 PSIG of pressure.

⚠ WARNING

Operating at concentrations above the intended ranges may render the instrument unsafe to operate, maintain, service or dispose of.

⚠ WARNING

Any light emitted from the front panel Status Indicator, regardless of color or state, shown in Figure 14 indicates one or more lasers are on.

⚠ CAUTION

During installation, do not position the analyzer so that it is difficult to operate the electrical disconnecting device (such as an emergency off (EMO) switch or breaker).

⚠ WARNING

If mounting in a 19” rack, this analyzer cannot support itself using a front rack mount kit alone. It must be supported by a shelf, or by user-provided “L” type support brackets.

⚠ CAUTION

Use the AC power cables supplied with the analyzer or a similarly rated cable. Check with Picarro technical support if you have questions about power cable replacement. An inadequately rated power cable can result in equipment damage.

⚠ CAUTION

Cords shall be RATED for the maximum current for the equipment and the cable used shall meet the requirements of IEC 60227 or IEC 60245. Cords certified or approved by a recognized testing authority are regarded as meeting this requirement. The connector type used should be: IEC320 C13.

⚠ CAUTION

If the analyzer has been stored at less than 10 °C, allow the components to equalize to room temperature before starting the installation process.

⚠ CAUTION

Equipment Damage: It is imperative that the analyzer have adequate ventilation and/or cooling to maintain the ambient temperature below 35 °C when operating. Do not place the pump or the instrument in any enclosure without providing adequate forced air flow.

⚠ CAUTION

Do not plug or block any perforations in the chassis of the instrument. Do not put anything near the instrument that will impede the air flow. Failure to provide adequate airflow, especially clearance at the front and rear panels, to ensure proper airflow and/or cooling to the analyzer will result in overheating of the analyzer causing a shutdown and potential damage. There should be 6" (15 cm) of clearance in the front and back of the analyzer.

⚠ CAUTION

To determine if the ventilation is adequate in an enclosure, monitor the temperature of the air near the instrument and adjust ventilation so that the ambient temperature is within specification. As a guide, the ambient temperature of the air around the instrument cannot exceed the specifications listed below.

Thermal Specifications	Min	Max	Description
Ambient Operating Temperature	10 °C	35 °C	Worst-case environmental limits (unless otherwise specified)

4.3 Analyzer Preparation

4.3.1 Ventilation Considerations

The instrument and pump require adequate ventilation in order to function properly. Do not plug or block any perforations in the chassis of the instrument. Don't place anything near the instrument that will impede the air flow.

4.3.2 Positioning

NOTE

The unit is shipped with rubber feet installed for benchtop use. Alternatively, it can be mounted in an equipment rack using the drawer-style rails included in the shipping crate. If the rails are used, the rubber feet must be removed so the unit can fit in a standard 5U rack opening. For instructions, see 4.5 Rack Mount Instructions

1. Remove the analyzer and the external vacuum pump from the shipping container.

2. Install the analyzer in a rack or place it on a cart or table.
3. Place the external vacuum pump near the analyzer in a rack, or on a cart or table.

⚠ CAUTION

If you rack-mount the analyzer, be sure to support it with a shelf or the provided rails; the analyzer cannot support itself on the front rack mounting brackets alone.

4. Unpack the analyzer accessories (vacuum line, cable kit, manual, and certificate of compliance).

NOTE

Store the certificate of compliance in a safe place. It may be required if you contact Picarro for service or questions.

5. Remove the caps from the analyzer Sample inlet and Vacuum connection ports.
6. Remove the caps from the pump vacuum inlet. Save the caps for reuse in case the analyzer and pump is stored, moved, or shipped.

4.3.3 Set A2000 Pump Input Voltage

1. If using an A2000 vacuum pump, set its input voltage to the correct level for your area by rotating the voltage selector switch located on the side of the pump next to the fuse holder.

1 Input Voltage Selector

Figure 7 - Vacuum Pump Voltage Selection

4.4 A2000 Pump and Gas Inlet Connections

Follow instructions in this section when using an A2000 pump with your analyzer.

4.4.1 Pump Connections

Refer to the following figure when using an A2000 pump with your analyzer.

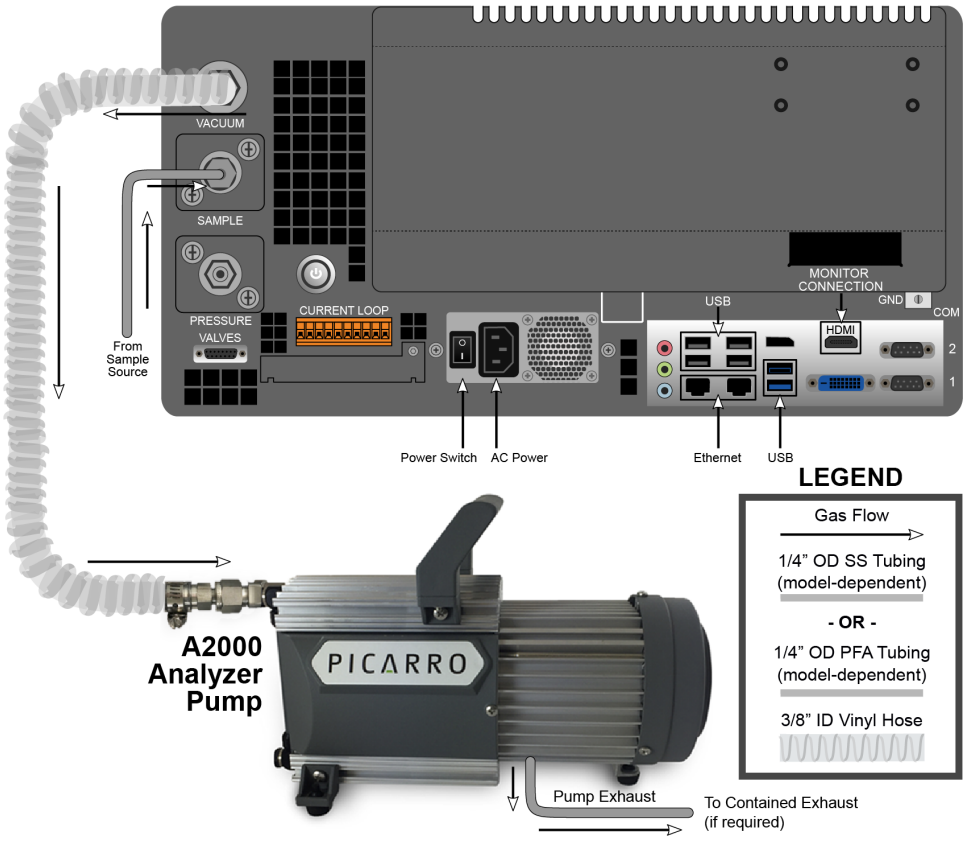


Figure 8 - Analyzer Setup with A2000 Pump

⚠ CAUTION

When working with hazardous gases, remove the pump exhaust muffler and adapt a tube to the vacuum pump exhaust port (shown in the above figure) and direct the exhaust to a safe place for venting the mixture of sample gases. For instructions, see Chapter G, Setting up Contained Exhaust Flow.

1. Connect the provided vacuum line between the analyzer port labeled VACUUM and the pump vacuum inlet.
2. If working with hazardous gases, see Chapter G, Setting up Contained Exhaust Flow for instructions on directing the pump exhaust to a safe venting environment.

4.4.2 Sample Gas Inlet Connections

There are two types of sample Inlet connections which are model-dependent.

- Analyzers that have stainless steel (SST) sample inlet connectors.
- Analyzers that have PFA sample inlet connectors.

4.4.3 Sample Gas Inlet Connection (SST Tubing)

1. Use 1/4” OD SST tubing and connector sets to connect from sample source to the sample inlet.
2. Place the two ferrules inside the nut as shown below.

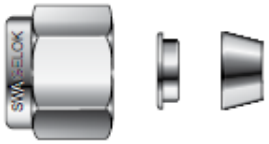


Figure 9 - Orientation of Inlet Nut and Ferrules (SST Tubing)

3. Loosely connect the nut to the INLET on the back panel of the analyzer, being careful not to let the ferrules fall out.
4. Insert the tubing into the back of the nut and through the ferrules, feeding it in as far as possible without deforming the tubing.
5. Hand tighten the nut.
6. Using a 9/16" wrench (not included), tighten the nut 1-1/4 turns.

   When reconnecting SST tubing

7. Inspect the ferrules. If you see any damage, replace the ferrules and follow the directions above for making a new connection.
8. If there is no damage, hand tighten the connector to the analyzer sample inlet.
9. Using a 9/16" wrench, tighten the nut 1/6 of a turn (60°).

4.4.4 Sample Gas Inlet Connection (PFA Tubing)

When making a new PFA gas inlet connection:

1. Use 1/4” OD PFA tubing and connector sets to connect from sample source to the sample inlet.
2. Place the two PFA ferrules inside the PFA nut as shown in the following figure.

Figure 10 - Orientation of Inlet Nut and Ferrules (PFA Tubing)

3. Loosely connect the nut to the INLET on the back panel of the analyzer, being careful not to let the ferrules fall out.

4. Insert the tubing into the back of the nut and through the ferrules, feeding it in as far as possible without deforming the tubing.
5. Hand tighten the nut.
6. Using a 5/8" wrench, tighten the nut 1-1/6 turns (1 full turn plus another 60°).

When reconnecting PFA tubing:

1. Inspect the ferrules. If you see any damage, replace the ferrules and follow the directions above for making a new connection.
2. If there is no damage, hand tighten the connector to the analyzer sample inlet.
3. Using a 5/8" wrench, tighten the nut 1/6 of a turn (60°).

4.5 Rack Mount Instructions

SI and PI series analyzers can be mounted in a standard 5U rack opening using slide rails or rack mount kit using additional shelf to support the weight of the analyzer. Use one the following procedures for the desired mounting configuration.

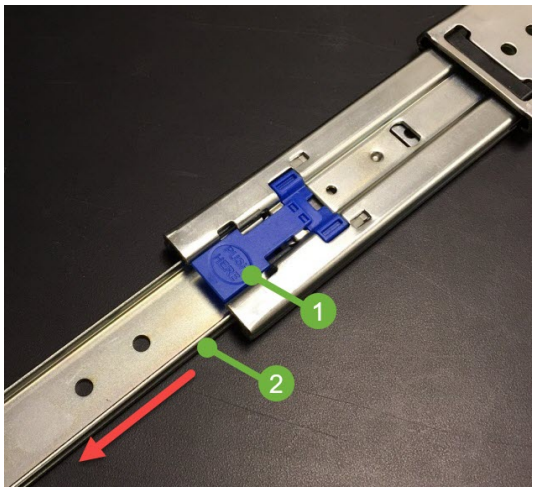
4.5.1 Rack Mount (Slide Rails)

Follow these instructions to mount the analyzer using slide rails.

NOTE

Mounting rails are not used with the SAM series of sampling systems. However, the front panel restraints are required. See section 4.5.2 Rack Mount (Mount Kit) for proper installation.

1. Remove the rack-mounting rails from shipping crate and remove packaging.
2. Extend each rail. Press the blue **PUSH HERE** button and remove the narrow inner slide from the assembly.



1. Press to Release
2. Inner Slide

Figure 11 - Inner Rail Slide Removal

3. Attach the inner slide to side of the analyzer as shown in the following figure using four included M4 x 8 button-head screws.
4. Repeat on the other side of the analyzer.

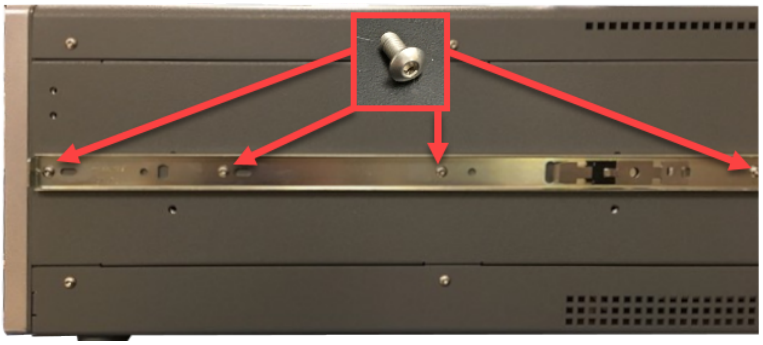


Figure 12 - Attaching Inner Slide Rails to Analyzer

5. Attach a front panel restraint (locking bracket) to each side of the analyzer using two included M4 x 8 button-head screws.

1 Front Panel Restraint

Figure 13 - Front Panel Restraint Installed

6. Mount the outer rails to the rack using supplied hardware at each end, or according to rack design.

Figure 14 - Outer Rail Mounted to Rack

NOTE

Equipment racks vary, and some customization may be necessary.

7. Remove the rubber feet from the analyzer using a Phillips screwdriver. This may be necessary to prevent clearance issues with adjacent instruments within the rack.

WARNING

Two-person lift required. This analyzer weighs 71 lbs (32.2 kg) When lifting the analyzer, use the technique described in the Safety section of this document (or follow your local regulations) .

8. Use two people to lift the analyzer, engage the inner rails on analyzer with outer rails in rack, and slide analyzer into place. Then secure the front panel restraints (Figure 13) to the rack frame.

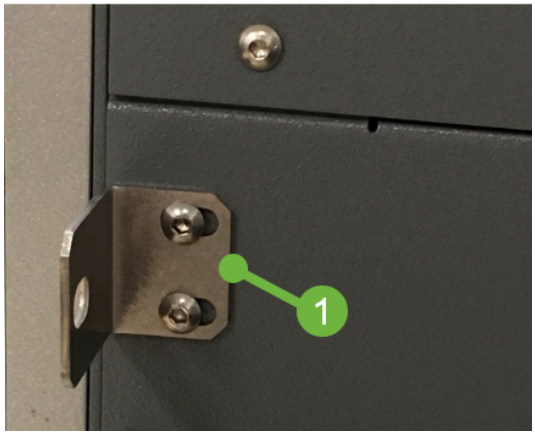
4.5.2 Rack Mount (Mount Kit)

Follow these instructions to mount the analyzer using the mount kit.

WARNING

If mounting in a 19” rack, this analyzer cannot support itself using a front rack mount kit alone. It must be supported by a shelf, or by user-provided “L” type support brackets.

1. Using the mount kit, attach a front panel restraint (locking bracket) to each side of the analyzer using two included M4 x 8 button-head screws.



1 Front Panel Restraint

Figure 15 - Front Panel Restraint Installed

2. Install the additional user supplied shelf or "L" brackets to support the weight of the analyzer as recommended.
3. Use two people to lift the analyzer into place. Then secure the front panel restraints (Figure 13) to the rack frame

NOTE

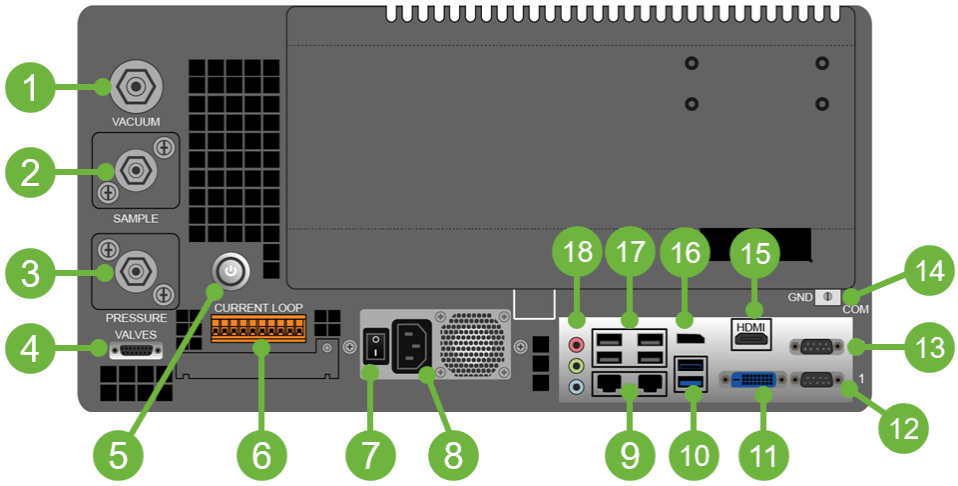
If needed, perform any additional steps to secure the analyzer per the user supplied support guidelines.

4.6 Electrical Connections

Refer to the following figure for connection points.

NOTE

This section is designated as Electrical Safety Task Type 2: Equipment is energized. Energized circuits are covered or insulated.



1. External Vacuum Port to Vacuum Pump
2. Gas Sample Inlet
3. Analyzer pressurized air inlet connection
4. Solenoid valve cable connection
5. On/Standby switch with indicator LED
6. 4-20 mA Output screw terminal block
7. Rocker power switch
8. AC Line power receptacle
9. Ethernet Ports – RJ-45 (2 ea.)
10. USB-2 Ports
11. DVI-D Video Monitor Port
12. Serial port for command interface (COM1)
13. Serial port for streaming data (COM2)
14. Ground binding post
15. HDMI Port
16. Display Port
17. USB Ports (4 ea.)
18. Audio In/Out Ports

Figure 16 - Rear Panel Diagram

1. Connect a monitor to the HDMI port at the back panel. The analyzer will detect the connection and adjust the resolution to match the monitor.
2. Connect a mouse and keyboard to a pair of USB ports.
3. Connect the provided AC power cable from the analyzer to the power source.

NOTE

The analyzer has a universal power supply that automatically adjusts to power sources ranging from 100-240 VAC, 50/60 Hz, 10 A max.

NOTE

The A2000 pump does not automatically adjust to power sources. If using the A2000 vacuum pump, ensure its input voltage is set to the correct level for your area by rotating the voltage selector switch located on the side of the pump next to the fuse holder (see Figure 6).

4. Check that the A2000 pump voltage input switch is set correctly.
5. Connect the provided AC power cable from the vacuum pump to the power source.
6. If used, connect the valve cable from the analyzer back panel to any solenoid valves.
7. If used, connect rotary valve (A0311 or A0311-S) to COM2 with its provided serial cable.

4.7 Chiller Laser Cooling

A chiller with a 50 mL water buffer tank is installed for reliable and efficient laser cooling. Please note the following:

- The coolant in the buffer tank is partially filled when shipped. Follow the instructions below before you begin measurements.
- Instrument must be powered off for water tube reconnection and water fill, refill, or drain.
- Check and confirm the flowing movement of coolant every six months or whenever a disconnection and reconnection of the buffer tank occurs.
- Inspect the water level in the reservoir every six months; add or refresh coolant in case of water loss or contamination.
- A bottle of coolant (manufacturer: Koolance, part number: LIQ-702CL-B) is shipped with the analyzer.
- Do not use water as coolant. Contact Koolance (https://koolance.com) for replacement bottles. Koolance has re-sellers in Asia, Australia, Europe, Canada, and the United States.
- The safety data sheet for LIQ-702CL-B is included in Chapter J, SDS for Koolance LIQ-702.

4.7.1 Chiller Setup

1. Inspect the water buffer tank for possible cracks, and external water tube breakage.

⚠ WARNING

If damage is observed, stop, and contact Picarro support to get the damage repaired before adding coolant.

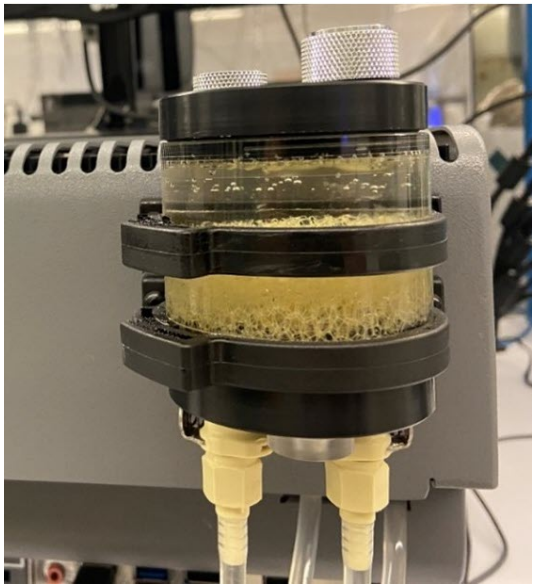


Figure 17 - Reservoir Connections at Time of Shipment

2. Rotate the black top lid counter-clockwise to open the tank as shown in the following figure.

Figure 18 - Reservoir Inspection

3. Fill the reservoir so that the coolant covers the sponge and reaches the last thread for the top lid.

Figure 19 - Reservoir Coolant Level

4. Disconnect the quick connect fitting by pushing down on the metal tab of one fitting and pull the fittings apart. Attach each fitting to the bottom of the reservoir as shown in the following figure.

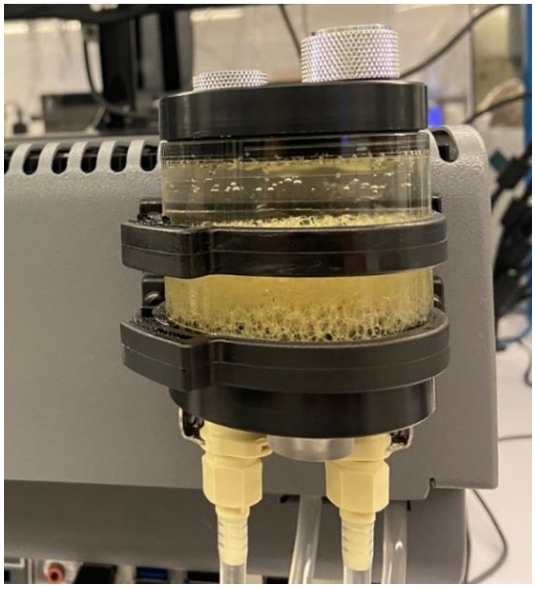


Figure 20 - Reservoir Connected and Ready to Run

5. Power on the analyzer per Startup procedure, see 5.1 Startup and check the coolant level while flowing. If the level drops below the level of the sponge in the reservoir, add coolant to full level directly from either one of two top venting ports.
6. To inspect the coolant flow, open the tank as shown and use a hex drive or a long pin to pinch the sponge, and reveal the two openings on the bottom of the reservoir. Make sure bubbles are forming.

Figure 21 - Confirmation of Coolant Flow

7. Replace the lid and tighten it clockwise.

WARNING

To turn off the analyzer, follow Shutdown, Section 5.2 Shutdown . Never remove the vacuum while the system is running. Doing so can damage the instrument which is not covered under warranty.

4.7.2 Chiller Maintenance

With TEC chiller, one buffer tank containing circulation coolant fluid is used for effective laser heat dispersion. The general industrial heat transfer medium, Koolance LIQ-702 is used, see Chapter J, SDS for Koolance LIQ-702.

The coolant should be maintained in proper level with refilling, or replacement if it is contaminated.

NOTE

Coolant level should be checked monthly on its level which is due to evaporation or other loss. If the level is no more than half of full tank and the liquid is clear, adding coolant is needed.

Adding Coolant

Open the top two sealing ports, add only proper coolant to its maximal level of coolant buffer tank. This can be done when the analyzer is in operation.

NOTE

Coolant clarity should be checked annually. The turbid coolant liquid indicates contamination. If the liquid is not transparent and the sponge in dark yellow, coolant replacement is needed.

Coolant Replacement

Approximately 50 mL of fresh coolant is needed. Use the following procedure to replace the coolant within the chiller.

1. Turn off the analyzer.
2. Disconnect the two quick connectors from the bottom of the buffer tank.
3. Remove the tank from its holder, open the top lid, dump all coolant, wash the sponge.

4. Install tank back to its folder, put sponge back, seal top lid
5. Open the two top sealing ports, add coolant to full level.
6. Connect the two quick connectors fully back to position. Make sure there are no kinks along the tubes.

NOTE

The reference coolant flow rate is typically as 0.25 lpm (liter per minute). A minimal flow rate of 0.15 lpm or above is required for laser cooling.

5 Analyzer Basic Operation

This section explains how to operate the analyzer using the GUI. It describes system startup, shutdown, and recovery procedures, desktop features. GUI Functions are detailed in section Chapter 6, GUI Functions.

⚠ WARNING

Using this analyzer in a manner not specified by Picarro may result in damage to the analyzer and render it unsafe to operate.

⚠ CAUTION

During operation, do not position the analyzer so that it is difficult to operate the electrical disconnecting device (such as an emergency off (EMO) switch or breaker).

NOTE

The illustrations shown in this chapter are for example only. What is shown on your instrument is dependent on the model analyzer in use and may differ.

5.1 Startup

1. Make sure the pump vacuum hose is connected between the analyzer and pump.

   ⚠ CAUTION

   Always turn on the external pump before powering up the analyzer. This ensures a safe start-up sequence.

2. Verify the power cable to vacuum pump is plugged in.
3. Switch power on at the pump.
4. Verify the power cable to the analyzer is fully inserted into the power receptacle.
5. At the analyzer back panel, press the main power switch to the ON (**I**) position.
6. If needed, press the round **Soft Power** button on the rear panel. The LED indicator illuminates green. See Figure 1, SI2112 Front and Back Panel.

The **Picarro Launch Pad** user interface displays and the **CRDS Data Viewer** (Figure 22) automatically starts within 30 seconds. For more information about the CRDS Data Viewer features, see Chapter 6, GUI Functions.

The analyzer will not begin producing data until the cavity temperature and pressure have reached their operational set points. A message will display in the Status Log window (Figure 22, bottom panel) when each set point is reached. An explanation of the most common status log messages can be found in 6.11 Measurement Status Log.

Data is saved automatically whenever the analyzer produces data. The data displayed on the CRDS is the continuous real time read-out from the analyzer. A user-relevant subset of this data is stored in:

/home/picarro/I2000/Log/DataLogger/DataLog_User/YYYY/MM/DD

where **Y** = **year**, **M** = **month**, **D** = **day**. For more information see, Chapter 1, File Management.

In order to measure discrete samples (such as individual gas bags) or from multiple locations (when switching valves draw in ambient air from different heights) a separate software window (coordinator) is used to control the sample source and match the corresponding real time read out with the sample source. Depending on system configuration, coordinator programs may not be included.

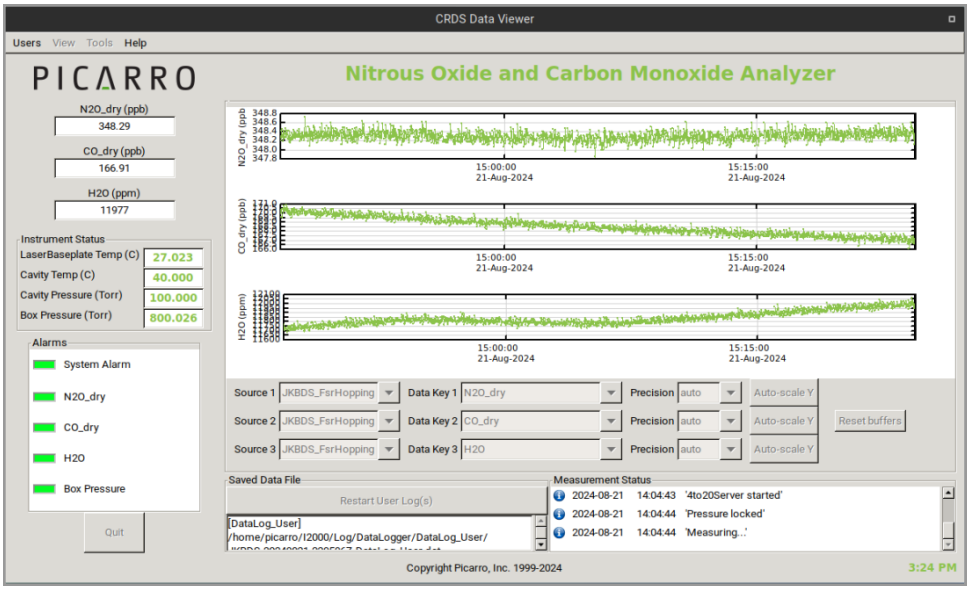


Figure 22 - CRDS Data Viewer Screen

5.2 Shutdown

This section describes how to safely shutdown the analyzer using dry gas, closing the CRDS application, and powering off the instrument from the Picarro Launch Pad.

⚠ CAUTION

A flow of clean, dry gas should always be directed to the instrument for several minutes prior to shutting 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.

⚠ CAUTION

Do not turn off the pump or disconnect the vacuum line while the instrument is operating.

1. With the pump still running, switch to a source of clean, dry gas at the sample inlet and allow it to run until the water channel reading on the GUI falls below 2000 ppm. This will prevent any damage from condensation to the cavity surfaces. This dry gas may be from a tank (target 2-3 PSIG pressure) or from a desiccant column like the DrieRite column, C0360, sold on store.picarro.com).
2. From the **CRDS Data Viewer** select the **Quit** button located in the lower left corner of the window.
3. A message displays prompting the user to confirm the shutdown. Once confirmed, the CRDS Data Viewer turns off.

NOTE

Note you must be logged in to shut down the analyzer.

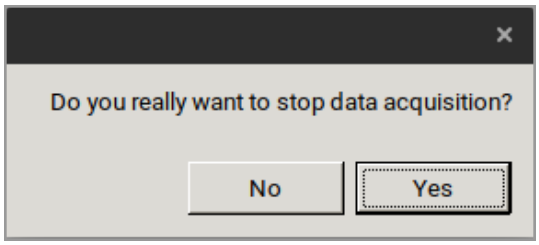


Figure 23 - Stop Data Acquisition Confirmation

4. From the **Picarro Launch Pad** select **Power Off** to tun off the hardware.
5. Manually turn off the pumps and dry gas only if system requires it.

NOTE

Leave any dry gas or desiccant attached to the inlet during this process.

6. When the instrument fans audibly turn off, and when the green power button light on the front of the instrument turns off, shut off the pump manually from the rocker switch located on the pump.

5.3 Analyzer Restart after 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 are common in the user location, Picarro recommends using an uninterrupted power supply (UPS) to protect the data stream and the health of the cavity.

5.4 Picarro Launch Pad

The Picarro Launch Pad is the entry point for starting and using the analyzer. It provides access to the CRDS Data Viewer, tools, settings, and administrative controls for the instrument such as managing user accounts. This section provides an overview of the Picarro Launch Pad's key features with additional information throughout this manual.

NOTE

Picarro Launch Pad features vary depending on user account types. Each section describes the account type that is required for each of the main menu options.

5.4.1 Home Menu

Account Type: All Users

The Picarro Launch Pad automatically starts in Guest account mode and displays the home menu upon startup of the analyzer. Note several options are not accessible until you login with a user account. The Home menu options are provided, as shown in the following figure.

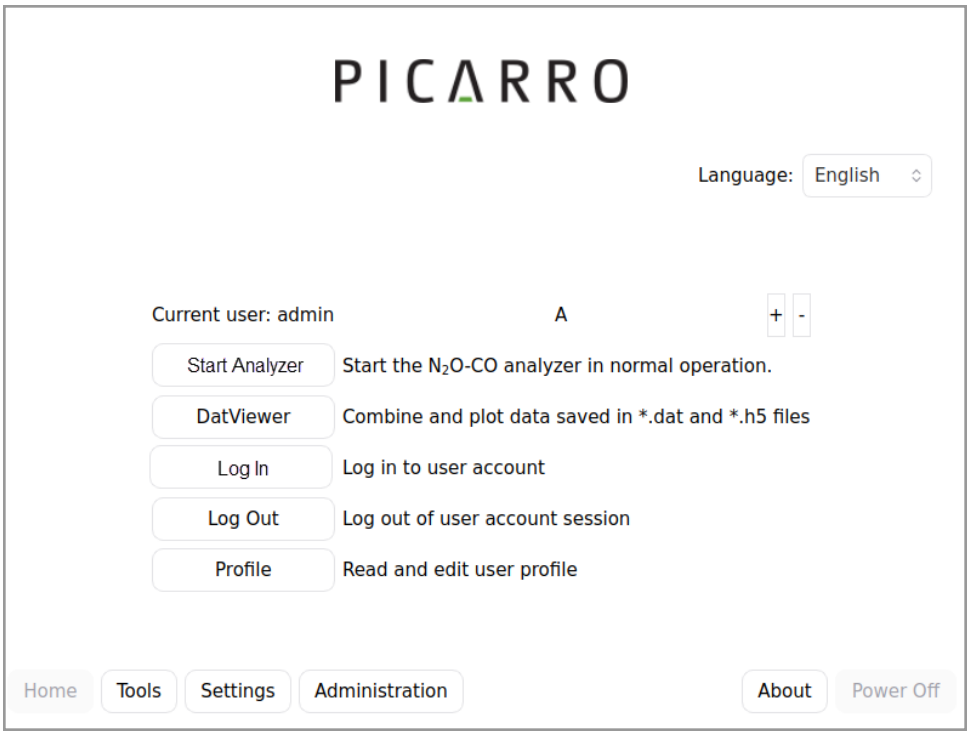


Figure 24 - Picarro Launch Pad/Home Menu

- **Start Analyzer** — Starts the analyzer and launches the CRDS Data Viewer.
- **DatViewer** — When clicked, a window opens that allows you to convert between *.dat and H5 data files and to make various graphical representations of your data over time periods longer than what is available in the software buffer. The instructions on using the Data File Viewer software are described in Chapter F, Data File Viewer. Note requires login to the Picarro Launch Pad.
- **Log In** — Provides access to the Picarro Launch pad and tools associated with a specified user account.

NOTE

Note options vary with different types of user accounts.

- **Log Out** — Concludes the user account session.
- **Profile** — Provides access to the User Management Tool to allow regular users to change their own password and administrators to manage user accounts.

NOTE

Requires a password to obtain entry. For more information, see 7.5 Viewing My Profile and 7 User Management.

5.4.2 Tools Menu

Account Type: Operators, Technicians, and Administrators

The Tools menu provides additional utilities for the instrument and include the following options as shown.

Figure 25 - Picarro Launch Pad/Tools Menu

- **CRDS Controller** — Displays the Cavity Ring-Down Spectrometer Controller to view technical information about the analyzer operation.
- **Ringdown Viewer** — Provides visual ring-downs for evaluation of CRDS operations.
- **Copy Files** — Allows data to be copied to an external device. Requires technician or administrator permissions.
- **Support Export** — Opens the CRDS Diagnostic Data Collector tool to curate support data for troubleshooting.

File Manager (Copy Files)

The File Manager is accessible from the Picarro Launch Pad from the Tools menu or directly from the CRDS Data Viewer Tools menu using the Files button. Follow the procedure to copy data to an external drive.

1. On the home page, click on **Files**.
2. From the Picarro Launch Pad, click on the **Tools** menu and **Copy Files** button.
3. Login using user credentials.
4. Plug in an external USB drive.

5. In the bottom right-hand corner, select **mount** and choose the desired drive. After selecting, files will be populated on the right side with from the USB drive
6. Using the upper left-hand corner drop down menu, select the type of file: **Data**, **Screenshot**, **User History**, **Validation Report**.
7. Highlight and select the desired files.
8. Click **Copy** to copy or move to transfer file to USB drive.
9. Unmount the USB drive when file transfer/copy is complete.

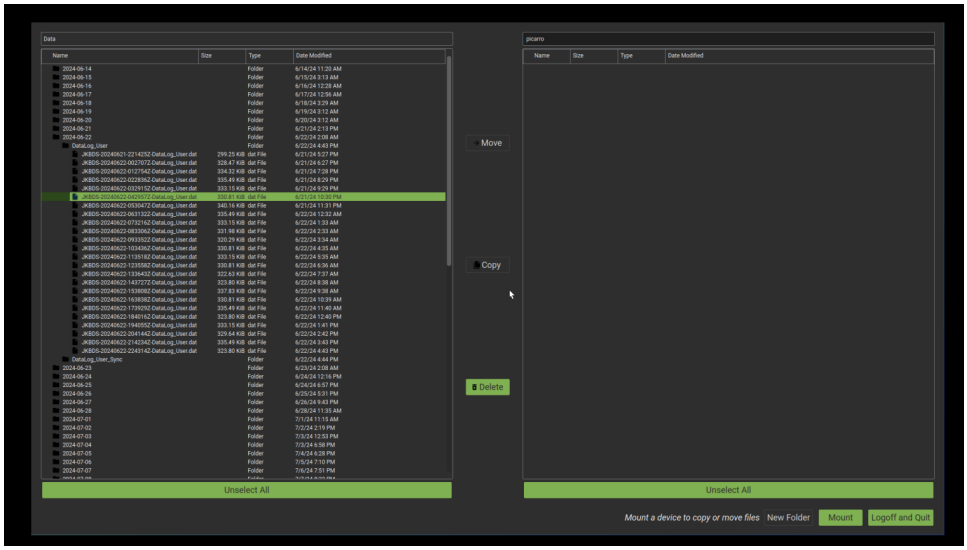


Figure 26 - Transfer Files Dialog

5.4.3 Settings Menu (Setup Tools)

Account Type: Technicians and Administrators

The Settings menu provides various configuration options for the analyzer and is described in detail in Chapter A, Setup Tools and Communication.

5.4.4 Administration Menu

Account Type: Administrators

The Administration menu provides the following options.

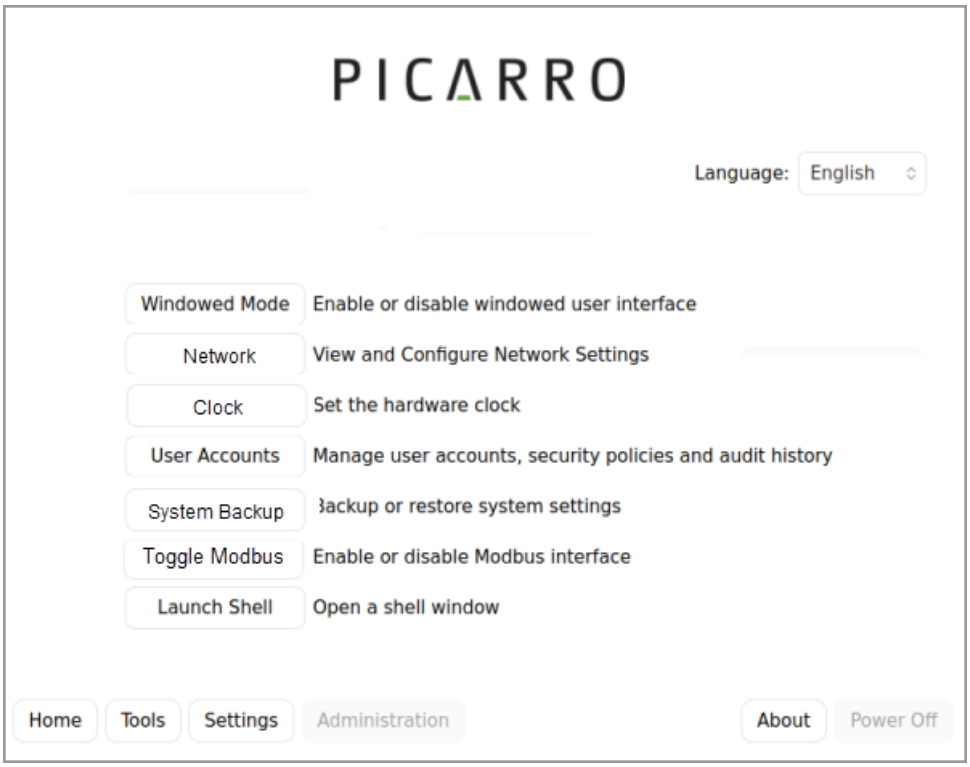


Figure 27 - Picarro Launch Pad/Administration Menu

- **Windowed Mode** — Displays the Picarro Launch Pad and utilities as windows within the user interface.
- **Network** — Provides configuration of network settings.
- **Clock** — Sets the time of the hardware clock.
- **User Accounts** — Provides access to the User Management Tool for managing user accounts, security settings and user history. Requires a password to obtain entry. For more information, see Chapter 7, User Management.
- **System Backup** — A mechanism for backing up or restoring system settings.
- **Toggle Modbus** — Allows enabling and disabling of the Modbus interface for configuration of the communication protocol.
- **Launch Shell** — Opens a command line interface.

5.4.5 Language Selector

The Language selector allows you to change the language of the user interface. This includes the Picarro Launch Pad and CRDS data Viewer. Use the following procedure to set the desired language.

1. From the Picarro Launch Pad select **English** or **Chinese .**

1 Language selector

Figure 28 - Language Selector

2. Click **OK** to confirm the language change.

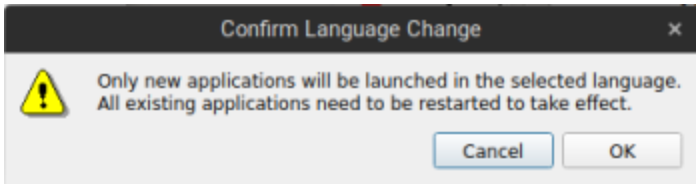


Figure 29 - Language Change Confirmation

NOTE

The selected language will display immediately for any new applications that are started. Restart any currently running applications for the change to take effect.

5.4.6 Zoom Level

Use the **+-** buttons to zoom the menu in or out.

1 Zoom In/Out buttons

Figure 30 - Picarro Launch Pad - Zoom Level

6 GUI Functions

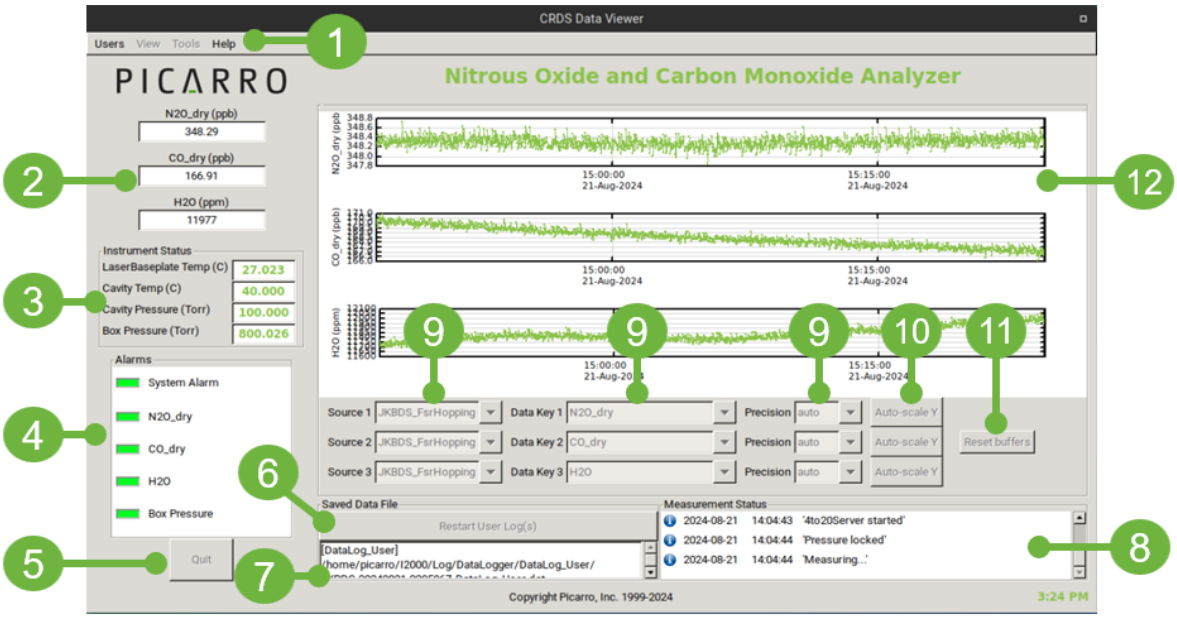
This chapter describes the GUI features of the CRDS Data Viewer.

NOTE

The illustrations shown in this chapter are for example only. What is shown on your instrument is dependent on the model analyzer in use and may differ.

6.1 GUI Overview

The features of the GUI as shown below are described in the following sections.



1. Users, View, Tools, and Help menus
2. Digital Readouts and Statistics
3. Instrument Status
4. Alarm Panel
5. Quit Button
6. Restart User Logs button
7. Data Log; Filename, and Path
8. Status Log Window
9. Data Source, Data Key, and Precision menus for data window content
10. Axis Auto Scaling
11. Reset Data Buffer
12. Data Windows

Figure 31 - CRDS Data Viewer GUI

6.2 Users, View, Tools, and Help Menus

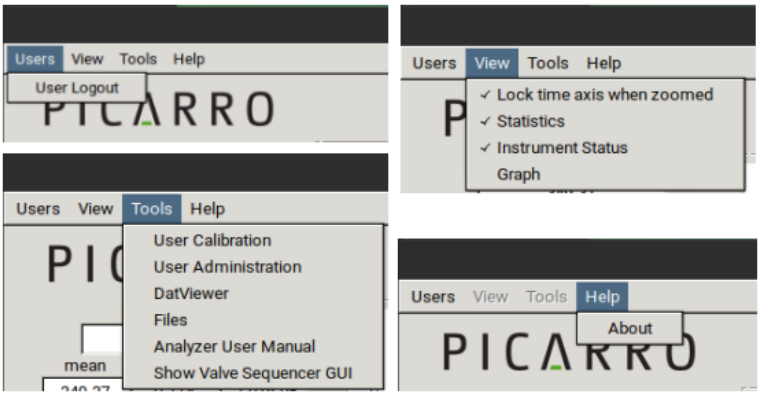


Figure 32 - CRDS Toolbar Options

6.2.1 User Menu

- **User Login** – Provides access to the CRDS Data Viewer. If you do not have an account one can be created by an administrator.
- **User Logout** – Disables access to the CRDS Data Viewer functions.

6.2.2 View Menu

The View menu provides the following options that can be enabled. Note that when toggled on, a check mark displays to indicate the enabled feature.

- **Lock/Unlock time access when zoomed** — When locked, forces the data windows to display the same time scale during zoom.
- **Statistics** — Toggles the measurement statistics display, see the 6.4 Digital Readouts.
- **Instrument Status** — Toggles the instruments status display. See the 6.5 Instrument Status.

- **Graph** — Set the desired number of line graphs to be visible on the CRDS Data Viewer.

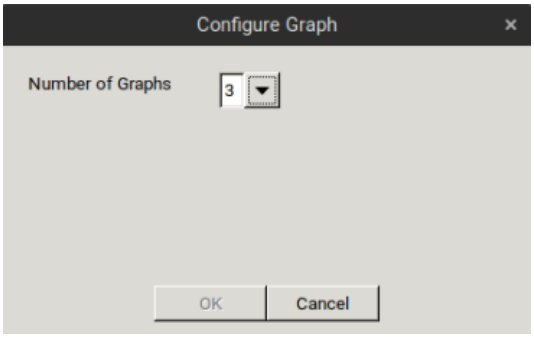


Figure 33 - Configure Graph Window

NOTE

The data buffer resets when the number of graphs are changed.

6.2.3 Tools Menu

Use the Tools drop-down menu to plot data, copy data, perform user admin tasks, calibrate the instrument, or show/hide the valve sequencer GUI. The Tools menu features are as follows:

- **User Calibration** — Opens the password protected user calibration window (default password is picarro).
- **User Administration** — Provides access to User Management options for managing user accounts, policies, viewing histories and profiles.
- **DatViewer** — Allows plotting of data saved in *.dat and *.h5 files.
- **Files** — Copies data to an external drive using the File Manager.
- **Analyzer User Manual** — Opens the user manual in PDF format.
- **Show Valve Sequencer GUI** — Toggle to display the external valve sequencer window (use alt-tab to bring it to the front).

6.2.4 Help Menu

- **About** — Displays the software release version of the instrument.

6.3 Alarms Panel

This panel is used to monitor the status of the internal instrument alarms. These indicators are gas concentration alarms, such as “N2O Too High/Low” depending on instrument configuration. The gas concentration alarm icons are off (grayed) when the respective concentrations are below a certain value, and they are illuminated red when the respective concentrations are above/below a certain value.

⚠ CAUTION

High/low alarm settings are not intended as a safety measure as configured at the factory, either with respect to human health or the health of the analyzer. It is up to the customer to determine the meaning and level of a "high" or "low" value based on their application.

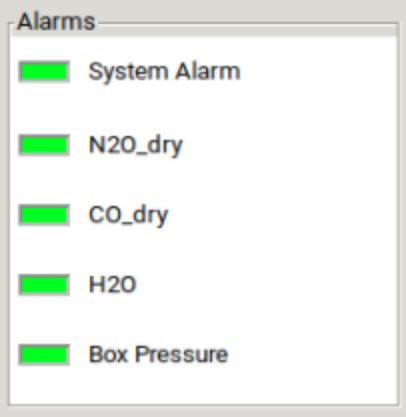


Figure 34 - Alarm Panel

Alarm Panel Indicators are colored as follows:

System Alarm:

- Green when the analyzer is measuring properly
- Flashing yellow when the analyzer is warming up
- Yellow when not warming up properly
- Red when not operating properly

Measurement Range Alarm:

- Green when concentration is within analyzer measurement range
- Red when above analyzer measurement range

Custom Range Alarm:

- Green when within boundaries set by the user
- Red when not within boundaries set by the user
- Grey when alarm is disabled by the user (these are disabled by default)

To view the alarm set point, click on the **Alarm Icon** and a dialog box displays indicating the alarm setting and allows the user to enable it or change the setpoint.

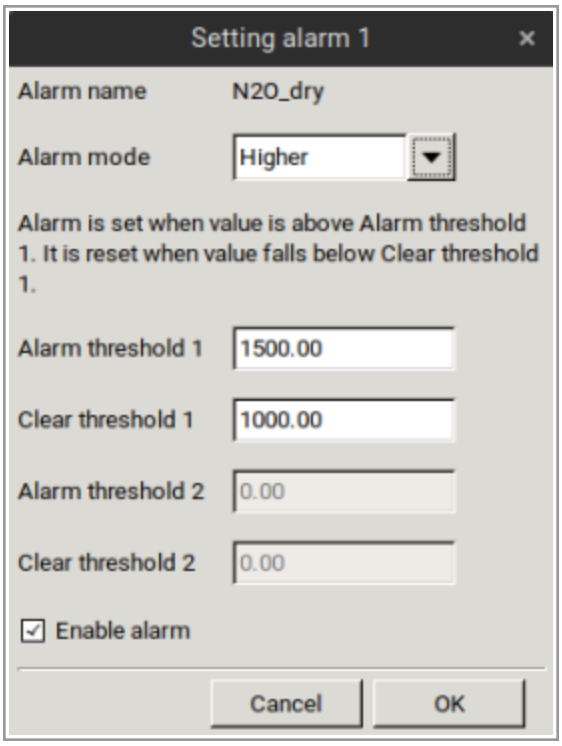


Figure 35 - Alarm Set Dialog

This features allows reading or changing the alarm settings and the ability to enable it or change the set point. The indicator illuminates when the concentration goes above the set point and resets (indicator off) below the set point. The alarm modes for gasses are:

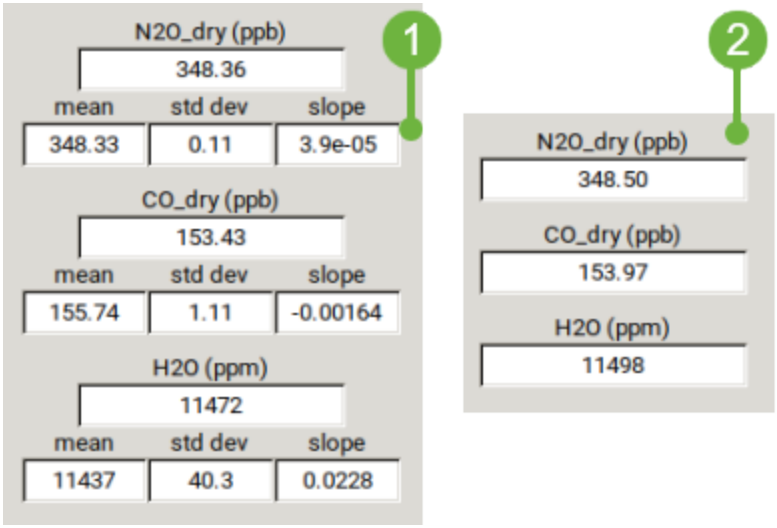
- Higher
- Lower
- Inside
- Outside

Type the value you wish to set the alarm to and click the **OK** button or **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. The units are those that appear in the GUI graph.

6.4 Digital Readouts

Displays the latest value recorded for the selected Data Key for each Data Window. Changing the Data Key changes the Digital Readout as well as the Data Window view.

If the **Statistics** entry is enabled in the **View** menu, 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 statistics of whatever data is in the data window. **Zooming** into a section of existing data will show the statistics statically for that time period, while the digital readout above the statistics continues to update with the latest value. See 6.13 Graph Zooming and Panning for more information.



1 With Show Statistics Enabled

2 With Show Statistics Disabled

Figure 36 - Digital Readouts Panel

6.5 Instrument Status

If these parameters are enabled through the **Instrument Status** entry in the **View** menu on the main toolbar, digital readouts for Warm Box temperature, Cavity Temperature, Cavity Pressure, and Box Pressure are displayed below the digital readouts panel.

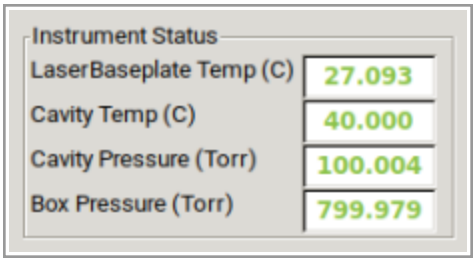


Figure 37 - Instrument Status Panel

6.6 Quit Button

Shuts down the analyzer. See 5.2 Shutdown .

Figure 38 - CRDS Quit Button

6.7 Restart User Log(s) Button

The analyzer automatically records all data collected on the instrument as .dat files. These are described further in section Chapter 1, File Management.

To start a new data file (time-coded to the current second), click the **Restart User Log(s)** button. The new file name should be visible beneath the button in a few seconds.

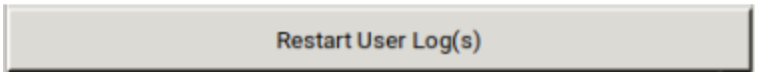


Figure 39 - Restart User Logs Button

6.7.1 Data Log Filename and Path

The filename and path of the active data log is displayed in this pane. The indicator is grayed-out when there is no active data log before gas measurement reporting begins. A new file is generated when the instrument starts reading gas concentrations, (e.g., “153719”) and subsequently at 1 hour increments (e.g., “163719”, “173719”). A new day folder (e.g., “2021\07\16”) will be generated at midnight, as will month and year folders at the appropriate times.

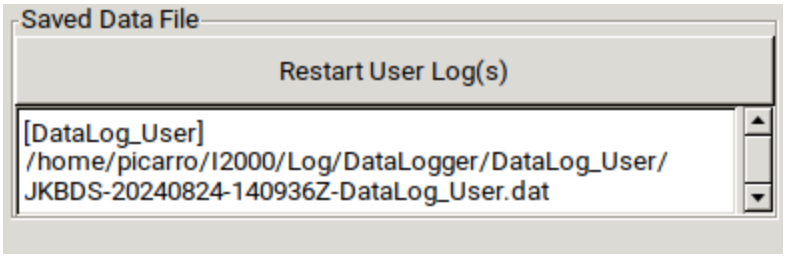
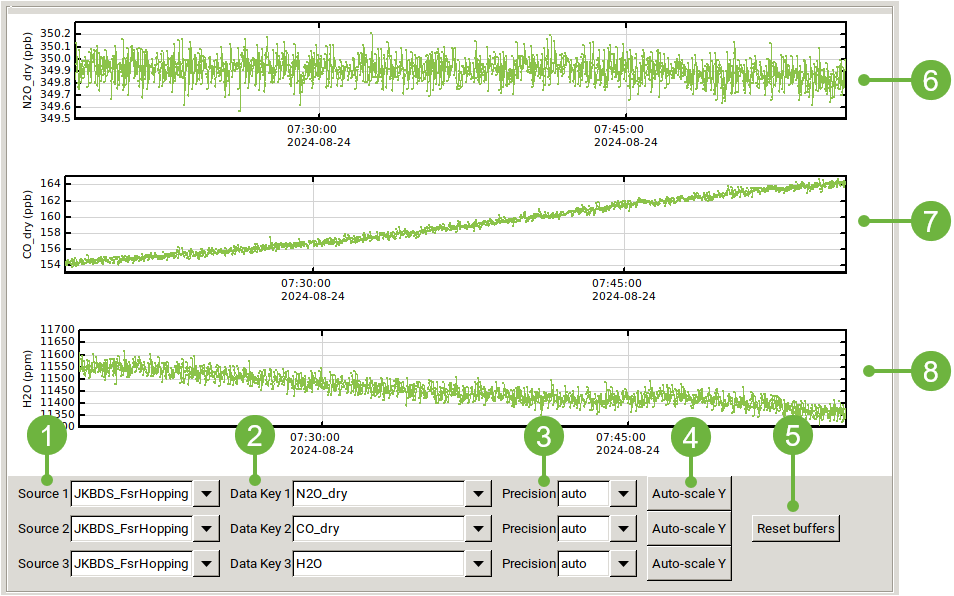


Figure 40 - Data Log Filename and Path Panel

6.8 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 streams are displayed using combinations from the **Data Source** and **Data Key** pull down menus. The precision displayed can be adjusted using the **Precision** menu. Auto-Scaling of the Y-axis is also available. Clicking any **Autoscale** button scales its Y-axis if the plot hasn’t done this automatically.



1 Source Keys
2 Data Keys
3 Precision
4 Auto Scale
5 Reset Buffers
6 Plot for Data Key 1
7 Plot for Data Key 2
8 Plot for Data Key 3

Figure 41 - Data Window Panel

6.9 Data Source and Data Key Pull Down Menus

Data Source and Data Key menus enables selection of the data stream that is viewed in the data window.

- **Gas concentrations** — If **instrument Analysis** (where instrument represents the system installed) is selected.
- **Sensor Readings** — If **Sensor** is selected, the analyzer's optical cavity pressure or temperature can be viewed, as well as the temperature of the electronics of the analyzer ("DASTemp", not directly controlled), and the temperature of the analyzer's wavelength monitor, indicated as "WarmBoxTemp."

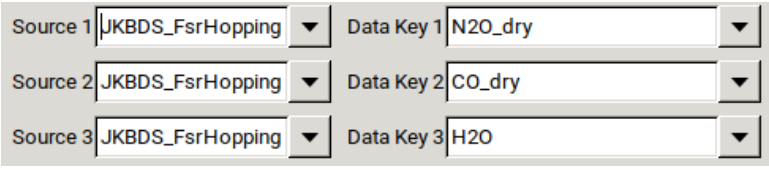


Figure 42 - Data Source and Data Key Pull Down Menus

6.10 Precision Pulldown Menu

Click on the pull-down 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. Auto precision is sufficient for nearly all applications.

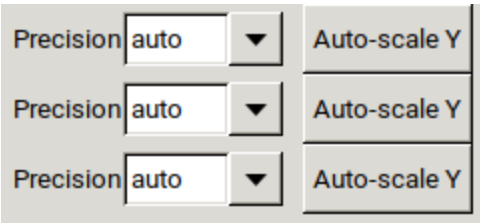


Figure 43 - Precision Pull-down Pane

6.11 Measurement Status Log

This window displays instrument status messages, in the following form: **YYYY-MM-DD HH:mm:ss**, then **Generic message text**.

6.11.1 Common Status Log Messages

Following are the most common messages that appear:

- **Pressure Stabilizing/Locked** — Displayed when the valve control system begins to allow flow through the analyzer and stabilizes the pressure inside the cavity.
- **Temperature Locked** — WB: When the temperatures of the warmbox have stabilized. This is typically the longest step in the startup sequence. **Startup**: Depending on ambient temperature, the analyzer and its hotbox temperature set point, this step may take as little as 20, or as much as 60 minutes. **Restart**: If the instrument is only stopped briefly, this may take a few seconds to a few minutes.
- **Preparing to Measure** — 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 shut down.
- **Measuring** — This is the normal mode of operation after startup has completed.

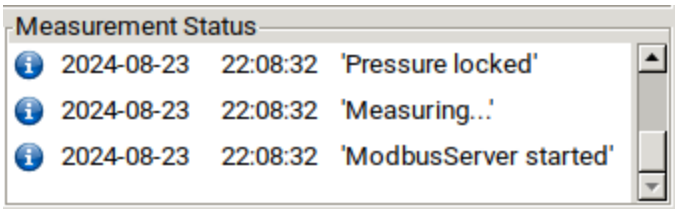


Figure 44 - Measurement Status Log

6.12 Reset Buffers Button

Click the **Reset Buffers** button to clear the internal data buffer of the GUI (this clears the current data traces from the graphs). 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.

6.13 Graph Zooming and Panning

6.13.1 Zooming In/Out

To **zoom in** on a specific region of the graph, move the cursor to the area of interest, **click/hold** the left mouse button, then drag as desired to create a box that covers the region of interest. When the box is drawn, release the **left** button and the boxed area will automatically scale to fill the data window.

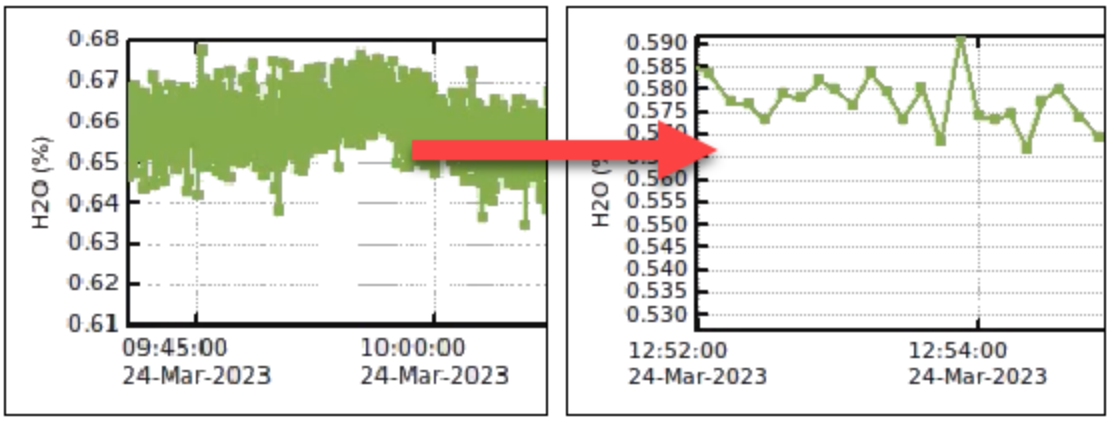
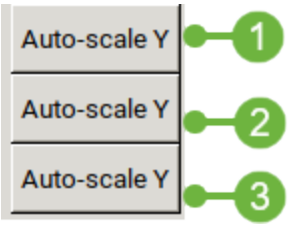


Figure 45 - Data Graph Zoom Function

To **zoom out** to see all data in the buffer, **double-click** the **left** button within the graph display. To **zoom out indefinitely**, **right click**. Right clicking multiple times zooms out further. To **auto scale** the y-axis of either graph, use the **Auto-Scale** buttons as shown in the following figure.

To **Zoom the X and Y** axes: hold down the **control** button and move the **cursor up/down** or **left/right** using the **right mouse** button



1 Top Plot

2 Middle Plot

3 Bottom Plot

Figure 46 - Auto-scale Buttons

6.13.2 Lock/Unlock Time Axis

Zoom and pan features are often useful when time axes are locked, and the user wishes to align the Y axis in multiple plots. To lock or unlock the time axis of each graph during zooming, from the **View** menu, select **Lock time axis when zoomed** or **Unlock time axis**.

6.13.3 Panning

To **pan the data in the X or Y axis**: hold down the **control** button and drag the cursor using the **left** mouse button.

7 User Management

7.1 Overview

User management includes:

- Managing user accounts, such as adding users and changing passwords.
- Setting user policies, such as password requirements and session duration.
- Viewing and saving user histories.

There are three user roles defined in the system: operator, technician, and administrator. The permissions are as follows:

Table 4 - User Accounts and Functions

Function	Not Signed In	Operator	Technician	Administrator	System Manager*
View Data Viewer	●	●	●	●	●
Set Alarms		●	●	●	●
Configure Data Viewer (partial)		●	●	●	●
Quit Measuring		●	●	●	●
Quit (software shutdown)		●	●	●	●
Configure Data Viewer (full access)			●	●	●
User Management			●	●	●
Software Management (installation/uninstallation)					●
**Contact Picarro support at support@picarro.com to obtain System Manager user access.*					

User management settings are available from the **Tools** menu in the Data Viewer or by using the **Picarro Launch Pad**. Use one of the following procedures.

From the Data Viewer:

1. From the **Users** menu, select **User Login**.
2. Login as an administrator (default user name is **admin**; default password is **admin**).
3. From the **Tools** menu, select **User Administration** to view the User Management a shown in Figure 47.

From Picarro Launch Pad:

1. Login to the **Picarro Launch Pad** as an administrator (default user name is **admin**; default password is **admin**).
2. Select **Administration** and **User Accounts**.
3. From the **User Management Tool** login as an administrator (default user name is **admin**; default password is **admin**).
4. The User Management window displays and has four tabbed states: **User Accounts**, **User Policies**, **User History** and **My Profile**.

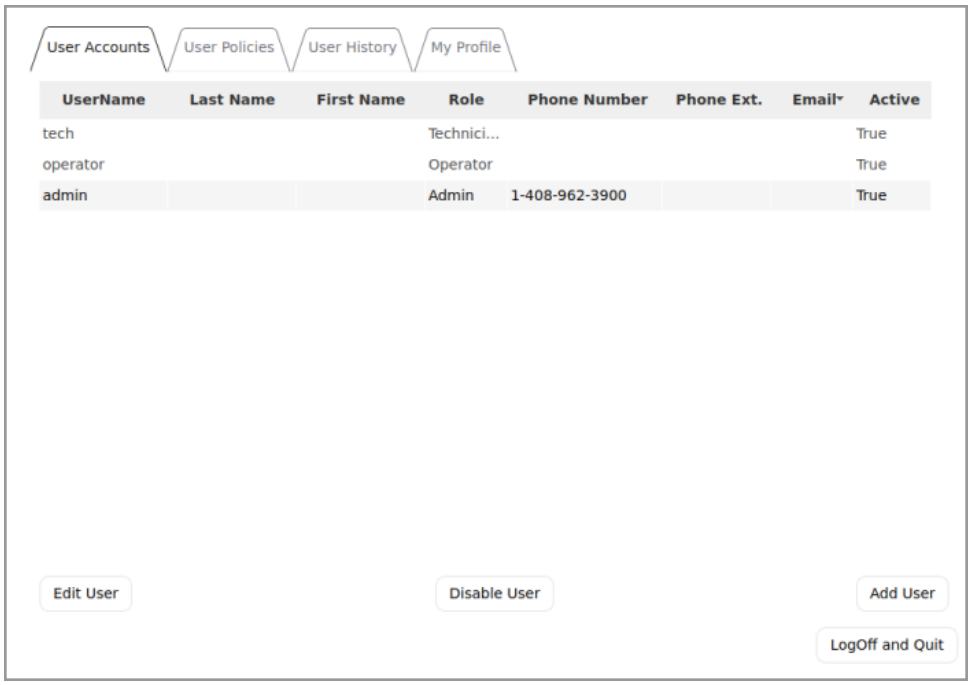


Figure 47 - User Management Window

7.2 Managing User Accounts

The following features are available from the User Accounts tab and are further described in this section:

- Add new users
- Disable users
- Change user passwords
- Change user roles

NOTE

The default user names that are provided with the analyzer are tech, operator, and admin. The default passwords are tech, operator, and admin, respectively. User names and passwords are both case sensitive.

7.2.1 Changing a User Password

1. In the **User Management** window, click the **User Accounts** tab.
2. From the list of users, click the user you want to change and select the **Edit User** button. The user account information displays.

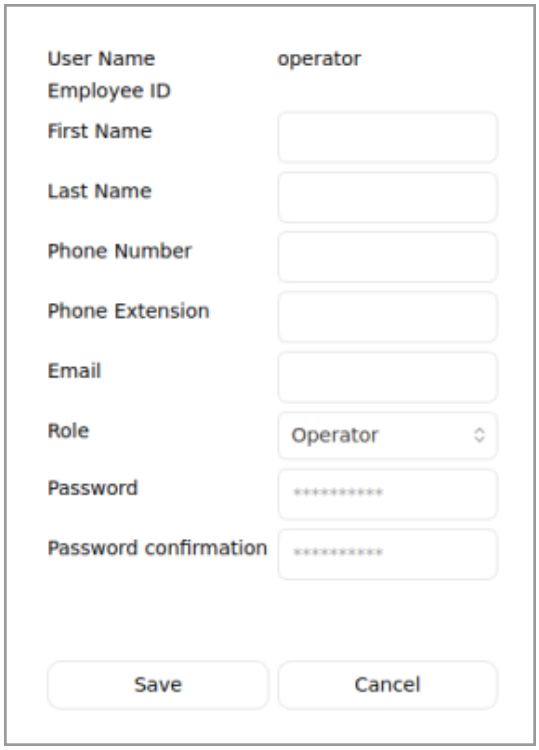


Figure 48 - Change Password

3. In the **Password** field, enter the new password.

NOTE

Passwords are case sensitive. Additional rules for passwords can be set in the User Policies tab. For more information, see 7.3 Setting User Policies

4. In the **Password Confirmation** field, re-enter the password.
5. Click **Save** to save the password

NOTE

To change your own password for your account, see 7.5 Viewing My Profile.

7.2.2 Changing a User's Role

1. In the User Management window, click the **User Accounts** tab.
2. From the list of users, select the user you want to change and click the **Edit User** button.
3. From the **Role** field, select the new role and click **Save**.

   The role is now changed to the desired setting.

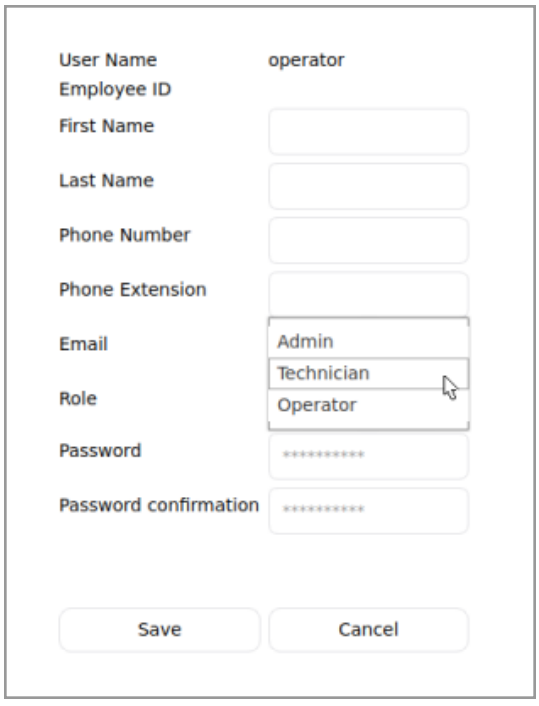


Figure 49 - Change Roles

7.2.3 Disabling a User Account

Users cannot be deleted from the system, but they can be disabled to prevent access to the software. Use the following procedure to disable a user.

1. In the **User Management** window, click the **User Accounts** tab.
2. From the list of users, select a user name.
3. Click **Disable User**; this will prompt you to confirm your choice.
4. Click **OK** to confirm the action.

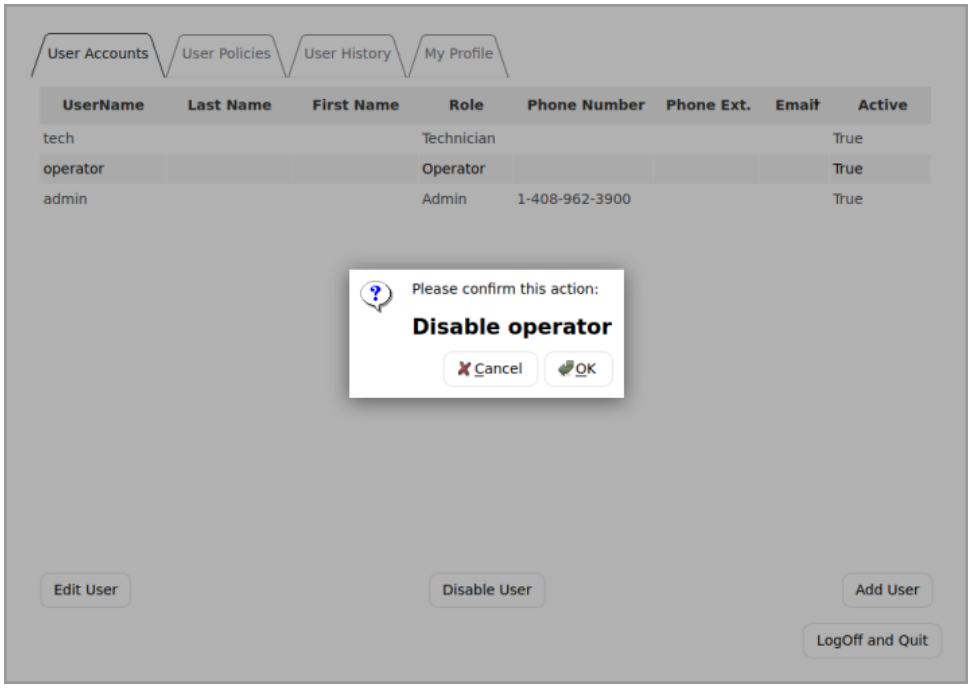


Figure 50 - Disable Users

7.2.4 Adding a User

1. In the **User Management** window, click the **User Accounts** tab.
2. Click **Add User**; this will display the **Add User** screen.

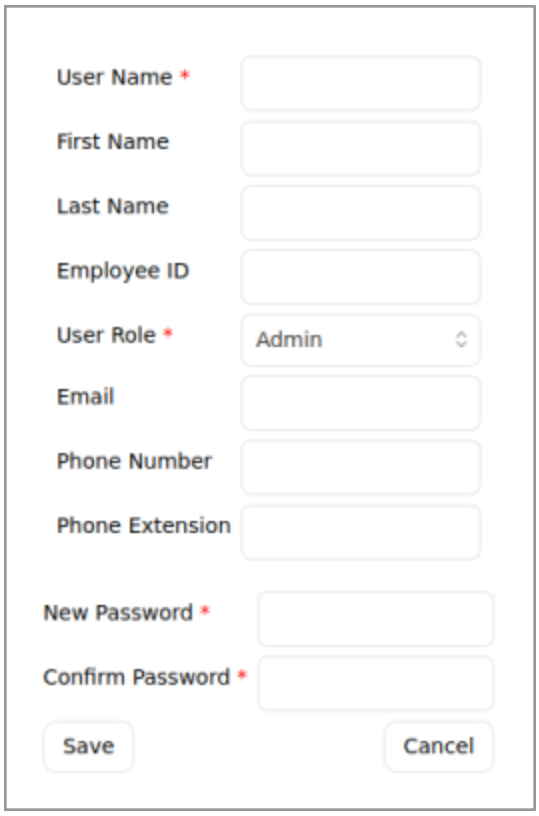


Figure 51 - Add User

3. Fill in the fields in the **Add User** window.
4. Click **Save** to open the New User Account dialog.
5. Review the user information and click **OK** to accept or **Cancel** to go back and edit the information.

7.3 Setting User Policies

1. In the **User Management** window, click the **User Policies** tab.
2. Make any changes. For more information, see the following 7.3.1 User Policy Descriptions.
3. Click **Save**. If you typed an incorrect value and want to undo any changes and revert back to the last saved configuration, click **Revert**.

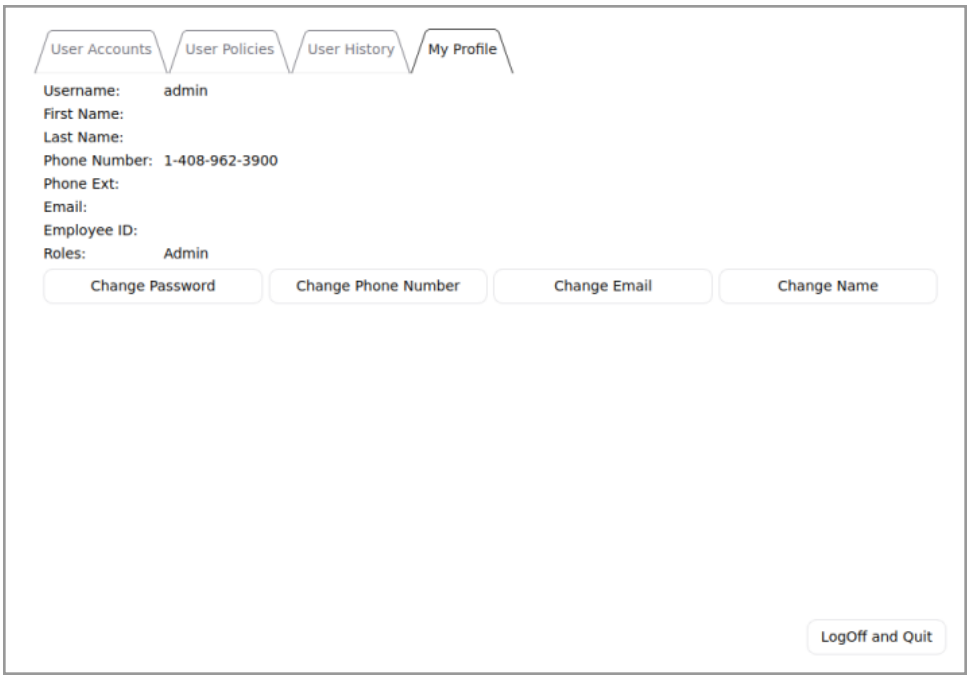


Figure 52 - User Policies Tab

7.3.1 User Policy Descriptions

The following table provides descriptions for the various user policies.

Table 5 - User Policies

Policy	Description
Password length	Specify that the length of passwords (6–15 characters) or turn off the length requirement.
Password complexity	When selected, all new passwords must have at least one number, one letter, and one special character. This will not impact existing passwords.
Password expiration	When selected, any passwords that reach the selected maturity will expire. Any user signing in with an expired password will be required to create a new password.
Previous passwords	When set, prevents a user from reusing a recent password. The system can remember up to 10 old passwords.
Limit login attempts	Tell the system to disable a user account after a set number of failed password attempts. The failed attempts are counted until the user successfully logs in. Once disabled, an admin will have to enable the account.

Policy	Description
Lock session	When set, the system will automatically logoff any user after a set period of inactivity, requiring the user to sign in again.
Change password	Allows the user to change their own password.
Change phone number	Allows the user to change phone number and restrictions.
Change email	Allows user to change their email address.
Change name	Allows the user to change first and last name.
Save user actions	When enabled, user actions (such as logging in) will be saved in the User History.

7.4 Viewing User History

1. In the **User Management** window, click the **User History** tab to see a list of all the logged events.

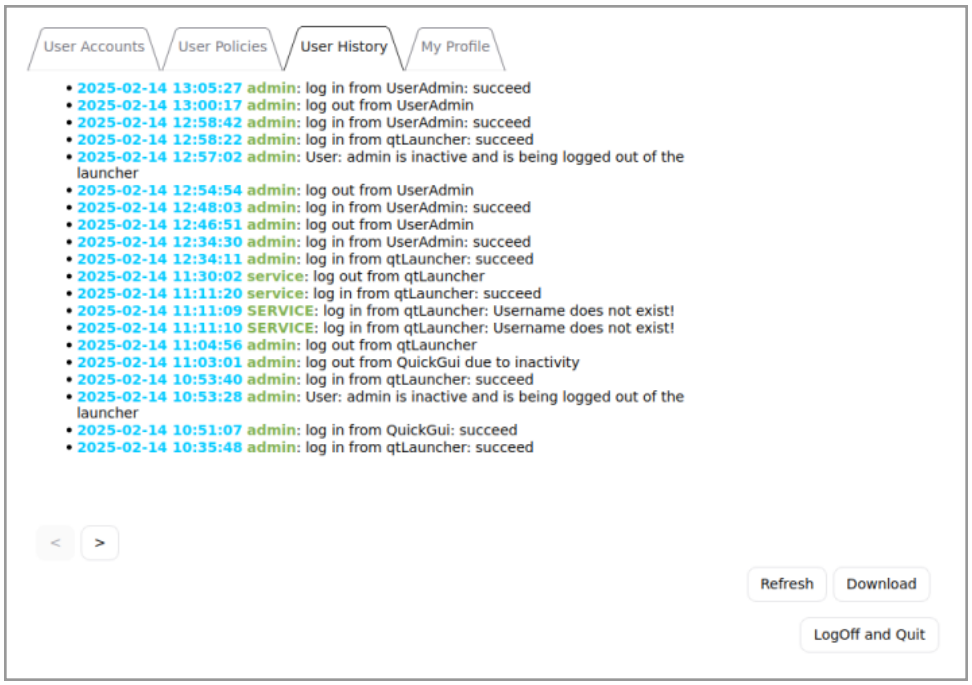


Figure 53 - User History Tab

2. Click the < and > buttons to navigate through the history (if the button is grayed out, then there are no additional pages).
3. To make sure the content is up to date, click **Refresh**.
4. To copy the user history onto a USB drive, click **Download**. This launches the File Manager, which will prompt to login. See File Manager (Copy Files) for details on copying files from the analyzer.

7.5 Viewing My Profile

The **My Profile** tab provides information about the user that is currently logged into the system. The change password, phone number, email and name options are available to the user if these settings were enabled in the **User Policies** tab by an administrator. The user can use these options to edit their own profile information.

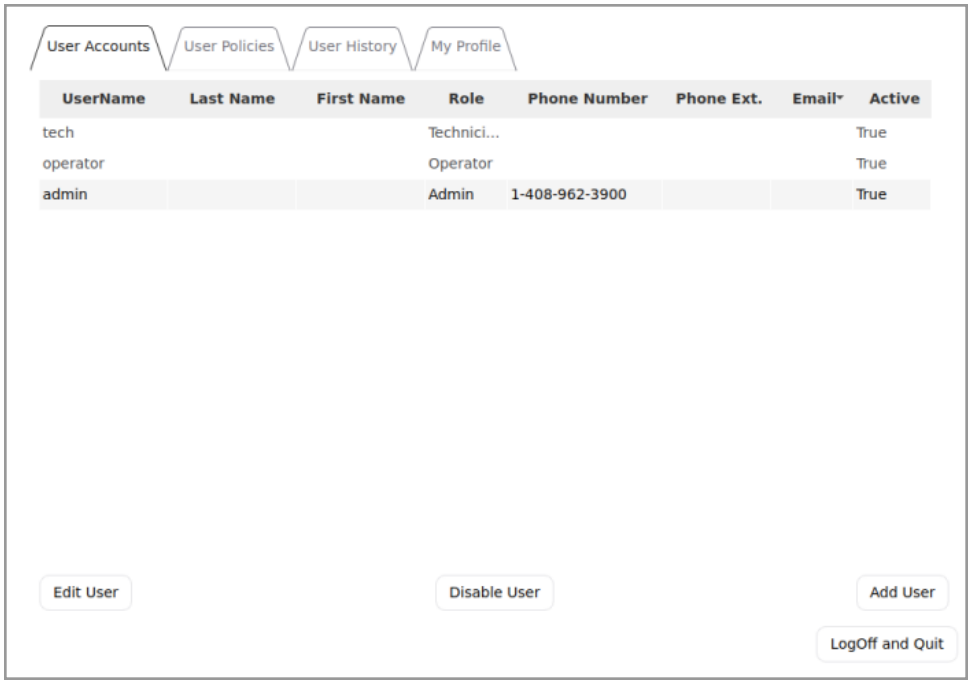


Figure 54 - My Profile Tab

8 File Management

The Picarro Analyzer generates ASCII-format text output files that are updated after each batch of concentration measurements is complete. The data files are stored primarily in DataLogger folders and are also mirrored in folders which retain more situational data. Some analyzers also produce discrete measurements stored in separate isotope data folders. All user data is archived, compressed, and retained, either shortly after the measurements or at a later point, to optimize space on the hard drive.

8.1 Data Archive

The archive directory is:

/home/picarro/I2000/Log/Archive

This archive stores daily measurement and RDF data. Each folder is designated by date (**YYYY-MM-DD**) and has subdirectories:

DataLog_Private, DataLog_User, DataLog_User_Sync, EventLogs, and **WBCAL**.

The Data Logger files are in a simple text format (white-space delimited) with a DAT file extension. By default, each file stores one hour of data.

Certain instruments may contain additional sub-folders under: */Home/UserData* relating to time synced file formats, soil flux, or GPS data, among others. If the user has any questions about this file structure, they can contact Picarro Support.

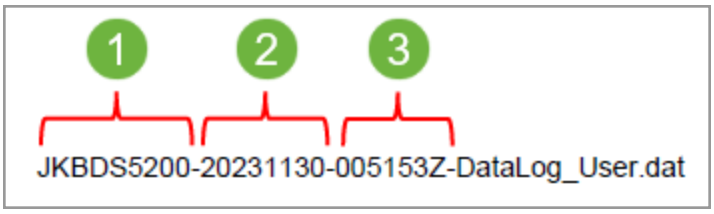
There are complete data files which include additional information beyond the concentration data including parameters such as instrument temperatures and pressure, set points and spectroscopic information. This information is generally not useful to the user, but can be useful for diagnostic purposes and is stored in the following directory:

/home/picarro/I2000/Log/Archive/yyyy-mm-dd/DataLog_Private

The archive files are in a HDF5 format, a more efficient data storing format with an .h5 file extension.

8.2 Data File Name

The file name is generated from the analyzer serial number, the date, and the time when the file was started. The specific time stamp depends upon the time the instrument was started and began measuring sample gas, so files seldom begin exactly at the top of the hour. For example:



1 Instrument Serial Number

2 Date

3 Time (Local)

Figure 55 - Example Data File Name

- **JKBDS5200**: the analyzer serial number
- **20231130**: the date, in format yyyymmdd (to allow chronological sorting of data files).
- **005153**: the time the file was started in the computer's local time 00:51:53, formatted as hhmmss using a 24-hour clock. Note that the time stamp of samples within the file is usually recorded in UTC (GMT) relative to the local time. For example, an analyzer in California will usually have a time stamp (UTC) within the file that is 8 hours ahead of the time stamp in the file name itself (UTC - 8).

8.3 File Archiving

Picarro instruments will not delete data. Some instruments will, however, compress and archive older data to conserve hard drive space. Raw data file archiving frequency and details can be modified in the file:

/home/picarro/I2000/AppConfig/Config/Archiver/Archiver.ini.

⚠ CAUTION

To avoid losing data, discuss with Picarro support before attempting any changes to the Archiver.ini file.

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

- **Directory = */home/picarro/I2000/Log/Archive***
  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 1.5 GB of data is to be kept before the system begins to archive old data.

- **Compress = True/False**
  Specifies if archived files are to be zipped – recommended setting is true to save hard drive space. True means files are zipped, false means files are not zipped.
- **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 archived first.
- **Quantum = 4**
  Generally, should not be changed. Specifies the files to be sorted by year\month\day\hour in the archived directory structure.

9 Modbus Communication

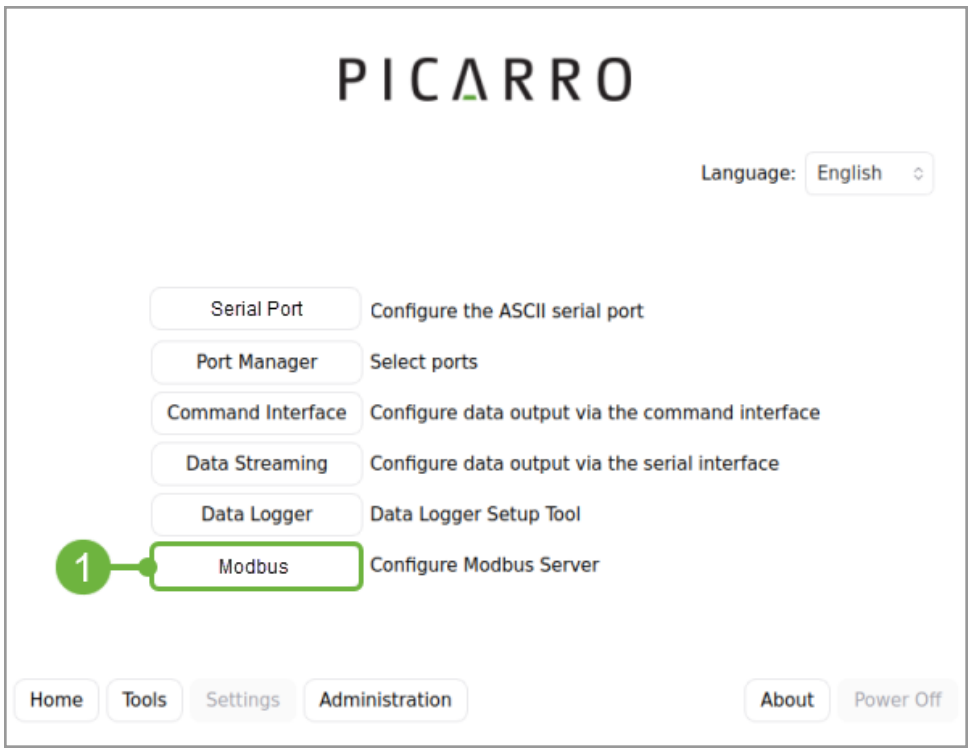
Modbus is a client/server data communication protocol to support communication to and from multiple devices connected to the same cable. Modbus can be configured for TCP/IP on port 50500 or RTU utilizing the analyzer's COM1 port. See the following section on how to configure Modbus communication.

9.1 Configuring Modbus Communication

1. From the Picarro Launch Pad, select **Config** followed by the **Modbus** button to configure the Modbus server as shown in the following figure.

NOTE

Note the Config menu requires login to access the configuration menu. Log in with a user name and password.



1 Modbus button

Figure 56 - Settings/Modbus Configuration

This displays the Modbus Settings window shown in Figure 57.

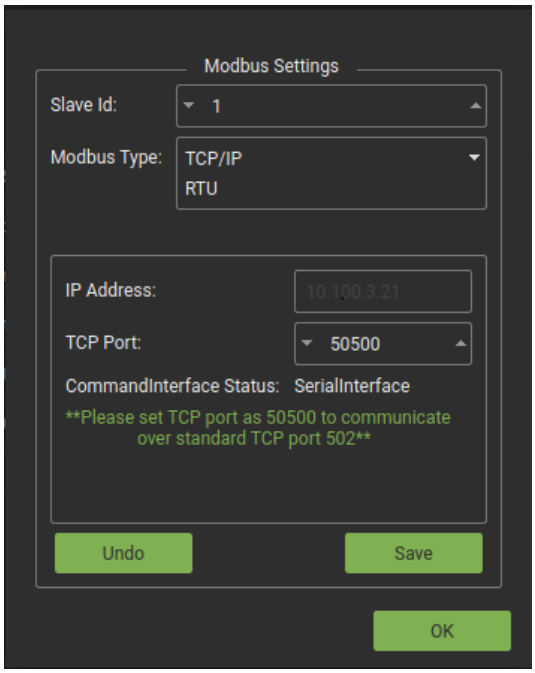


Figure 57 - Modbus Settings Window

2. From the Modbus Settings window the following configuration options are available:
   - **Slave ID** — The analyzer's Slave ID.
   - **Modbus Type** — The Modbus Communication Protocol: TCP/IP or RTU. For more information, see section 9 Modbus Communication.
   - **TCP Port** — Designates the TCP port if TCP/IP is selected.

   Additionally, the window displays the CommandInterface Status. However, if Modbus Type is set to RTU, then the CommandInterface on COM 1 is disabled.

9.2 Modbus Data Registers Overview and Setup

This section describes the basic types of MODBUS data registers and setup information.

Table 6 - MODBUS Register Types

Name	Size	Access
Input Register	16 bits	Read-only
Holding Register	16 bits	Read-write
Discrete Input	1 bit	Read-only
Coils	1 bit	Read-write

9.2.1 Modbus TCP Setup Notes

- MODBUS is configured for TCP/IP on port 50500.
- When MODBUS is configured on port 50500, communication is also possible via port 502.
- If MODBUS is configured as TCP/IP and the IP address of analyzer is changed, the user needs to restart the host application to run MODBUS with the updated IP address.
- MODBUS over TCP/IP does not support privileged ports (0 to 1023), except for port 502.

9.2.2 Modbus RTU Setup Notes

- MODBUS RTU uses the analyzer's COM1 port.
- To establish connection between master and slave over MODBUS RTU, user needs to establish connection using "Straight Through Cable".
- When MODBUS is configured for RTU, CommandInterface on COM1 is disabled.

9.3 Modbus Register Maps

- Data returned is in big endian format if it utilizes more than one Modbus register.
- If input register functionality is not available for a given analyzer type, the instrument will return value as "NaN" for float values and "False" for 1-bit registers.
- Memory map is continuous memory. If a user tries to read a register address for which functionality is not available, it will return "0". For example, reading address "0" for coil registers returns "0" since the address does not exist.
- If a user tries to read a register address outside of maximum register memory map, the request will return an exception. For example, reading address 156 for coil register will return exception code "0x02" (Illegal address).
- System time is in milliseconds since 0001-01-01 AD.

9.4 Input Register Map

Most of the readings in Picarro analyzer are the float type and need 32-bit data. Each parameter utilizes two registers, out of which the first one stores the MSB and the second stores the LSB of the float number.

Table 7 - Input Registers

Address	Description	Units	Type	Comments
0-5	Time stamp	Unitless	String	Long value return as 12 byte string. Date will be in format YYMMDDHHMMSS
6-7	N2O Concentration	ppb	Float	
8-9	N2O_ID	ppb	Float	8 for N_2O

Address	Description	Units	Type	Comments
10-11	N2O_30sec	ppb	Float	
12-13	N2O_2min	ppb	Float	
14-15	N2O_5min	ppb	Float	
16-17	N2O_Maximum	ppb	Float	
18-19	N2O_Minimum	ppb	Float	
20-21	CO Concentration	ppb	Float	
22-23	CO_ID	ppb	Float	5 for CO
24-25	CO_30sec	ppb	Float	
26-27	CO_2min	ppb	Float	
28-29	CO_5min	ppb	Float	
30-31	CO_Maximum	ppb	Float	
32-33	CO_Minimum	ppb	Float	
34-35	H2O Concentration	ppm	Float	
36-37	H2O_ID	ppm	Float	0 for H_2O
38-39	H2O_30sec	ppm	Float	
40-41	H2O_2min	ppm	Float	
42-43	H2O_5min	ppm	Float	
44-45	H2O_Maximum	ppm	Float	
46-47	H2O_Minimum	ppm	Float	
48-199	Reserved			
200-201	CavityPressure	Torr	Float	
202-203	CavityTemp	deg C	Float	
204-205	DasTemp	deg C	Float	
206-207	EtalonTemp	deg C	Float	NaN

Address	Description	Units	Type	Comments
208-209	WarmBoxTemp	deg C	Float	NaN
210-211	OutletValve	Unitless	Float	
212-213	Gas1_instrCal_ slope	Unitless	Float	NaN
214-215	Gas1_instrCal_ offset	Unitless	Float	NaN
216-217	Gas1_userCal_ slope	Unitless	Float	NaN
218-219	Gas1_userCal_ offset	Unitless	Float	NaN
220-221	Gas2_instrCal_ slope	Unitless	Float	NaN
222-223	Gas2_instrCal_ offset	Unitless	Float	NaN
224-225	Gas2_userCal_ slope	Unitless	Float	NaN
226-227	Gas2_userCal_ offset	Unitless	Float	NaN
228-229	Gas3_instrCal_ slope	Unitless	Float	NaN
230-231	Gas3_instrCal_ offset	Unitless	Float	NaN
232-233	Gas3_userCal_ slope	Unitless	Float	NaN
234-235	Gas3_userCal_ offset	Unitless	Float	NaN
236-237	Gas4_instrCal_ slope	Unitless	Float	NaN
238-239	Gas4_instrCal_ offset	Unitless	Float	NaN

Address	Description	Units	Type	Comments
240-241	Gas4_userCal_ slope	Unitless	Float	NaN
242-243	Gas4_userCal_ offset	Unitless	Float	NaN
244-299	Reserved			
300-301	Etalon1	Unitless	Float	NaN
302-303	Etalon2	Unitless	Float	NaN
304-305	Ratio1	Unitless	Float	NaN
306-307	Ratio2	Unitless	Float	NaN
308-309	Reference1	Unitless	Float	NaN
310-311	Reference2	Unitless	Float	NaN
312-385	Reserved			
386-387	Errors	Integer	Float	
388-389	Measurement_ Status	Integer	Float	

9.5 Discrete Input Register Map

The following table describes the discrete input registers. Please note the following:

- All data unit are unitless unless otherwise noted.
- All data types are floats unless otherwise noted.
- All unused addresses are reserved.

Table 8 - Discrete Input Registers

Address	Description
1	MasterSystemStatus
2-5	Reserved
6	CavityPressureStatus
7	CavityTempStatus

Address	Description
8	WarmBoxTempStatus
9-72	Reserved
73	Incomplete_GAS1_spectrum
74	Incomplete_GAS2_spectrum
75	Incomplete_GAS3_spectrum
76	Incomplete_GAS4_spectrum
77	Incomplete_GAS5_spectrum
78	Incomplete_GAS6_spectrum
79	Incomplete_GAS7_spectrum
80	Incomplete_GAS8_spectrum
81	GAS1_baseline
82	GAS2_baseline
83	GAS3_baseline
84	GAS4_baseline
85	GAS5_baseline
86	GAS6_baseline
87	GAS7_baseline
88	GAS8_baseline
89	GAS1_performance
90	GAS2_performance
91	GAS3_performance
92	GAS4_performance
93	GAS5_performance
94	GAS6_performance

Address	Description
95	GAS7_performance
96	Reserved

9.6 Holding Register Map

The following table describes the holding registers.

Table 9 - Holding Registers

Address	Description	Type	Comments
1-4	System time	Integer	Integer representing milliseconds from 1AD January 1st to now
5-8	Username	String	
9-12	Password	String	
13-200	Reserved		
201-202	User data 1	Float	
203-204	User data 2	Float	
205-206	User data 3	Float	
207-208	User data 4	Float	
209-210	User data 5	Float	
211-212	User data 6	Float	
213-214	User data 7	Float	
215-216	User data 8	Float	
217-218	User data 9	Float	
219-220	User data 10	Float	
221-222	User data 11	Float	
223-224	User data 12	Float	
225-226	User data 13	Float	

Address	Description	Type	Comments
227-228	User data 14	Float	
229-230	User data 15	Float	
231-232	User data 16	Float	
233-234	User data 17	Float	
235-236	User data 18	Float	
237-238	User data 19	Float	
239-240	User data 20	Float	

9.7 Coil Register Map

Table 10 - Coil Register Map

Address	Description	Type	Function
1	EnergizeSolenoidValve1	Float	get_system_time
2-115	Reserved	Float	
116	ShutDownHost	Float	MODBUS_ParkInstrument
117	ShutDownInstrument	Float	MODBUS_ShutdownInstrument
118-150	Reserved		
151	GetTime	Float	get_system_time
152-154	Reserved		
155	SetPassword	Float	Change_UserPassword
156	Logout	Float	MODBUS_UserLogoff
157-200	Reserved		
201	GetUserData_1	Float	GetUserData_1
202	SetUserData_1	Float	SetUserData_1
203	GetUserData_2	Float	GetUserData_2
204	SetUserData_2	Float	SetUserData_2

Address	Description	Type	Function
205	GetUserData_3	Float	GetUserData_3
206	SetUserData_3	Float	SetUserData_3
207	GetUserData_4	Float	GetUserData_4
208	SetUserData_4	Float	SetUserData_4
209	GetUserData_5	Float	GetUserData_5
210	SetUserData_5	Float	SetUserData_5
211	GetUserData_6	Float	GetUserData_6
212	SetUserData_6	Float	SetUserData_6
213	GetUserData_7	Float	GetUserData_7
214	SetUserData_7	Float	SetUserData_7
215	GetUserData_8	Float	GetUserData_8
216	SetUserData_8	Float	SetUserData_8
217	GetUserData_9	Float	GetUserData_9
218	SetUserData_9	Float	SetUserData_9
219	GetUserData_10	Float	GetUserData_10
220	SetUserData_10	Float	SetUserData_10
221	GetUserData_11	Float	GetUserData_11
222	SetUserData_11	Float	SetUserData_11
223	GetUserData_12	Float	GetUserData_12
224	SetUserData_12	Float	SetUserData_12
225	GetUserData_13	Float	GetUserData_13
227	GetUserData_14	Float	GetUserData_14
228	SetUserData_14	Float	SetUserData_14
229	GetUserData_15	Float	GetUserData_15

Address	Description	Type	Function
230	SetUserData_15	Float	SetUserData_15
231	GetUserData_16	Float	GetUserData_16
232	SetUserData_16	Float	SetUserData_16
233	GetUserData_17	Float	GetUserData_17
234	SetUserData_17	Float	SetUserData_17
235	GetUserData_18	Float	GetUserData_18
236	SetUserData_18	Float	SetUserData_18
237	GetUserData_19	Float	GetUserData_19
238	SetUserData_19	Float	SetUserData_19
239	GetUserData_20	Float	GetUserData_20
240	SetUserData_20	Float	SetUserData_20

10 Troubleshooting

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 Support at +1 408 962 3991 (US) or +31 85 888 1650 (International) or support@picarro.com.

10.1 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.

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

10.2 Sample Pressure not Controlled to 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.

1. **Pressure low** — 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. Check for blockages in the lines, or regulators that are turned off, especially by removing all items upstream of the inlet to see if the pressure returns to the spec. If removing plumbing from upstream of the instrument inlet doesn’t work, the inlet particulate filter may need to be replaced. See Chapter 11, Maintenance for more information.
2. **Pressure high** — 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

11 Maintenance

The advanced, rugged design of Picarro Analyzers provides stable, long-term operation with minimal service or maintenance. Except for the following items, the analyzer and pump are not user serviceable. Should either appear to malfunction, please refer to the Troubleshooting Guide or contact Picarro Customer Support (support@picarro.com).

As described below, users may obtain preventive maintenance components as part of a service plan, as part of a designated PM kit, or individually from the Picarro store.

11.1 Service Plans

In addition to basic telephone and email support and remote diagnostics, service plans include additional warranty, factory repairs, and parts. Plans are available for purchase by contacting sales@picarro.com. The following service plans are available for the PI5310 and G5000 analyzers:

- **W3105 Premium Service Plan** — Extended warranty; free factory repair; free field replaceable parts. See data sheet for complete terms and conditions.

11.2 Particulate Filter Replacement

There are two user-replaceable filters in the PI5310 analyzer. One is located behind the Sample inlet, and another is located behind the Pressure inlet. Both are accessible from the back panel by releasing the captive screws and sliding the filter out of its bay within the analyzer. This section describes filter replacement for the Sample and Pressure inlets. Replacement filter kits can be purchased from Picarro.

NOTE

Gasses at the Sample inlet is filtered by two in-line, sub-micron particulate filters before they reach the measurement cavity. The inner filter is not user replaceable. It is located within a heated pressure-box. If the inner filter fails, contact Picarro for service or repair. The outer filter (located just behind the Sample inlet) is user-replaceable.

CAUTION

The inner filter (in the sample path) is not user replaceable. Do not open the analyzer. Inner filters must be replaced by a Picarro certified technician. USER REPLACEMENT OF THE INNER FILTER OR BREAKING THE ANTI-TAMPER TAPE ON THE INNER FILTER VOIDS THE WARRANTY.

11.2.1 Symptoms of a Clogged Filter

Filters can become clogged with continual use.

If liquid water is sucked into the inlet line, it may clog the filter and impede the flow (usually for a few days) until it evaporates.

Some symptoms of a clogged filter are:

- The analyzer pressure is low
- Low flow into the analyzer, causing unusual measurements
- Response time is slower than usual

11.2.2 Solutions for Water Incursion

Do NOT turn off the analyzer when a filter is wet or replace a wet filter. Liquid water in the filter can cause condensation on the optics if the analyzer is allowed to cool when the filter is wet.

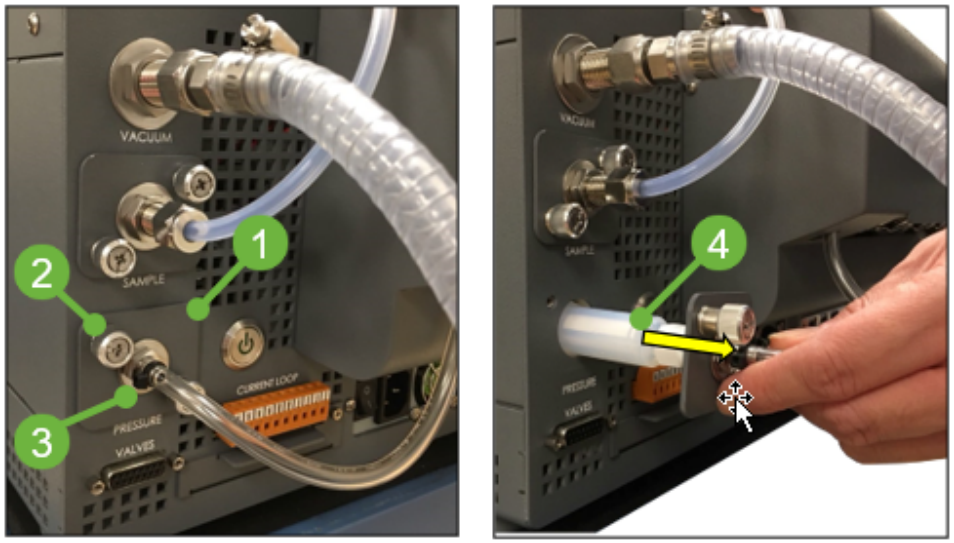
- Dry the filter by running Clean Dry Air (CDA) through the analyzer. If the analyzer functions normally after drying, a filter replacement is not necessary.
- If drying the filter does not solve the problem, replace the filter.

11.2.3 Required Parts and Tools

- S3266 PI/SI5000 User Maintenance Kit
- 9/16" open end wrench
- Flathead screwdriver for releasing captive screws (if needed).

11.2.4 Pressure Inlet Port Particulate Filter Replacement

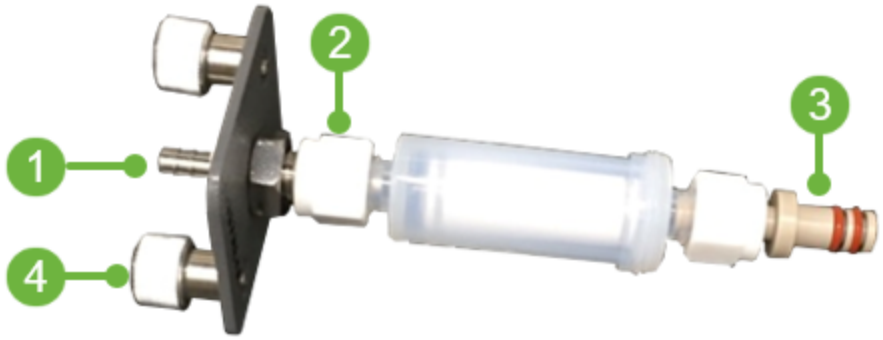
1. Shut down the analyzer by following 5.2 Shutdown , and move the analyzer to a clean work environment.
2. Release the captive screws and slide the filter assembly out of the analyzer filter bay. There may be some resistance as the filter is removed. This is due to the frictional resistance of the male quick-disconnect O-rings within the female receptacle.



1. Removable Inlet Bulkhead
2. Captive Screws
3. Pressure Inlet
4. Removing Filter

Figure 58 - Pressure Inlet Port

3. The following figure shows the pressure inlet port filter assembly after removal. It is not necessary to remove the hose from the barbed inlet port.



1. Barbed pressure Inlet Port
2. Compression Nut
3. Male Quick Disconnect
4. Captive Screw (2 ea.)

Figure 59 - Pressure Inlet Filter — Removed

4. Remove the old filter from the bulkhead assembly by loosening the compression nut. Remove the ferrules and discard.

Figure 60 - Removing Filter from Pressure Inlet Bulkhead

5. Remove the male quick-disconnect from the filter outlet by loosening the compression nut. Remove the ferrules and discard.

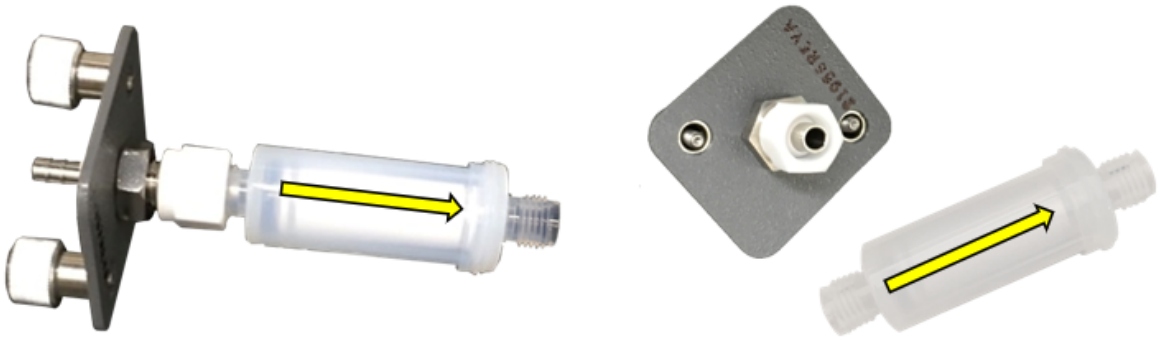


Figure 61 - Filter Removed from Pressure Inlet Bulkhead

6. Install the new ferrules onto the bulkhead compression fitting.
7. Attach a new filter to the bulkhead compression fitting.

   Ensure the flow direction arrow on the filter is pointing away from the bulkhead compression fitting. Also ensure the tube and ferrules are fully seated into the filter fitting before fully tightening the nut.
8. Tighten the nut on the fitting until the final bit of thread is just showing past the nut.

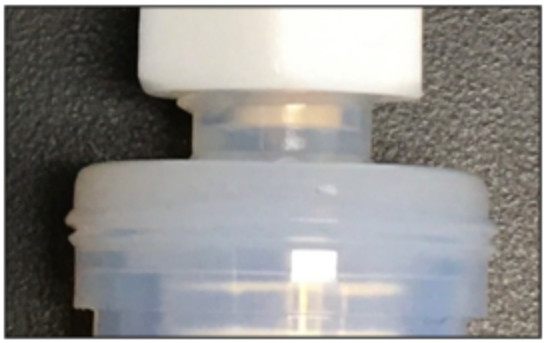


Figure 62 - Tightening the Filter Fittings

9. Install the new ferrules onto the quick disconnect fitting.
10. Reinstall the male quick disconnect to the new filter. Ensure the tube and ferrules are fully seated into the filter fitting before fully tightening the nut.
11. Tighten the nut on the fitting until the final bit of thread is just showing past the nut (Figure 62).
12. Slide the completed assembly into the analyzer filter bay and secure the plate by tightening the captive screws.

NOTE

When the filter assembly is about half an inch from the analyzer chassis, you will meet resistance as the male quick-disconnect enters its receptacle. You will need to firmly push it inward to fully seat the assembly. Then the captive screws can be tightened.

11.2.5 CPU Fan

The analyzer CPU fan is user-replaceable and is available per the following service kit:

CPU Fan for MI990 Motherboards

- **S3267**: PI5000 CPU Fan Replacement Kit. Includes the S3263 (CPU Fan) and required tools for replacement.

11.2.6 A2000 Pump Rebuild Kit

The pump rebuild kit is the only component not currently sold as part of a preventive maintenance kit because the replacement frequency is not strictly annual (frequency depends on pump usage).

The A2000 pump diaphragms and valves are user-replaceable. Use the following link to order rebuild kits and to find the instructional video and supporting maintenance document.

- Pump Rebuild Kit: Used with SI2xxx, G2xxx analyzers (except Flight and Flux analyzers)

S2009 Rebuild Kit for A2000 Vacuum Pump – If viewing this manual as a paper hard copy, enter the following URL in your browser:

http://store.picarro.com/For-Analyzer/Pump/Rebuild-kit-for-Picarro-A2000-vacuum-pump.html

11.3 Cleaning and Decontamination

Clean the outside of the analyzer with a clean dry cloth. Users should never access or clean the inside of a Picarro analyzer. For decontamination, run clean dry air (CDA) through the analyzer. If the analyzer does not decontaminate after running CDA for several hours, contact Picarro.

12 Transportation and Storage

If the analyzer is transported or stored, use the following procedure to prepare and repack it into the original packaging.

⚠ CAUTION

When shipping or relocating the analyzer, it is important to protect it from mechanical shocks. Failure to do so can compromise its performance. When shipping the analyzer, use its original packaging only.

12.1 Shutdown and Preparation

⚠ CAUTION

A flow of clean, relatively dry gas should always be directed to the instrument for several minutes prior to shutting 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. See 5.2 Shutdown , for specific shutdown instructions for your model analyzer.

1. Click on the **Quit** button located on the left side of the Data Viewer window.
2. A window displays prompting the user to confirm the shutdown. Click **Yes** to continue the shutdown process.

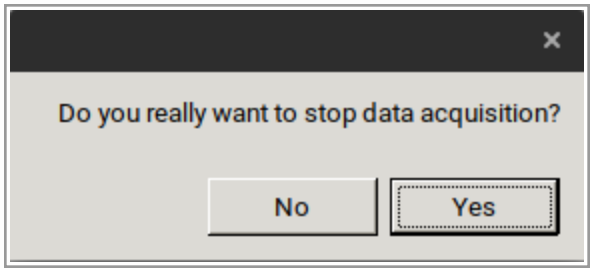


Figure 63 - Stop Data Acquisition/Shutdown

3. Confirm the level of water vapor prior to shutdown. Click **No**, if the analyzer was dried before shutdown. Click **Yes**, if the analyzer requires dry gas to reduce the moisture content.

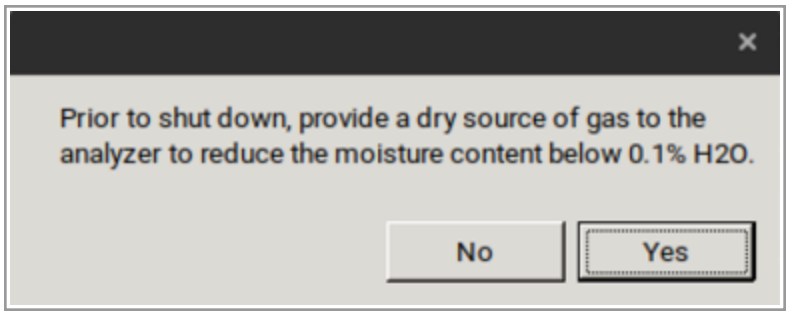


Figure 64 - Reduce Moisture Content/Shutdown

Once confirmed, the analyzer software and hardware will turn off.

4. Manually turn off the pumps and dry gas (if used).
5. Disconnect all tubing and electrical connections from the analyzer.
6. To prevent contamination and possible damage to the connector threads, place protective caps on all gas connections.

12.2 Packing

1. Place the analyzer in a plastic bag with a package of desiccant. Seal the bags with tape. If shipping the pump, do the same for it.
2. Pack the analyzer and pump in the original shipping containers ensuring that all the foam pieces are in place to protect the analyzer during shipping.

A Setup Tools and Communication

A.1 Analyzer Settings and Tools

The **Analyzer Setup Tools** is accessed by using the **Picarro Launch Pad** and **Settings** button. These set of tools allow 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), and optionally configured electrical interface for additional measurement monitoring.

NOTE

You must be logged in as a technician or administrator to access the Analyzer Setup Tools under Settings.

The settings of the Setup Tool are explained in the next pages in brief. A more in-depth description of the material is provided in the subsequent sections. If you have any questions about the Setup Tool, please contact Picarro or refer to Picarro Community for further details.

https://www.picarro.com/support/community

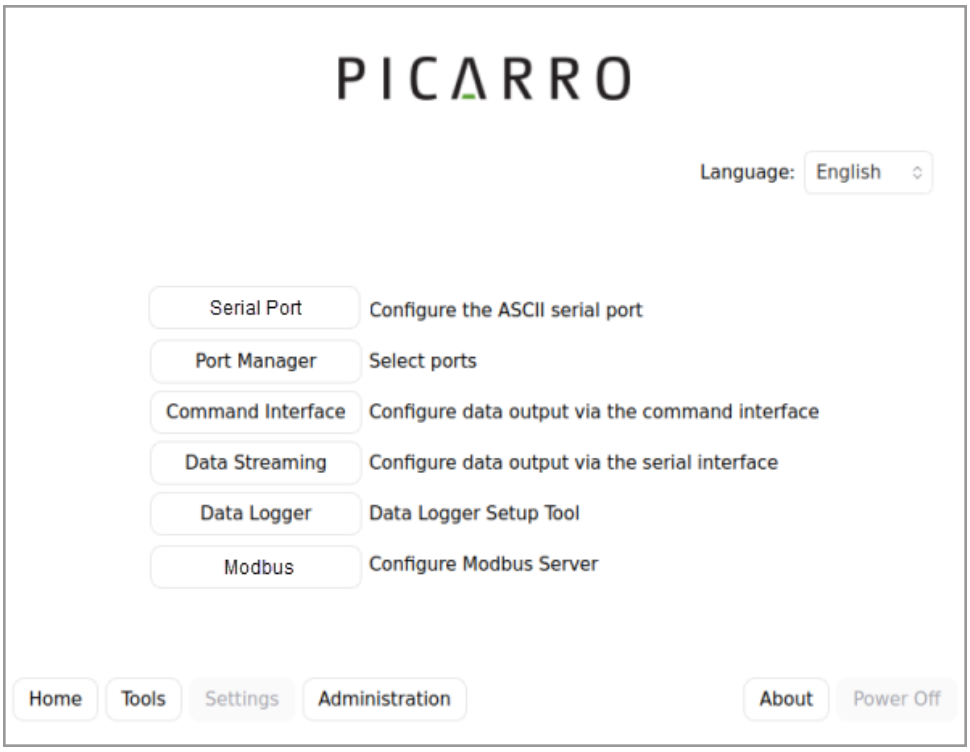


Figure 65 - Analyzer Setup Tools

NOTE

Before running any of the setup tools, the instrument software must be stopped. From the CRDS Data Viewer, select the Quit button and click Yes when prompted to stop data acquisition. The Setup Tool options are now active.

A.1.1 Serial Port

The **Serial Port** menu is accessible from the Settings Menu and displays the configurations of COM1 (used for Command Interface, query-based data output) and COM2 (used for Data Streaming). Users need to set the COM port protocol by using the Serial Port Configuration feature located from the Picarro Launch Pad, Config, and selecting the **Serial Port** button.

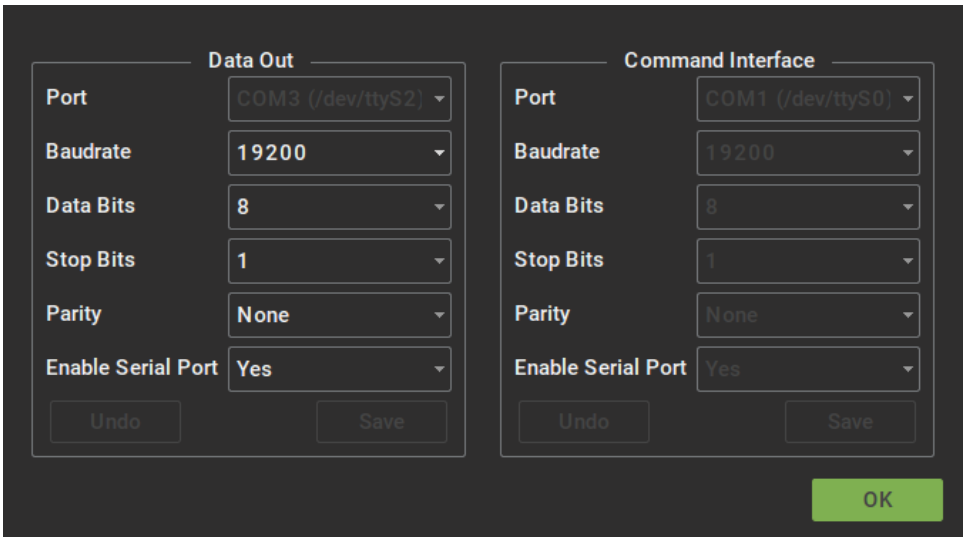


Figure 66 - Serial Port Settings

Configure the ASCII serial port by setting the Data Out and Command Interface parameters that are used for RS-232 serial communication.

The following options are provided:

- **Port** — Indicates the desired communication port.
- **Baudrate** — Specifies the rate at which bits are transmitted.
- **Data Bits** — Specifies the number of data bits to transmit.
- **Stop Bits** — Specifies the number of bits used to indicate the end of a byte.
- **Parity** — Indicates the type of parity checking.
- **Enable Serial Port** — Enables or disables the communication port specified in the Port field.

After making changes, select **Save** to apply the changes or **Undo** to revert to the previous configuration. Click **OK** to close the window.

A.1.2 Port Manager

The **Port Manager** allows you to control digital data output/input by using the serial port or TCP/IP.

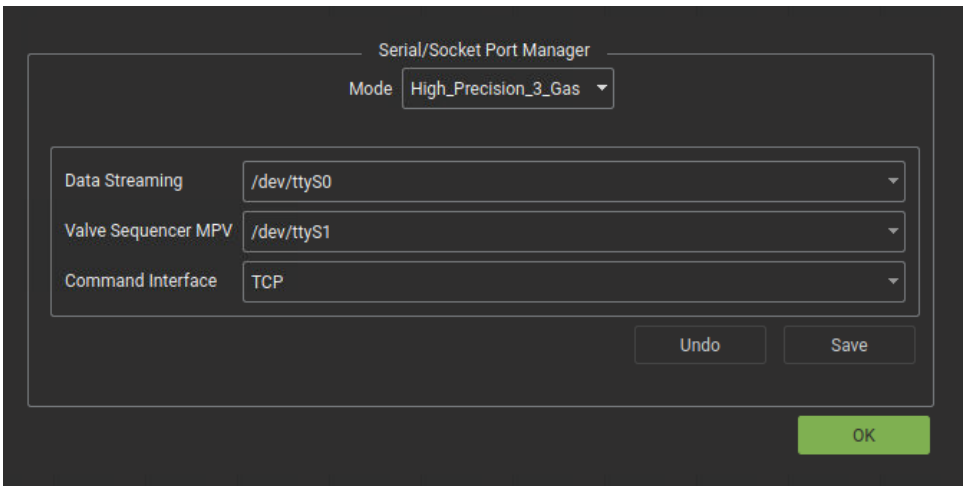


Figure 67 - Serial/Socket Port Manager Settings

The following options are available within the Port Manager menu:

- **Data Streaming** — The port you want your data to stream through(COM1/COM2/Off)
- **Valve Sequencer MPV (Multi Position Valve)** — The port you want to connect your MPV to (COM1/COM2/Off)
  For more information on the configuring for external valves, see Chapter 1, Controlling External Valves.
- **Command Interface** — (COM1/COM2/TCP/Off).
  Make sure there are no COM port conflicts before clicking **Save**.

After making changes, select **Save** to put these changes into effect and click **OK** to close the window.

A.1.3 Command Interface — Specifying Digital Data Output

The **Command Interface** allows you to specify the data elements that are sent by using COM port/TCP (specified in the Port Manager).

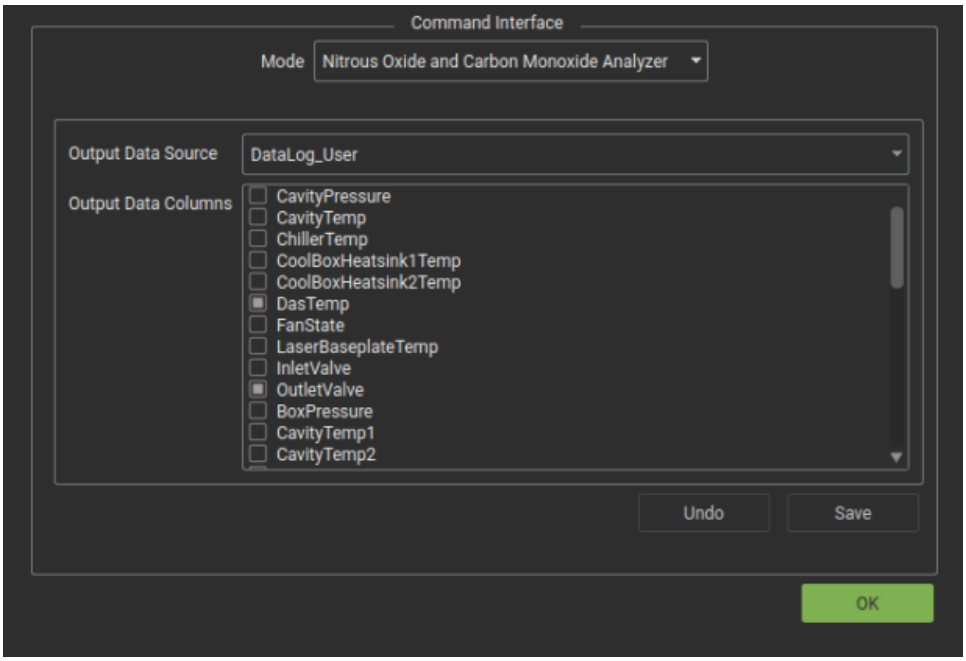


Figure 68 - Command Interface Settings

Two types of data can be specified here:

Output Data Source:

- Datalog_User
- DataLog_User_Sync (relevant only for Flux G2311-f analyzers)

Output Data Columns:

- The data columns are output in the order they are checked, e.g., H_2O, could come before CO_2. Command Interface enables an external device to send a set of predetermined commands to a Picarro analyzer. The Picarro returns data or metadata on the basis of the command received.

After making the appropriate changes, click **Save** to put changes into effect and then **Exit** to close the window.

A.1.4 Command Interface — Specifying Digital Data Output

The **Data Streaming** menu allows you to specify the data elements that you want to send by using COM port (specified from the Port Manager).

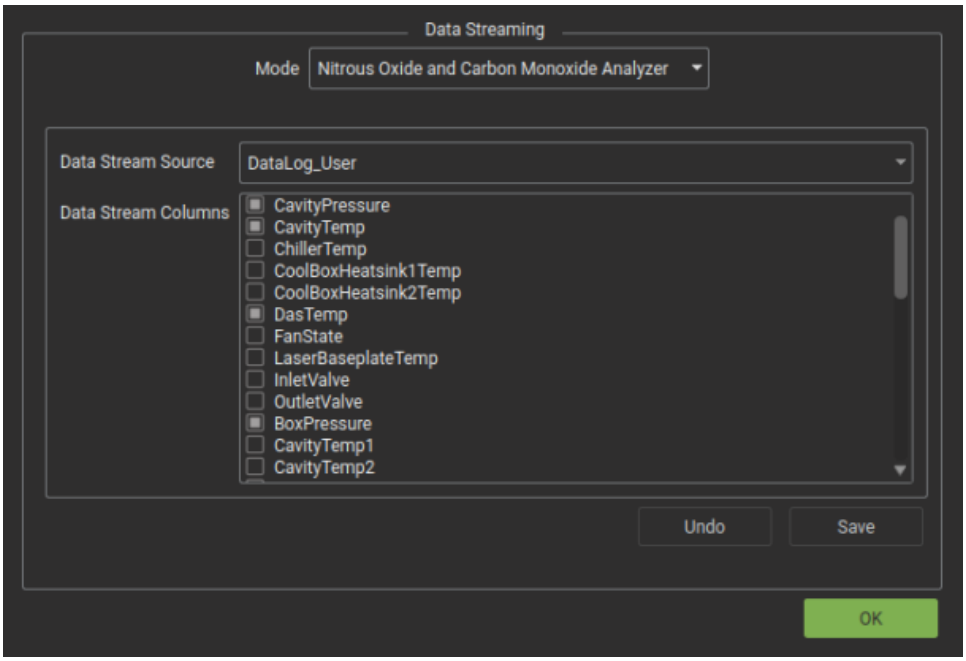


Figure 69 - Data Streaming Settings

Two types of data can be specified here:

Output Data Source:

- Datalog_User
- DataLog_User_Sync (relevant only for Flux G2311-f analyzers)

Output Data Columns:

- The data columns are output in the order they are checked, e.g., H_2O, comes before CO_2. Command Interface enables an external device to send a set of predetermined commands to a Picarro analyzer. The Picarro returns data or meta-data on the basis of the command received.

NOTE

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

After making the appropriate edits, click **Save** to put changes into effect and then **OK** to close the window.

A.1.5 Data Logger

The **Data Logger** allows the user to configure various data file saving details, including which data elements are written to data files.

Figure 70 - Data Logger Setup Settings

The following data file options can be specified:

- **Data Columns** — Controls which data elements are written to data files.
- **Hours of Each Log File** — Controls the size of each data document.
- **Enable Mailbox Archiving** — Enables archiving of data in the mailbox folder: */home/picarro/l2000/Log/Archive/DataLog_Mailbox*

- **Archived Directory Structure** — Specifies part of naming convention for data documents.
- **Total User Log Storage Size (GB)** — Specifies the size of storage allowed for User Data (Recent Data).
- **Mode** — Changes the way the analyzer fits and displays data in the data viewer on the basis of gas matrix, species reported, precision, and dynamic range.

After making the appropriate edits, click **Save** to put changes into effect and then **OK** to close the window.

A.2 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 using the serial command interface, please see the Picarro Analyzer Remote Interface Programming Guide.

NOTE

This command set may also be used across a TCP/IP interface through an Ethernet connection. Please contact Picarro for further details if needed.

A.2.1 Remote Data Access

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

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

The Internet connection need not be permanent and may be a dial-up connection accessible by using a user-supplied USB modem. The task of sending data and/or synchronizing the clock on the analyzer is performed using the */home/picarro/I2000/HostExe/RemoteAccess.exe* program.

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 time servers.

The initialization file is:

/home/picarro/I2000/AppConfig/Config/UtilitiesRemoteAccess/RemoteAccess.ini

It should be placed in the same directory as the executable RemoteAccess.exe. The file has one required section named LOGGING and optional sections named NTP 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 opened. A total of ten backup log files are kept.

A.2.2 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 time 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.

A.2.3 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. 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 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 email 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 email 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

B Alarm Status

ALARM_STATUS is a data column output by the instrument to warn the user when the instrument measures a gas that could produce data that falls outside of the operational range of the instrument. Falling outside of the operational range of the analyzer can cause the instrument to perform with a lack of precision, accuracy, or data rate. ALARM_STATUS is a flag nominally set to 0 when measuring ordinary ambient air and can be set to a number corresponding to a binary mask of a specific alarm.

The following table provides the alarm status bit assignments.

Table 11 - Alarm Status Bit Assignment

Bit	7	6	5	4	3	2	1
Alarm	Cavity Pressure	Cavity Temp	LaserBase plateTemp	Box Pressure	[H_2O]	[CO_ dry]	[N_2O]
Nominal	100 ± 0.05 Torr	40 ± 0.01 Degree C	27 # ± 0.1 Degree C	800 ± 1 Torr	< 22000 ppb	< 1500 ppb	< 1500 ppb
# Some hot operated lasers may be set to higher laser base-plate temperature.							

Each decimal ALARM_STATUS reading converts to binary and uses the above table to identify the detailed alarm as single or combination.

The following table provides several examples.

Table 12 - Alarm Status Definitions

ALARM_ STATUS	Binary Mask	Alarm Definition
0	0000000	All alarm cleared; analyzer is in normal operation.
1	0000001	N_2O_dry concentration is over 1500 ppb.
6	0000110	CO_dry concentration is over 1500 ppb, and H_2O concentration is over 22000 ppm.
32	0100000	Cavity Temperature is out of setting range.
64	1000000	Cavity Pressure is out of setting range.

C Data Log Columns

The following table describes all columns contained in the data log. The data log provides a complete set that includes all outputs produced by the analyzer and the data logs described in Chapter 8, File Management and found in:

/home/picarro/I2000/Log/Archive/YYYY-MM-DD/DataLog_User/

Table 13 - PI5310 Data Log Columns

Data Key	Units	Definition
ALARM_STATUS	Unitless	Alarm status bit mask (see C Data Log Columns)
ALARM_WORD_0	Unitless	
BoxPressure	Torr	Coolbox pressure reading
BoxPressureLock	Unitless	Status of coolbox pressure locking in range
CO	ppb	Raw CO concentration reading in gas stream
CO_dry	ppb	CO concentration reading (dry) in gas stream
CavityPressure	Torr	Sample pressure in cavity
CavityTemp	°C	Averaged temperature of cavity body
CavityTemp1	°C	Cavity temperature #1 (by front cavity mirror)
CavityTemp2	°C	Cavity temperature #2 (between #1, #3)
CavityTemp3	°C	Cavity temperature #3 (between #2, #4)
CavityTemp4	°C	Cavity temperature #4 (by rear cavity mirror)
ChillerTemp	°C	Coolant temperature in TEC cooler block
CoolBoxAuxTec	Unitless	Coolbox TEC control signal
CoolBoxHeatsink1Temp	°C	Front TEC heatsink temperature in coolbox
CoolBoxTec	NA	
DasTemp	°C	Temperature sensor on DAS – PCBA, ~ +6 offset to environmental temperature
DetectorAdc	Unitless	Baseline ADC signal from detector

Data Key	Units	Definition
FDC_ALARM	NA	
FRAC_DAYS_SINCE_JAN1	Days	Days since January 1, 1970
FRAC_HRS_SINCE_JAN1	Hours	Hours since January 1, 1970
H2O	ppm	H_2O concentration reading in gas stream
INST_STATUS	Unitless	Instrument status bit flag
InletValve	Unitless	Inlet valve current signal for coolbox pressure control
JULIAN_DAYS	seconds	Time assigned since January 1, 4713 BC
LED_STATE	Unitless	LED state for front panel
Laser1Current	Unitless	Laser current signal sent to Laser
Laser1Tec	Unitless	TEC signal for laser temperature control
Laser1Temp	°C	Laser temperature
LaserBaseplateTec	°C	NA
LaserBaseplateTemp	Unitless	NA
MPVPosition	Unitless	Multi-port valve state selected
N2O	ppb	Raw N_2O concentration reading in gas stream
N2O_dry	ppb	Raw N_2O concentration reading (dry) in gas stream
OutletValve	Unitless	Outlet valve current signal for cavity pressure control
P_stable	Unitless	Whether cavity pressure is steadily controlled
Pcavity	Torr	Pressure in measurement cavity
Pcavitystd	Torr	Standard deviation of pressure in cavity over one measurement

Data Key	Units	Definition
SpectrumID	Unitless	Number assigned to measurement of species. 170 for PI5310.
ValveMask	Unitless	Binary valve mask of triggered solenoid valve
allLow	Unitless	Binary flag if all gas concentrations are low
base1	ppb/cm	Base lose in peak1 (N_2O) spectral region.
base31	ppb/cm	Base lose in peak31 (H_2O) spectral region.
base40	ppb/cm	Base lose in peak40 ($^{13}CO_2$) spectral region.
base50	ppb/cm	Base lose in peak50 (CO) spectral region.
c13o2	ppm	Raw $^{13}CO_2$ concentration reading in gas stream
c13o2_dry	ppm	$^{13}CO_2$ concentration reading in gas stream with dry correction
co_fineLaserCurrent	Unitless	Fine laser current at the peak of CO spectral line
co_fsrIndex	Unitless	Fsr index of CO peak within whole acquired spectra
copts	Unitless	Number of points on CO absorption peak
cords	Unitless	Number of ring-downs on CO absorption peak
di_rms	Unitless	RMS of fineLaserCurrent to fsrIndex 2nd order polynomial fit
dm_latency	Seconds	Time for data to move through Datamanager
fitBackground	ppb/cm	Averaged detector background to last raw ringdown traces, 4x
fit_time	Seconds	Duration to fit data to model
gaps	Unitless	Number of gaps in the spectra within last measurement interval
interval	Seconds	Duration for one-point measurement

Data Key	Units	Definition
max_cavity	Torr	Maximal cavity pressure within last measurement interval
max_diff_cavity	Torr	Maximal cavity pressure difference with last measurement
max_fitter_latency	seconds	Duration to fit data to model
min_cavity	Torr	Minimal cavity pressure difference with last measurement
mode_span	Unitless	Number of modes in fit region
n2o_fineLaserCurrent	Unitless	Fine laser current at the peak of N_2O spectral peak
n2opts	Unitless	Number of points on N_2O absorption peak
n2ords	Unitless	Number of ring-downs on N_2O absorption peak
ngroups	Unitless	Number of fsr group modes in fit region
ntopper	Unitless	Number of points at the CO peak
numpoints	Unitless	Number of ringdowns in spectra
peak1	ppb/cm	Peak absorption of N_2O feature
peak31	ppb/cm	Peak absorption of H_2O feature
peak40	ppb/cm	Peak absorption of $^{13}CO_2$ feature
peak50	ppb/cm	Peak absorption of CO feature
peak_height	ppb/cm	Peak height of CO absorption peak
pzt_adjust	Unitless	PZT adjustment after each measurement
pzt_mean	Unitless	PZT average value in each measurement
pzt_offset	Unitless	Effective PZT value with adjustment
range_shift	fsr	Spectra offset in FSRs from nominal position

Data Key	Units	Definition
rejected	Point	Number of ringdowns rejected by fsr-hopping grouping filter
res_pre	Unitless	Residuals after fitter scheme #0 (pre-fit)
resa	Unitless	Residuals after fitter scheme #3-5 (reference for N_2O peak fit)
resb	Unitless	Residuals after fitter scheme #6 (reference for CO peak fit)
residuals	unitless	Residuals after fitter scheme #1 (pre-fit)
shifta	cm^{-1}	Base shift after fitter scheme #3-5
shiftb	cm^{-1}	Base shift after fitter scheme #6
spect_duration	Seconds	Duration to collect spectrum
spect_latency	Seconds	Duration to send spectrum
str1	Unitless	Raw strength of peak#1 (N_2O) without any corrections
str1_dry_TC	Unitless	Strength of peak#1 (N_2O) with temperature, interference, and dry corrections. Converts to N2O_dry with its scaling factor.
str1_spec	Unitless	Strength of peak#1 (N_2O) with temperature and interference corrections. Converts to N_2O with its scaling factor.
str1_spec_raw	Unitless	Last good “str1_spec” without cavity pressure burst
str31	Unitless	Raw strength of peak#31 (H_2O) without correction.
str31_spec	Unitless	Strength of peak#31 (H_2O) with interference correction. Converts to H_2O with its scaling factor.
str31_spec_raw	Unitless	Last good “str31_spec” without cavity pressure burst

Data Key	Units	Definition
str40	Unitless	Raw strength of peak#40 ($^{13}CO_2$) without correction.
str40_dry_TC	Unitless	Strength of peak#40 ($^{13}CO_2$) with temperature and dry corrections. Converts to c13o2_dry with its scaling factor.
Str40_spec	Unitless	Strength of peak#40 ($^{13}CO_2$) with interference correction. Converts to c13o2 with its scaling factor.
str40_spec_raw	Unitless	Last good “str40_spec” without cavity pressure burst
str50	Unitless	Raw strength of peak#50 (CO) without any corrections
str50_dry_TC	Unitless	Strength of peak#50 (CO) with temperature, interference, and dry corrections. Converts to CO_dry with its scaling factor.
str50_spec	Unitless	Strength of peak#50 (CO) with temperature and interference corrections. Converts to CO with its scaling factor.
str50_spec_raw	Unitless	Last good “str50_spec” without cavity pressure burst
time	Seconds	Current time in EPOCH format
timestamp	milliseconds	Current time, (time*1000 + 62135596800000)
tipstd	ppb/cm	Loss standard derivation of peak RD-group at CO peak#50
tiptop	ppb/cm	Loss average of peak RD-group at CO peak#50
y1	cm^{-1}	Linewidth of N_2O peak
y31	cm^{-1}	Linewidth of H_2O peak
y40	cm^{-1}	Linewidth of $^{13}CO_2$ peak
y50	cm^{-1}	Linewidth of CO peak

D Enabling/Disabling Data Output

The instrument allows for customization of the data output. Several data outputs can be enabled and disabled. Follow the instructions below to customize the data output.

1. Back up the following .ini file. This is useful if recovery of the original file is needed.
2. Modify the applications section as shown below. Adding **#** in front of the highlighted lines disables the application load; removing the **#** enables the application. Avoid any random mistyping or errors in this file.
3. Restart the computer to make the changes effective.

The .ini file resides in the following directory:

/home/picarro/I2000/AppConfig/Config/Supervisor/supervisorEXE_JKBDS.ini

[Applications]
EventManager = 50000
Driver = 50010
Archiver = 50060
RDFreqConverter = 50015
SpectrumCollector = 50075
FsrHoppingController = 50016
Fitter1 = 50180
MeasSystem = 50070
DataManager = 50160
SampleManager = 50080
InstMgr = 50110
AlarmSystem = 50100
ValveSequencer = 50200 # COM#2 by default, upper port of right-bottom of rear panel
CommandInterface = 50120 # COM#1 by default, lower port of right-bottom of rear panel
4to20Server = 50290 # COM#4 by default, on motherboard
QuickGui = # 50220
DataLogger = 50090
#Controller = 50050
ModbusServer =
BackupSupervisor =
FileEraserSimplified =
……

E Analog Current Signal Output

Four channels of 4-20 mA current analog output are available on the back of the analyzer.

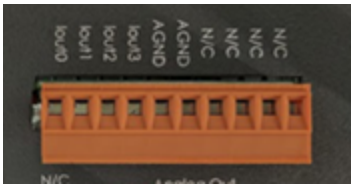


Figure 71 - 4–20 mA Output with Terminal Connector

Conversion from current readings to measurement value:

Measurement = Min + [I(reading, mA) – I0 (4 mA)] / 16 (mA) * (Max- Min)

For example, channel#0 reading of 6.735 mA indicates:

N_2O (ppb) = 0 + (6.735-4.0) / 16 * (2000.0-0.0) = 341.875.

Channel#3 reading of 7.805 mA indicates:

H_2O (ppm) = 0 + (7.805-4.0) / 16 * (500000.0-0.0) = 118,906.3.

By default, the settings for the four channels are as follows:

Table 14 - Signal Output Settings

	Iout0	Iout1	Iout2	Iout3
Monitoring	N_2O_dry	CO_dry	H_2O	Cavity Pressure
Units	ppb	ppb	ppm	Torr
Min	0.0	0.0	0.0	0.0
Max	2000.0	2000.0	50000.0	1000.0

E.1 Connecting the 4–20mA Signal Output

To connect to the output:

1. Using your fingers, pull the 4–20 mA terminal connector straight back away from the analyzer.

Figure 72 - Removing the Terminal Connector

2. Use a small slotted screwdriver to loosen the retaining screw for the desired terminal.

Figure 73 - Terminal Connector Retaining Screws

3. Insert the stripped end of the wire into the terminal.
4. Tighten the retaining screw.
5. Repeat for each desired terminal.
6. Slide the terminal connector back onto the analyzer with the retaining screws facing down; there should be a soft click when the connector is set into its proper position.

NOTE

If shielding is desired, connect the drain wire of the shielded cable to the ground lug on the back panel. Do not connect the shield to the ground pins of the 4–20 mA connector. Connect only one end of the shielded cable to the ground lug to avoid ground loops.

F Data File Viewer

F.1 Quick Start Guide

The following sections introduce the user to all possible functionalities of the Data File Viewer in detail. This section describes the most common, simple use case.

The Data File Viewer software allows the user to concatenate multiple one-hour files into one larger file, enabling the user to observe trends over several days of measurements.

1. To start, translate the UserData files from DAT to H5. The **Batch Convert option** (B) allows user s to select any folder containing instrument data from a given day.

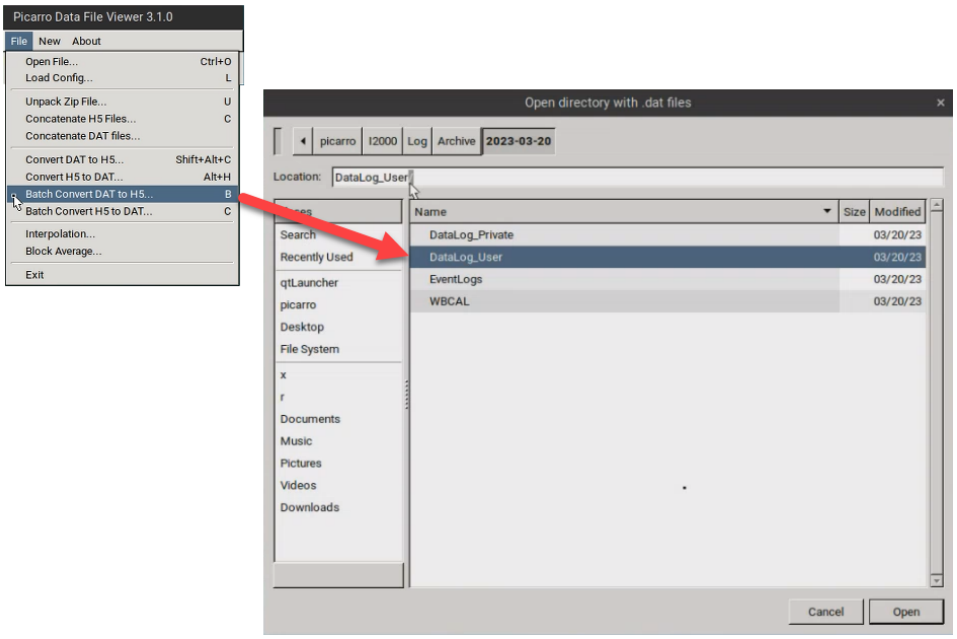


Figure 74 - Batch Convert DAT to H5 – Navigation

2. In the source folder there are now copies of the original files translated into the H5 format.
3. From **File** menu select **Concatenate H5 Files** (**C**) to combine the H5 files into a time series. Take care to select exactly the same folder in the file viewer window.
4. In the Select Variables window, click **All** to move over all variables for concatenation. If concatenating large records, the user can instead select only a few variables by clicking the variable name on the left dialogue, and clicking the double arrow button. Confirm by clicking **OK**.

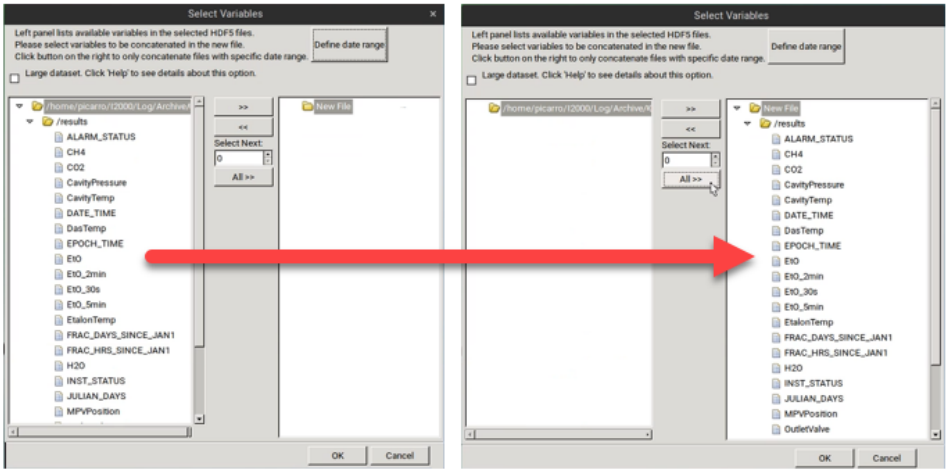


Figure 75 - Selecting Variables for Concatenation

5. The user will then be asked to confirm the file name for the concatenated data. The default location is the parent folder for the selected day, and the filename by default describes the time span of the measurements within. Successful concatenation is indicated by the filename automatically being displayed in the main data file viewer window as shown in the following figure.

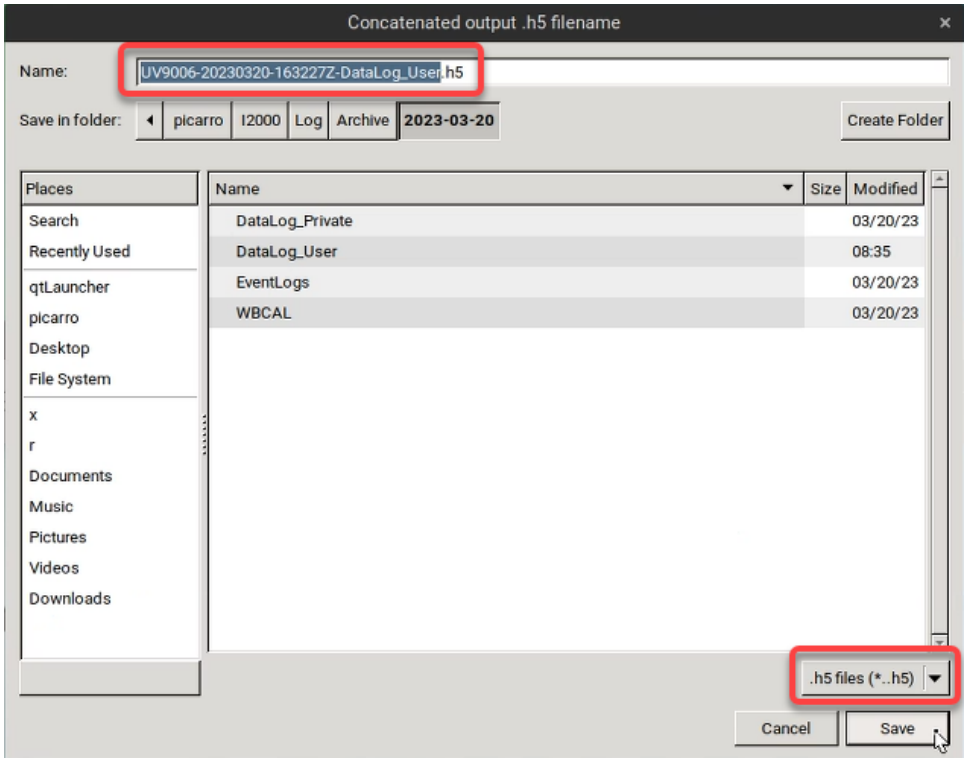


Figure 76 - Concatenated Output .h5 Filename

NOTE

You can concatenate several days into one larger file, either by following steps 1-3 for selected folders, or by copying all their DAT files into a new folder and performing steps 1-5 just once.

6. With the file now opened, the user can select how many **Time Series** to display on the screen.

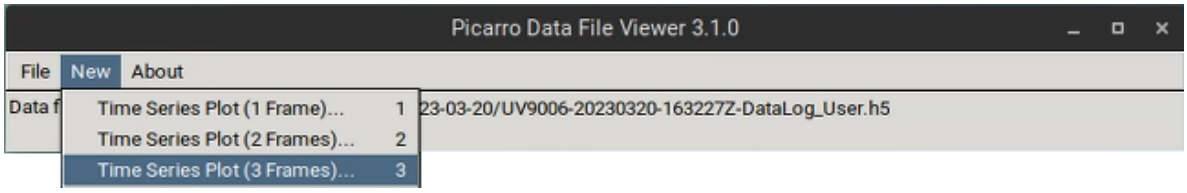


Figure 77 - Time Series Selection Options

7. In the new window that displays, select the variables from the **Var Name** dropdown on the right of each plot. Deselect **Autoscale y** if the data stream has a large amount of variability in the Y-axis.
8. Please read the following sections to learn more about features of the Data File Viewer.

F.2 Data File Viewer Overview

The Picarro Data File Viewer software is located from the **Picarro Launch Pad**, **Home** menu. This software allows you to graph and to conduct statistical analysis of the raw data. Additional functions include Allan Variance plot and quadratic or polynomial fittings. The Picarro Data File Viewer includes two main menus: File and New.

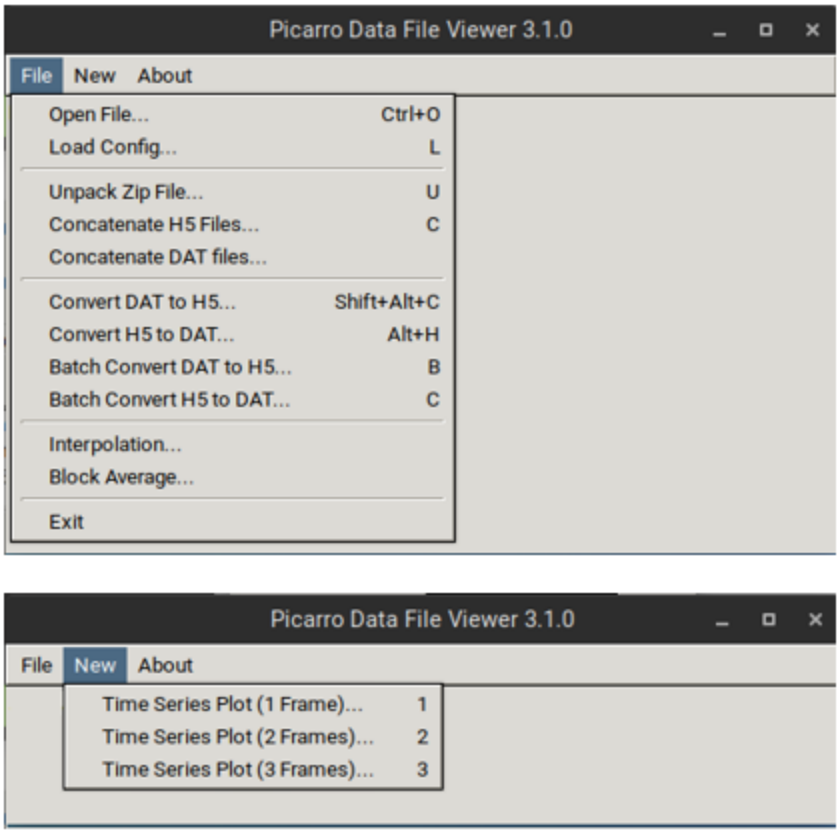


Figure 78 - Picarro Data File Viewer – File and New Menus

F.2.1 File Menu

This section describes the functions available from the Data File Viewer File menu.

Open File

File > Open File: Opens a Picarro data file (HDF5 format) for data analysis and visualization. After opening the data file, you can create a new time series plot. Refer to F.2.2 New — Time Series Plot for more information.

Load Config

File > Load Config: Loads a configuration file (ini format) to restore parameters of a workplace. Refer to F.3.1 Save Configuration for more information.

Unpack Zip File

File > Unpack Zip File: Use to concatenate all H5 files inside the zip file into a single H5 file. Refer to Concatenate H5 Files below for details.

Concatenate H5 Files

File > Concatenate H5 Files: Use to concatenate multiple files and zip archives of H5 files into a single H5 file. Navigate to the desired folder or use the **Define Date Range** button to specify a date range of files to concatenate. (see Define Date Range).

After selecting the path of the data files, Data File Viewer will automatically search an H5 file in the specified zip/folder and look for all available variables in the H5 file. The variables are then listed in the **Select Variables** window in the left panel, and users can use the **>>** button to move variables to the right panel for concatenation.

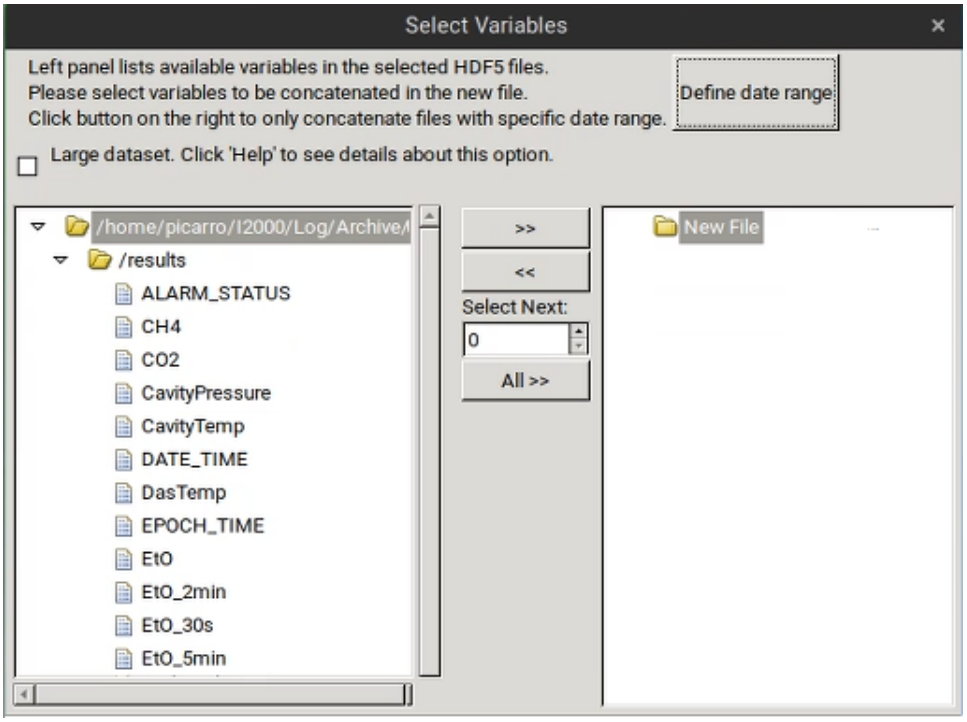


Figure 79 - Select Variable Form

NOTE

This screenshot is for example only. The species selections shown on your analyzer may vary.

Define Date Range

Data File Viewer can search data files within the desired date range and then concatenate such files into an H5 file.

By default, TimeZone is set to your local time zone. However, if data were taken elsewhere, select the time zone where data was taken.

Select File > Concatenate H5 Files, and click **Define Date Range** to specify the desired date range as shown in the following figure.

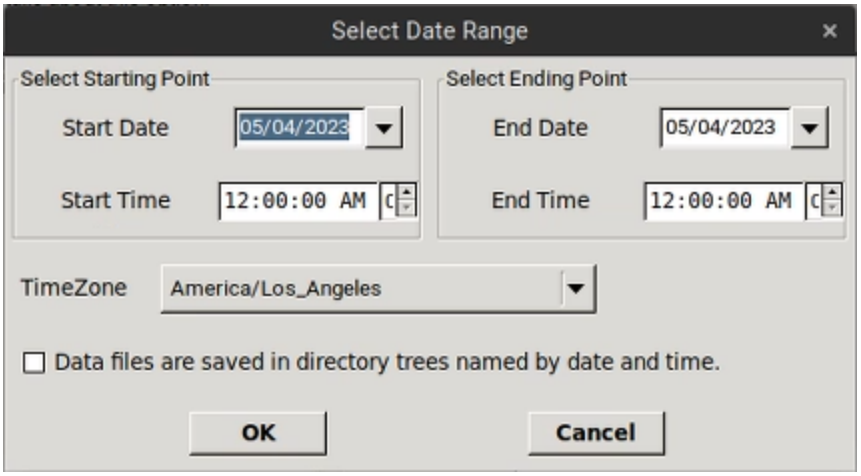


Figure 80 - Define Date Range Dialog

Picarro software saves data in directories that are named by the creation year, month, and day. Select Data files are saved in directory trees named by date and time option if the target folder has this file structure. This allows Data File Viewer to only search folders within the desired date range, which can substantially reduce processing time.

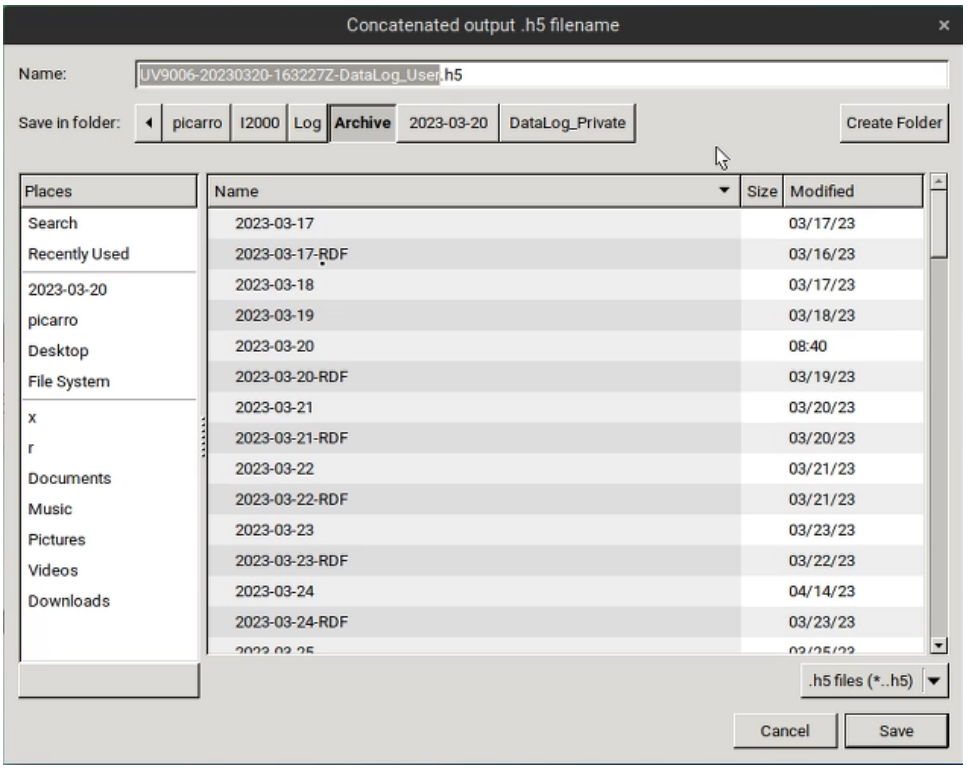


Figure 81 - File Structure of Data File Viewer

NOTE

To save processing time, Data File Viewer does not open data files, but only determines data acquisition time based on the file name.

CAUTION

Do not define a time range for data files whose names have been changed.

NOTE

Data File Viewer does not concatenate data files exactly within the defined time range. This is because the time extracted from file name is different from the data acquisition time. To not miss data points, Data File Viewer expands the specified time range, so the resulting data set normally has a wider time range than the user specification.

Convert DAT to H5

Select File > Convert DAT to H5 to convert a file in DAT format to HDF5 format. These formats are described below:

- **DAT Format**: DAT files accepted by DatViewer store tabular data (numbers and text) in plain text.
  - Each line of the file is a data record. Each record consists of one or more fields separated by whitespaces.
  - The first line of the data file indicates column names.
  - There must be a field “EPOCH_TIME” to store the acquisition epoch time (expressed as seconds since Jan 1, 1970) of the data. Otherwise, the first and second fields must be “DATE” and “TIME”. The “DATE” field must have the format “mm/dd/yyyy” or “yyyy-mm-dd”, and the “TIME” field must have the format “HH:MM:SS(.sss)” where (.sss) is an optional fraction of seconds.
- **HDF5 Format**: HDF5 is a data model, library, and file format for storing and managing data. (See the HDF5 Home Page on the HDF Group website https://www.hdfgroup.org/ for more information.) When converting DAT to HDF5 format, Data File Viewer creates a table named “results” to the contained data.

Convert H5 to DAT

Select File > Convert H5 to DAT to convert a file in a HDF5 format to DAT. These formats are described in Convert DAT to H5.

NOTE

Data File Viewer does not concatenate data files exactly within the defined time range. This is because the time extracted from file name is different from the data acquisition time. To not miss data points, Data File Viewer expands the specified time range.

Interpolation

Interpolation describes the method for constructing data points with a range of a discrete set of known data points. Select **File > Interpolation** to perform interpolation on a time grid with a constant interval.

Block Average

Select **File > Block Average** to divide a data set into small blocks based on a user-defined block size. The average is calculated for data in each block, and the results are saved in a new H5 file.

NOTE

The specified block size must be greater than the average data interval.

Because the data interval is normally not a constant (unless interpolation is performed), fluctuations in the data interval will affect block averaging if the block size is comparable to the average data interval.

F.2.2 New — Time Series Plot

You can specify to include create time-series plots with one, two, or three frames. New plots display in the Time Series Viewer.

NOTE

This screenshot is for example only. The species shown on your analyzer may vary.

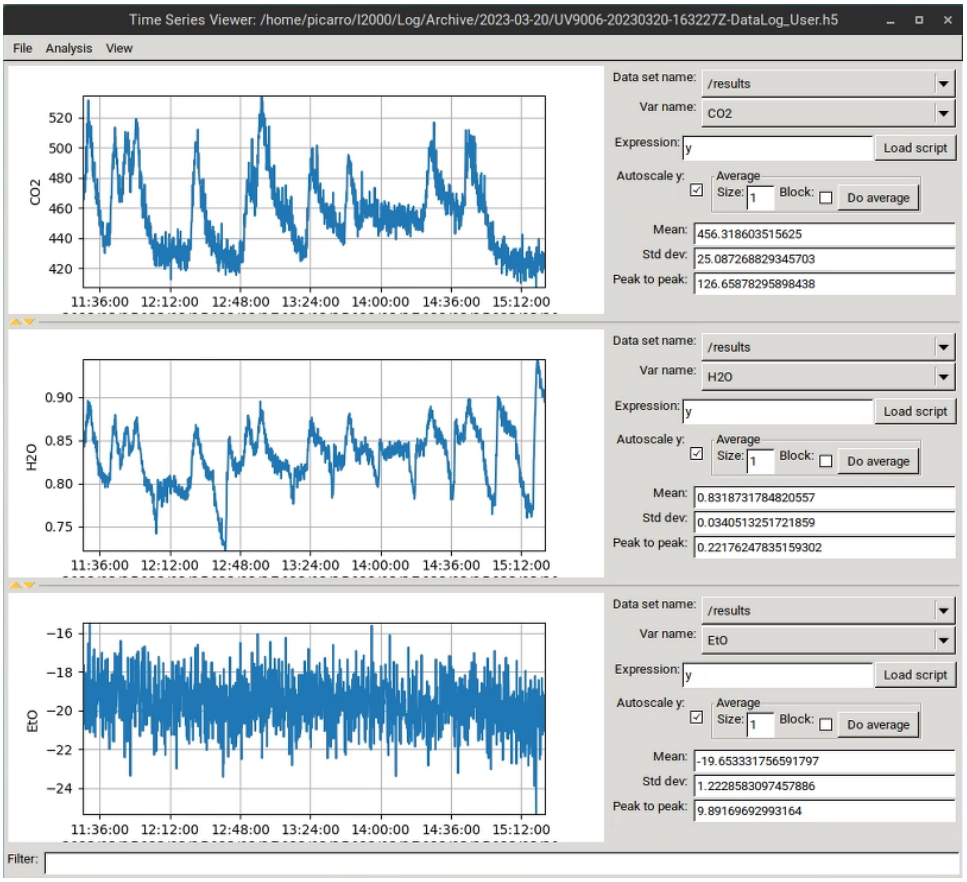


Figure 82 - Time Series Viewer

The next section describes the options available on the **Time Series Viewer** menu bar. Refer to The Time Series Viewer Canvas or more information on the Time Series Viewer UI features and options.

F.3 Time Series Viewer Menus

The Time Series Viewer form includes the following menus:

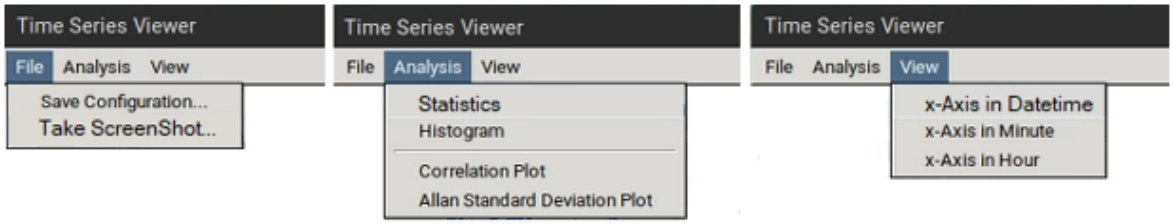


Figure 83 - Time Series Viewer Menus

Use the **File** menu to save a configuration or take a screenshot.

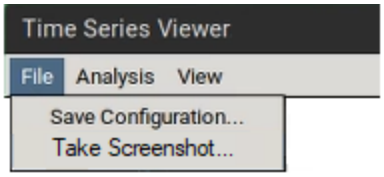


Figure 84 - Time Series Viewer – File Menu

F.3.1 Save Configuration

Click **File > Save Configuration** to open the **Feature Capture** form. With this form, you can save figure properties, expressions, filters, and other settings to a configuration file so that it can be easily loaded in the future.

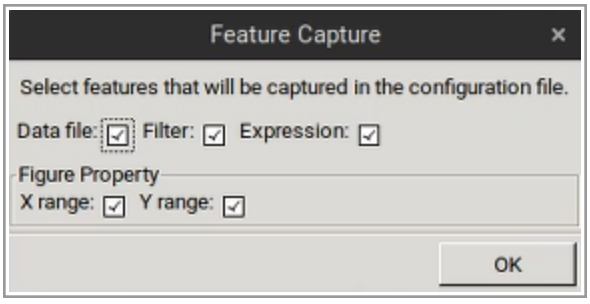


Figure 85 - Time Series Viewer – Feature Capture

⚠ CAUTION

If a feature is not captured, it will be omitted when the configuration file is loaded.

Depending on the features captured, loading a configuration file can have different effects. For example:

- If all features are captured, a saved workplace is reproduced.
- If a data file is not captured, saved parameters are applied to the data file in memory.
- If an expression is not captured, plots will not be transformed.
- If X (Y) range is not captured, figures are auto-scaled on the x (y) axis.

F.3.2 Take Screenshot

Use **File > Take ScreenShot** to take a screenshot of the Time Series Viewer and save it as a .png to a specified file.

F.3.3 Time Series Viewer Analysis Menu

Use the Analysis menu to calculate statistics, generate a histogram, and to plot correlations and Allan Standard deviations.

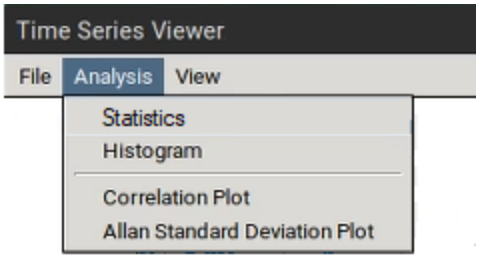


Figure 86 - Time Series Viewer – Analysis Menu

Statistics

Use **Analysis > Statistics** to calculate mean, standard deviation, and peak to peak for all plots in the current window.

Histogram

Use **Analysis > Histogram** to generate a histogram of data.

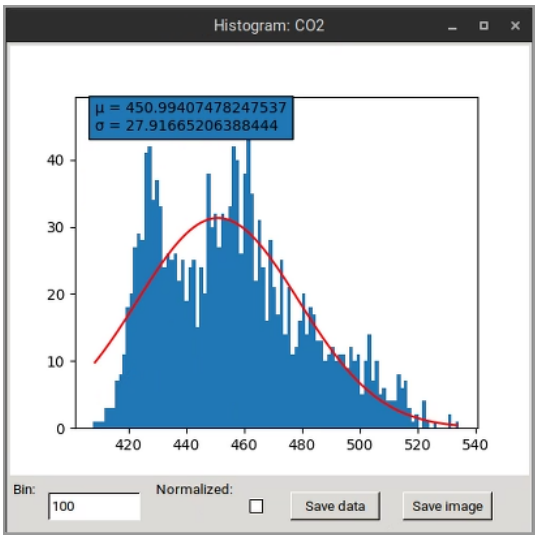


Figure 87 - Histogram Window

Histogram Window Features

- **Red Line** — A Gaussian function fitted to the histogram. Fitting results of μ and σ are shown in the top-left corner of the plot.
- **Bin** — Specifies the number of intervals that the range of values is divided into.
- **Normalized** — When selected, the sum of the histograms is normalized to 1.
- **Save data** — Saves histogram data to a CSV file.
- **Save image** — Saves the histogram image as a JPEG/PNG/PDF file.

Correlation Plot

Use **Analysis > Correlation Plot** to plot Y-axis data in one frame versus that in the other. This can be used when two or more frames exist in the current Time Series Plot window. See the Correlation/XY Plot for details.

Allan Standard Deviation Plot

Use **Analysis > Allan Standard Deviation Plot** to create an Allan Standard Deviation plot (versus a standard deviation plot) for data in the current window. See Allan Variance Wikipedia page for more information.

F.3.4 Time Series Viewer View Menu

Use the View menu to view X-axis information in date-time, minute, or hour format.

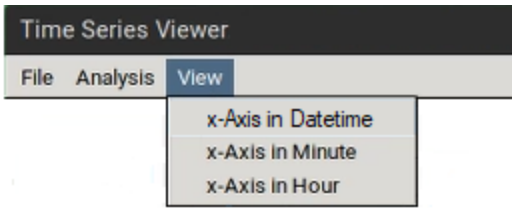


Figure 88 - Time Series Viewer – View Menu

NOTE

When switching from Datetime to Minute or Hour, the X-axis data is subtracted from the earliest point shown in the panel and then converted to the desired unit.

F.3.5 The Time Series Viewer Canvas

The Time Series Viewer canvas is comprised of interactive graphs and a variety of configuration options.

NOTE

This screenshot is for example only. The species shown on your analyzer may vary.

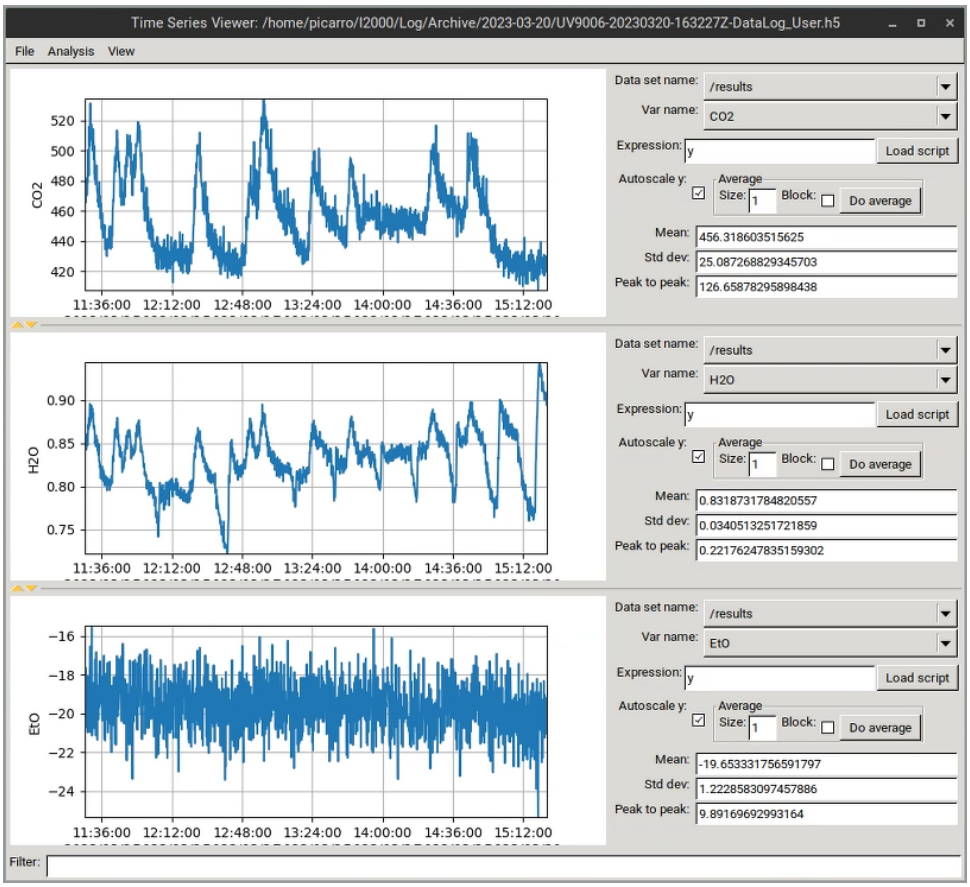


Figure 89 - Time Series Viewer Canvas

Mouse Options and Graph Transform

The following mouse actions can be used in the canvas graphs:

- **Left-click and drag** — Zooms into the selected area of the plot.
- **Left-click and drag with the SHIFT key down** — Pans the plot.
- **Left-click and drag with CTRL key down** — Zooms out from the plot.
- **Left-click and drag with ALT key down** — Stretches the plot.
- **Right-click** — Opens an additional menu. Refer to the Right-click menu below in the next section.

Right-click Menu

Right-clicking on the canvas opens a pop-up menu:

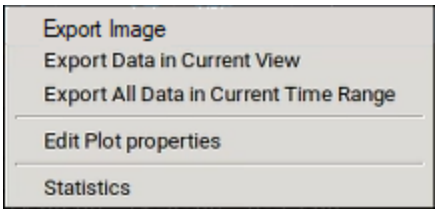


Figure 90 - Canvas Right-click Pop-up Menu

The following options are available from the right-click menu.

- **Export Image** — Exports the current plot as a jpeg, png, or pdf file.
- **Export Data in Current View** — Exports only date/time and the selected variable in the current view to an HDF5 or CSV file.
- **Export All Data in Current Time Range** — Exports all variable columns of the selected dataset in the current time range to an HDF5 file. Refer to Concatenate H5 Files on Page 81 for more information.
- **Edit Plot Properties** — Opens the Image Editor form where the following options can be specified.

Image Editor

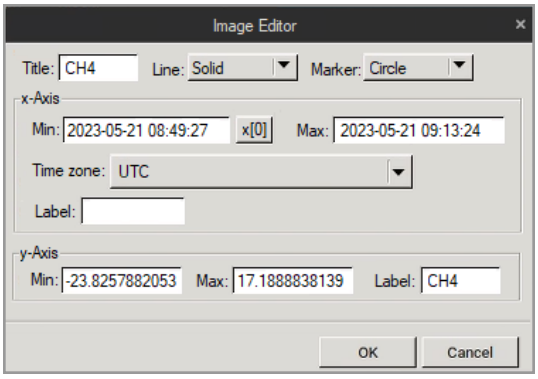


Figure 91 - Time Series Viewer Image Editor

Image Editor Form Options:

- **Title** — Edits the title of the plot.
- **Line** — Specifies the line pattern of the plot. If None is selected, the data points will be plotted without connecting lines.
- **Marker** — Specifies the marker type to indicate data points. If None is selected, data points will not be shown.
- **x-Axis** — Min and Max: Specifies the minimum and maximum date range for the X-axis.
- **x[0]** — Sets the earliest time of the dataset as the minimum of the X-axis.
- **Time zone** — Sets the time zone for date/time variables. This defaults to the local time zone.

- **Label** — Specify labels for the X-axis and the Y-axis.
- **y-Axis** — Min and Max: Specifies the minimum and maximum of data displayed on the Y-axis.

Dataset Name and Var Name

An HDF5 file can store one or more tables. Each of these tables is called a Dataset. A table can contain one or more columns. Each column is called a variable (Var).

Use the **Dataset name** drop down to select the dataset that is used for this time series graph. Use the **Var name** drop down to select the column in the dataset to use in the graph.

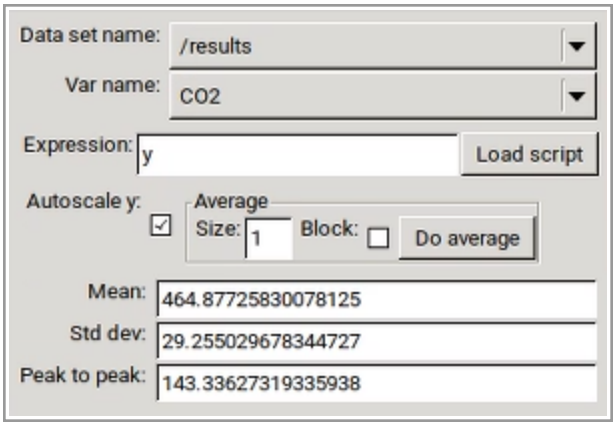


Figure 92 - Time Series Viewer Dataset Options

Autoscale Y

When the **Autoscale Y** option is selected, the Time Series Viewer will autoscale on the Y-axis to make sure that all data within the range of the X axis is displayed. This feature can make it hard to see small signals when large signals blow the Y axis out, so it is often advisable to deselect this check box for dynamic or spikey datasets.

Average

If **Block** is selected, a block average is calculated when you click the **Do average** button. Otherwise, a moving average is calculated.

For a block average, **Size** specifies block size in unit of a minute. For a moving average, **Size** specifies subset size in unit of data points.

REMINDER

Averaging is performed after the Filter and Expression are performed.

Mean, Std Dev, and Peak to Peak

The **Mean**, **Std dev** (Standard deviation) and **Peak to peak** fields (Figure 92) provide all the statistical information of data in the current view.

Correlation/XY Plot

The **Correlation/XY Plot** window includes three menu items: **File**, **Fitting** and **Analysis**. For details about the File menu, see F.3.1 Save Configuration and F.3.2 Take Screenshot. Fitting and Analyst are described below.

REMINDER

The canvas in this plot is interactive. For details about the plot canvas, see F.3.5 The Time Series Viewer Canvas.

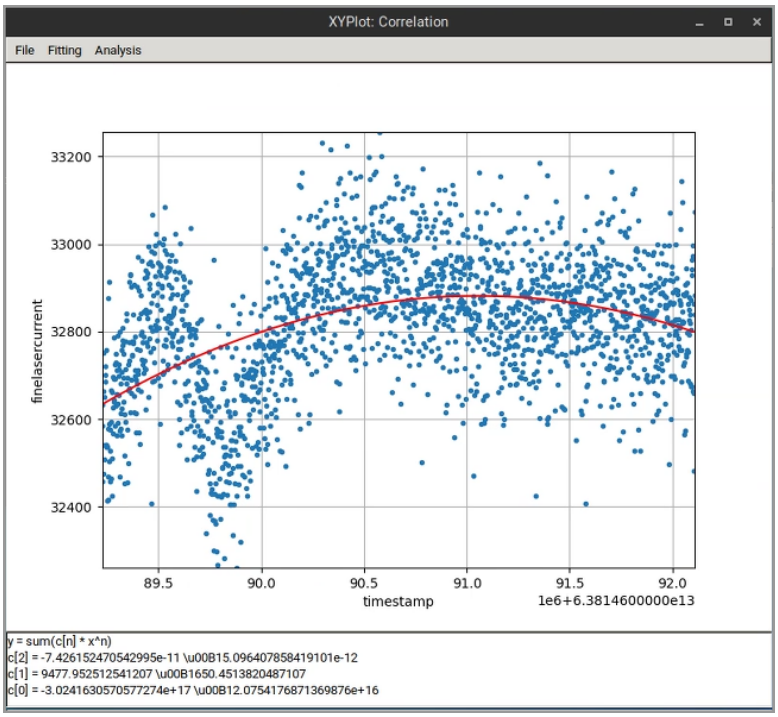


Figure 93 - Correlation XY Plot

F.3.6 Fitting Menu

The Fitting menu includes three options which are described below.

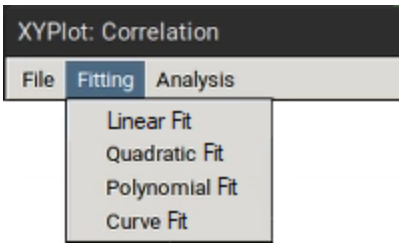


Figure 94 - Fitting Menu

Fitting allows you to specify one of four fitting methods to include in the Correlation/XY plot:

- **Linear Fit** — Specifies to fit to linear function:
  $y = c1x + c0$
- **Quadratic Fit** — Specifies to fit to quadratic function:
  $y = c2x2 + c1x + c0$
- **Polynomial Fit** — Specifies to fit polynomial function of degree n:
  $y = \Sigma\, cnxn$
- **Curve Fit** — Specifies to use non-linear least squares to fit an arbitrary function to data.

F.3.7 Analysis Menu

The Analysis menu has two options: **Integration** and **Statistics**.

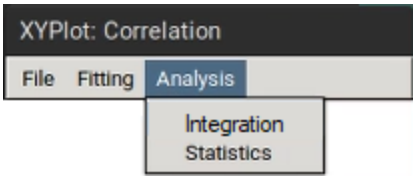


Figure 95 - Analysis Menu

- **Integration** — Calculates area under the curve using the composite trapezoidal rule.
- **Statistics** — Calculates mean, standard deviation, and peak to peak for data in the current view.

After applying any of the above Analysis options, the results, statistics, or fitting function with coefficients are displayed in the lower portion of the Correlation Plot window.

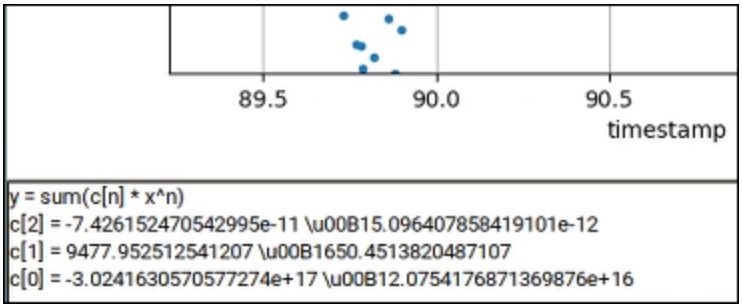


Figure 96 - Results of Quadratic Fitting

G Setting up Contained Exhaust Flow

The A2000 vacuum pump is shipped with a noise dampener attached to the exhaust port. When a hazardous gas exhaust line from the pump is needed, it requires replacing the noise dampener with an adapter that allows a 1/4” OD exhaust tubing connection. Use the following instructions when installing a pump exhaust line.

1 Exhaust Port with Noise Dampener

2 Vacuum Port

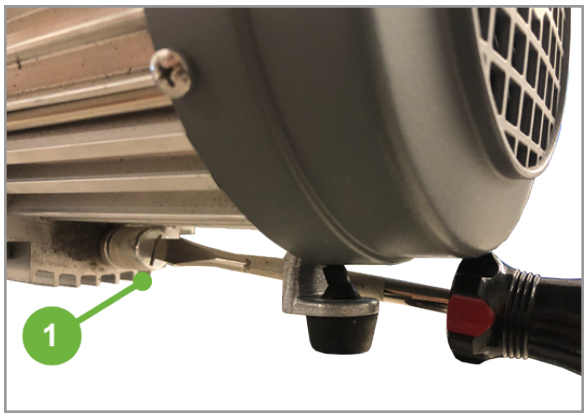
Figure 97 - A2000 Pump Vacuum and Exhaust Ports

G.1 Tools and Parts Required

- Long flathead screwdriver (6” x 5/16” recommended)
- 9/16” open end wrench
- Swagelok ISO parallel thread adaptor 1/4"-1/8” SS-400-1-2RS (Picarro PN 22928)
- Swagelok gasket SS-2-RS-2V (Picarro PN 22929)
- 1/4" tubing and stainless-steel ferrule set
- Snoop leak-detection fluid or similar soap solution

G.2 Directions

1. Remove the noise dampener fitting from the bottom of the pump using a long flathead screwdriver (Figure 98).

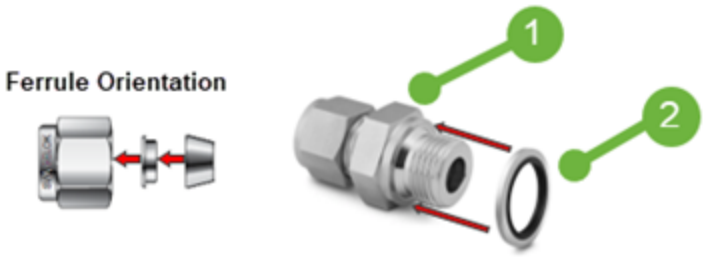


1 Noise Dampener

Figure 98 - Pump Noise Dampener Removal

2. Slide the adapter gasket PN 22929 onto the adapter fitting PN 22928 (Figure 99), screw it into the pump exhaust port, and then tighten it 1/4 turn using a 9/16” wrench.
3. Remove the Swagelok nut and ferules from the adapter fitting to ensure their orientation is as shown below, then loosely reattach to the adapter.
4. Slide the 1/4” exhaust tubing into the Swagelok nut and ferules until the tubing is fully seated, then using a 9/16" wrench, tighten the nut approximately seven flats (420 degrees).

   A guide to this process can be found on the Picarro Video Gallery here: https://mktg.picarro.com/acton/media/39674/picarro-video-gallery



1 Adapter Fitting PN 22928

2 Adapter Gasket PN 22929

Figure 99 - Pump Exhaust Line Adapter Fittings

5. With the pump running on room air, apply Snoop leak detection fluid to the installed exhaust components to confirm that the system is leak tight. Instructions for leak testing using Snoop can be found in this video: https://vimeo.com/375518688 (go to time 5:20 in the video)

H External Valve Sequencer

H.1 Introduction

The Picarro analyzer can control two types of valves:

- **Rotary Selector Valve** — Digitally controlled valve used to send selected flow from one of many inputs (up to 16) into the analyzer.
- **Solenoid Valves** — DC voltage powered valve with normally open (NO) and normally closed (NC) positions. These can be 2-way or 3-way valves.

Both types of valves can be simultaneously controlled through a common software interface called the External Valve Sequencer (described in H.6 External Valve Sequencer Software Overview) which is available from the **Tools** menu on the GUI.

Picarro offers two rotary valve and two solenoid valve solutions:

- **A0311** — 16-Port Distribution Manifold.
- **A0311-S** — 16-Port Distribution Manifold (Silco) which is optimized for use with sticky and reactive gases.
- **S3112** — 3-Way stainless steel solenoid valve with 1/4” fittings.
- **S3136** — 3-Way stainless steel solenoid valve with 1/8” fittings.

H.2 A0311 16-Port Distribution Manifold

H.2.1 Compatibility

The A0311 (Figure 100) is broadly compatible with most Picarro analyzers except for those with known surface and chemical compatibility issues (such as the G2103, SI2103, SI2108, SI2104, SI2205, G2307, G2509, and PI2114).

H.2.2 Function

The A0311 and External Valve Sequencer GUI makes it easy to program the sequence and duration of sample intake from various attached sampling lines, flasks, or bags. The manifold is controlled using either the Picarro analyzer GUI or an external hand-pad (included with the A0311).

The A0311 samples up to 16 gas sources. During operation, the selected line is routed through the valve into the analyzer. The 15 lines that are not selected terminate in the valve.

NOTE

For detailed instructions on integrating the A0311 with your analyzer, refer to the 16-Port Manifold, User Manual, Including A0311, A0311-S, A0310 (P/N 40-0038).

Figure 100 - A0311 – 16-port Distribution Manifold

H.3 A0311-S 16-Port Distribution Manifold (Silco)

H.3.1 Compatibility

The A0311-S (Figure 101) is broadly compatible with all Picarro analyzers but is optimized for use with sticky and reactive gases in the following platforms, nominally:

- G2103, SI2103, SI2108, SI2104, SI2205, G2307, G2509, and PI2114

H.3.2 Function

For users who require faster response performance, the A0311-S is a 16-Port distribution manifold with a flow through valve for reduced memory effects. Designed to optimize response time in the presence of reactive gases, the A0311-S uses SilcoNert® coated components, PFA tubing, and an additional vacuum pump.

The sampling duration and sequence is easily programmed through the Picarro External Valve Sequencer GUI. This design is ideal for fast switching between different locations for specialty applications in semiconductor, pharmaceutical, environmental research, and other industries.

NOTE

For detailed instructions on integrating the A0311-S with your analyzer, refer to the 16-Port Manifold, User Manual, Including A0311, A0311-S, A0310 (P/N 40-0038).

Figure 101 - A0311-S – 16-Port Sequencer – Fast Multiport Gas Sampler

H.4 Setting Up Solenoid Valves

The Valve Sequencer software can control up to six solenoid valves. Each valve should operate using 12 VDC with a maximum quiescent current of 500 mA. Most analyzers come with a valves cable that can be connected to the solenoid valves, and if not, one can be purchased by contacting support@picarro.com.

⚠ CAUTION

Be careful to avoid shorting the solenoid valve output pins, as this will blow the relays on the power board, requiring a costly replacement.

The valve connector cable should be connected to the 15-pin connector at the lower left corner of the analyzer. There are six pairs of wires with connectors labeled V1, V2, … V6 with 2-pin female Molex connectors (Molex #43020-0200) for connection to the solenoid valves. For valves wired with matching Molex connectors, connect V1 to the solenoid valve 1, V2 to solenoid valve 2, etc. Do not connect the solenoid valve to the analyzer ground – use only the provided electrical connectors.

H.5 Setting up a Rotary Selector Valve

The (null modem) 9-pin female connector cable should be attached to its corresponding 9-pin male port (COM 2) on the analyzer. The other end of the cable connects to the 9-pin port on the A0311. Please note the 9-pin connector cable is not supplied with the instrument – only as part of the A0311 kit.

H.6 External Valve Sequencer Software Overview

The External Valve Sequencer software allows the user to define a sequence of (repeating) steps within which rotary valve positions and/or solenoid valve positions can be defined uniquely at each step.

H.6.1 Opening the Sequencer

From the CRDS Data Viewer, Users dropdown menu login using your username and password. Then, from the Tools drop-down menu, select Show Valve Sequencer GUI. The Picarro valve sequencer window displays, but typically sitting behind the main GUI. Hitting alt-tab brings the Valve Sequencer GUI to the front.

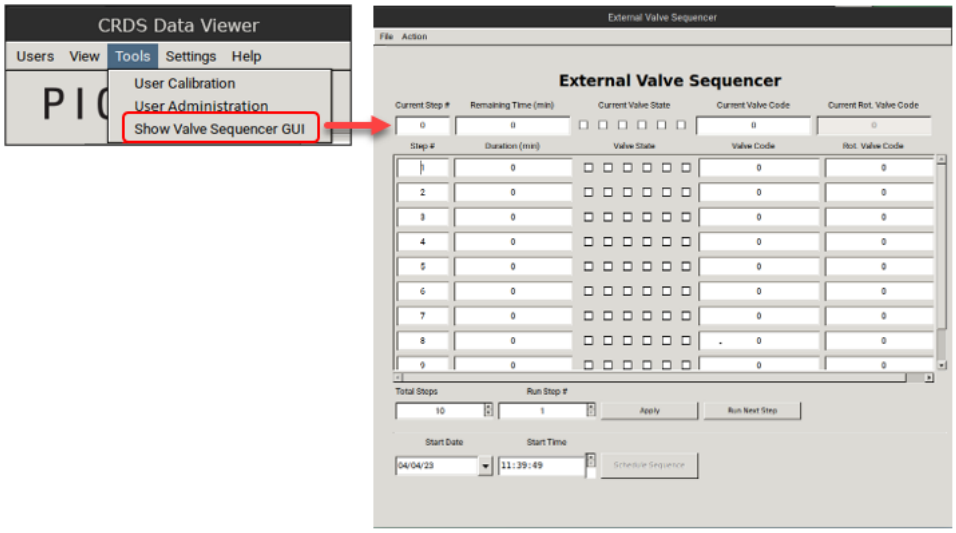


Figure 102 - Launching the Valve Sequencer GUI

H.6.2 Valve Sequencer UI Menus

The sequencer GUI provides the following dropdown menu options.

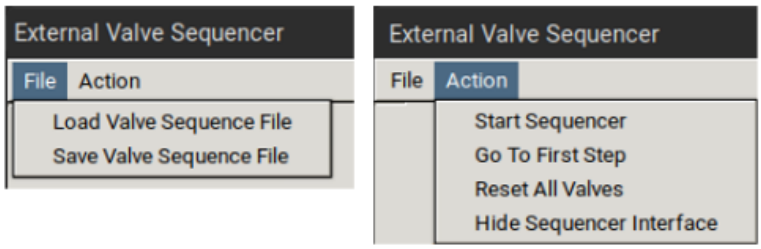
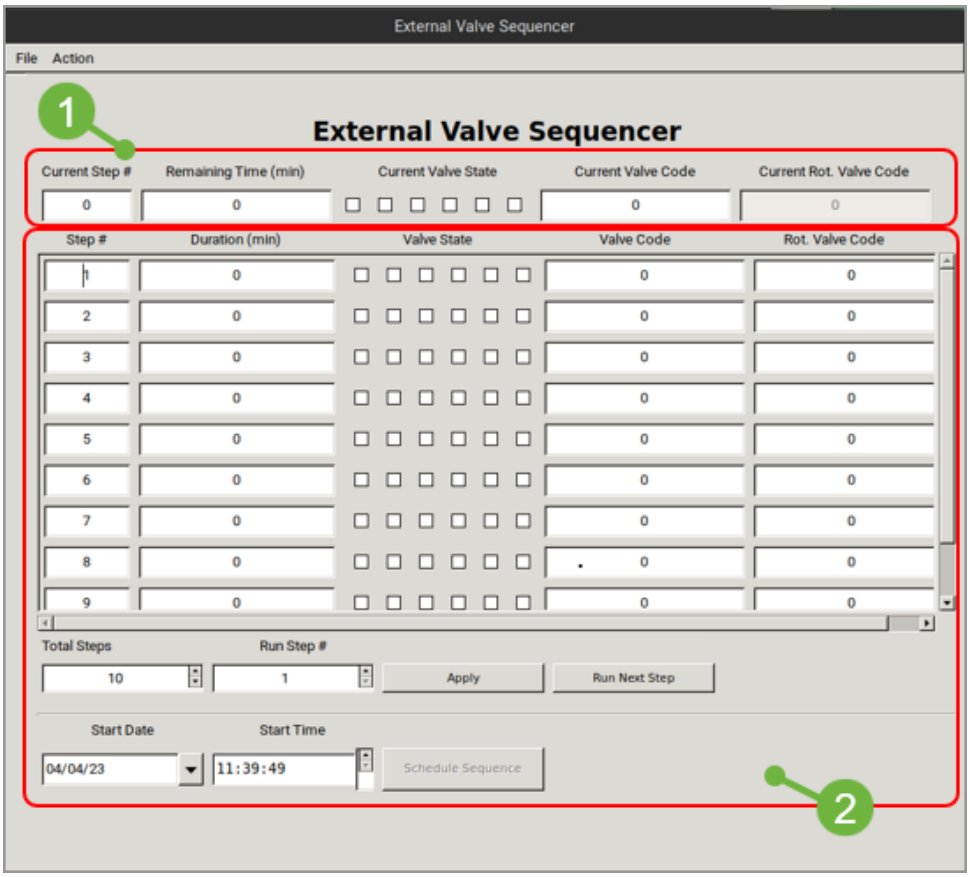


Figure 103 - Valve Sequencer UI Dropdown Menus

The following figure provides functional descriptions of the External Valve Sequencer UI.



1. Current step and valve state status panel (when sequencer is running)
2. Sequencer configuration controls

Figure 104 - External Valve Sequencer UI

The **Current Step #**, the **Remaining Time (min)**, and the **Current Valve State** are shown in the topmost row of the valve sequencer command window. The duration of each step is set in decimal minutes; for example, 15 seconds would be entered in as 0.25 minutes.

While a sequence is inactive, **Current Step #** will typically read "**0**". Once the user has selected **Start Sequence** from the **Action** menu, or once the user clicks **Apply** from the GUI, the **Current Step** value will change to **1**, corresponding to the first step defined below it, and will continue through the steps, returning to Step 1 once the last step is completed.

If a user wishes to perform a set of steps only once, they may set a final step with a very long duration, or wait until the sequence is finished, and at the end of the last step, click **Stop Sequence** from the **Action** menu.

Under **Action**, the **Go to First Step** menu item restarts the sequence from step 1. When the first step in the sequence starts, the "Current Step" value will change to "**1**". This will begin the sequence if the sequence is currently active.

H.7 Programming and Saving a Valve Sequence

Each "step" in the sequence can be used to set the rotary valve to a given position or activate selected solenoid valves for a set period. Multiple steps can be carried out in sequential order to switch between different gas sources, flush out a manifold, or to perform other gas handling operations.

1. Create the number of desired steps in the sequence by clicking the up/down arrow for **Total Steps**.
2. For each step, select the box for each solenoid valve to be opened. The check mark in the **Current Valve State** window indicates a solenoid valve is set to its "normally closed" value in the case of a 3-way, or to its "open" value in the case of a 2-way on/off valve. The positions from left to right correspond to solenoid valves V1 to V6.
3. The rotary selector valve position can be set in the column labeled **Rot. Valve Code**. Enter the number that corresponds to the desired valve position. A value of 1 in this field corresponds to position 1 on the rotary valve. Only one rotary position can be selected per step.
4. The upper right box, **Current Rot. Valve Code**, displays the current value while a sequence is active. It should be white if a rotary valve is connected, turned on, and detected by the software. If the box is grayed out, the rotary valve is not detected (if so, consult your rotary valve manual).
5. For each step, set the desired **Duration**. This is determined by the value entered in the **Duration (min)** field, where the duration of the step is in minutes. If duration values are set to <0.1 minutes, they may not be carried out accurately.
6. The **Valve Code** column (not used with the rotary valves) is a configuration-dependent, read-only display field that shows the total state of that particular step in a numerical binary sum of form 2 (Valve Number -1). When powered, the following valve values are produced, and then added together for the final Valve Code.

   Valve 1 Powered = $2^{(\text{Valve number-1})} = 2^{(1-1)} = 1$
   Valve 2 Powered = $2^{(\text{Valve number-1})} = 2^{(2-1)} = 2$
   Valve 3 Powered = $2^{(\text{Valve number-1})} = 2^{(3-1)} = 4$
   Valve 4 Powered = $2^{(\text{Valve number-1})} = 2^{(4-1)} = 8$
   Valve 5 Powered = $2^{(\text{Valve number-1})} = 2^{(5-1)} = 16$
   Valve 6 Powered = $2^{(\text{Valve number-1})} = 2^{(6-1)} = 32$

The maximum displayable value is 63 (=1+2+4+8+16+32), when valves 1-6 are all powered. All other combinations of valves are unique binary sum values which denote the specific combination of any of the six valves.

This **Valve Code** value active at a particular point in time can be shown in the main Picarro software GUI as **SolenoidValves** or sometimes **ValveMask** (this may require going to **Settings** > **Service Mode** > **password picarro**). The Rotary valve code can be displayed as **MPVPosition**.

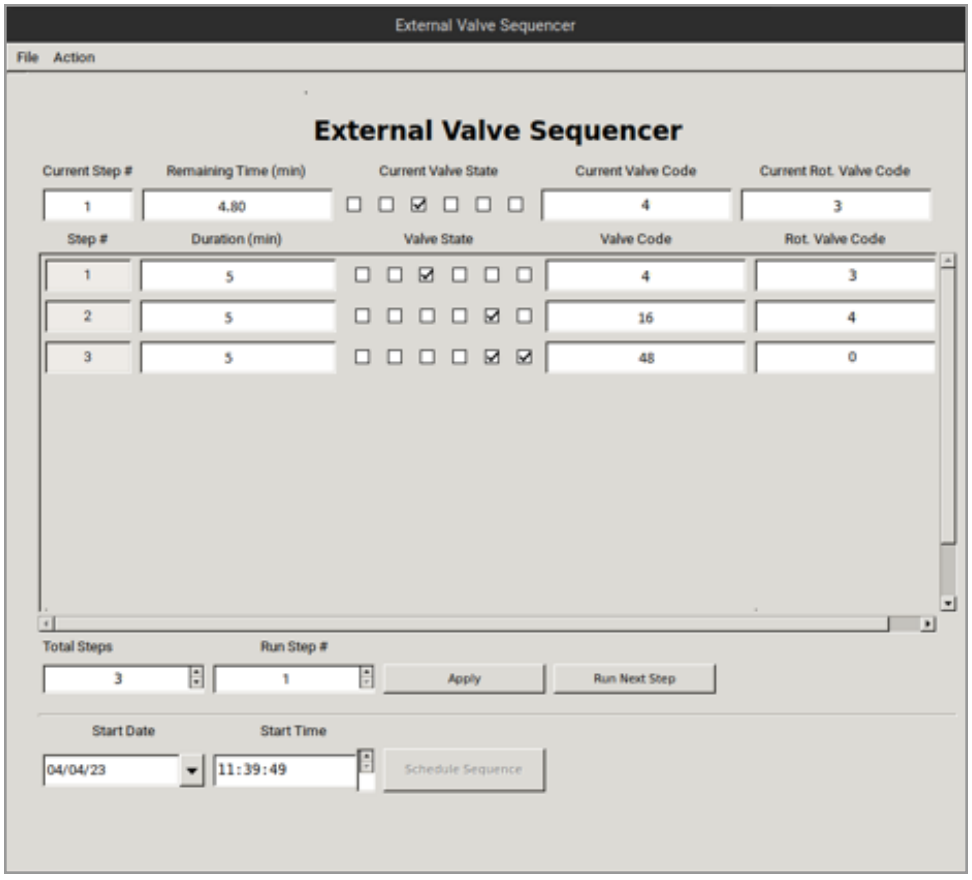


Figure 105 - Example 15 Minute Sequence

NOTE

Above is a 15 minute valve sequence. It opens 5 minutes for each solenoid valve (#1, #2 and #3), and each of rotary valve (#4, #5 and #6).

7. Once the valve sequence has been programmed, it can be saved by selecting **Save Valve Sequence File** under the **File** menu (Figure 103). The sequence may be saved with any name the user chooses.

H.8 Loading and Running a Saved Sequence

H.8.1 Loading a Saved Sequence

1. Under the File menu, select **Load Valve Sequence**.

   All the sequence files are in:

   /home/picarro/I2000/InstrConfig/ValveSequencer/Name of the Sequence File

2. To load an existing valve sequence file, select the desired sequence name.

   If the user has been running a different sequence from the one that was loaded, the user needs to press **Run Next Step** to initialize the newly selected sequence, or alternately go to **File** > **Go To First Step** and **Start Sequencer**.

H.8.2 Running a Sequence

1. Under the Action menu, select **Start Sequencer**.

   This selection will change to Stop Sequencer once the sequence starts. (The sequencer should be activated if it was disabled, but not necessarily to change from one sequence to another.) The sequence will repeat itself indefinitely until disabled or the software is exited.

2. Once the sequencer is running, the user can select **Hide Sequencer Interface** under the **Action** menu; the sequence will continue to run even with the UI hidden, and will automatically continue if the instrument ever loses power from the wall and restarts after power is restored. (However, the timing of the sequence will be offset relative to the intended cadence.)

3. To bring the sequencer interface back into view, from the main Picarro GUI, go to **Tools** > **Show/hide Valve Sequencer** again.

H.8.3 Skipping Steps or Advancing to a Particular Step

If desired, the valve sequence can be forwarded to the next step of the sequence by clicking the **Run Next Step** button on the UI. To jump to a particular step, increment the **Run Step #** field and click **Apply**.

H.8.4 Stopping the Sequencer

1. Under the **Action** menu, select **Stop Sequencer**.

   This will leave all valves in their current state. In some situations, it is convenient to program the last step in the sequence to be a safe or default valve state.

2. Should the user need to put the solenoid or rotary valves into a safe/default state, the sequencer can be advanced to the last step using the **Run Next Step** button.

H.8.5 Resetting Valves

Under the **Action** menu, selecting **Reset All Valves** will deactivate/reset all valves to their default state.

H.8.6 Valve Sequencer Data Records

For each individual measurement the analyzer makes, the valve codes and rotary valve positions corresponding to the valve states at that point in time are saved alongside the concentration data as long as the variable is selected from the **Picarro Launch Pad**, **Settings**, **Data Logger Setup**, **Data Columns** window.

If the desired variable is not available, select **Service Mode** and then select the value from the variables that populate into the **Data Columns** window and click **Save**. Note the changes will take effect after the software restarts.

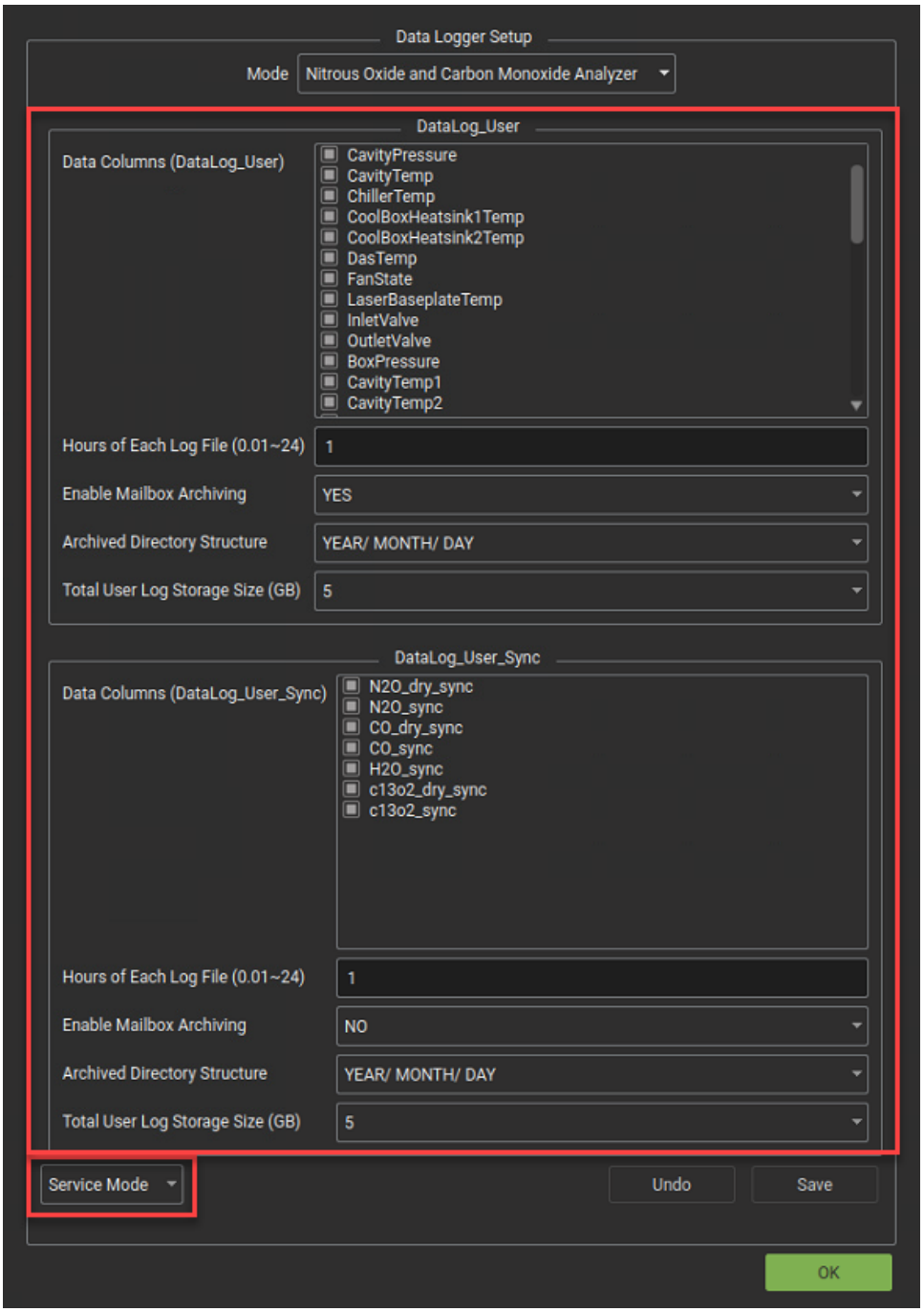


Figure 106 - Data Logger Service Mode

NOTE

If no solenoid valves are present, the codes will be recorded regardless of whether a valve is connected.

NOTE

If no steps are defined, and no sequence is active, these values will display 0.

H.9 Scheduling a Sequence

Users may schedule a sequence to start at a particular time in the future, often at the top of the hour, or at midnight for a recurring sequence with an hourly or daily cadence. The **Schedule Sequence** button is typically greyed out when the user shows the valve sequencer because the start time has passed. To begin a run in the future, select the desired date under **Start Date**, and the desired time under **Start Time**. When both values are in the future, the **Schedule Sequence** button will become active, and the user may click it. When the scheduled time arrives, the sequence will start automatically.

I Introduction to Technology

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:

- The analyzer contains the spectrometer, sample chamber, and a computer with a hard drive to store and analyze data. The single analyzer module controls the operation of the system and converts spectroscopic measurements into gas concentration data.
- The external vacuum pump draws the sample gas through the instrument.

I.1 Cavity Ring-Down Spectroscopy (CRDS)

Nearly every small gas-phase molecule (e.g., CO_2, H_2O, H_2S, NH_3) and isotopologue (e.g., $H_2{}^{18}O$, $^{13}CO_2$, $^{15}N^{14}N^{16}O$) uniquely absorb specific wavelengths of near-infrared light. The strength of the light absorption is related to the concentration of a molecule in a sample and the distance that light travels through the sample, called the path length.

Conventional infrared spectrometers are typically only sensitive enough to detect trace gases at levels in the part-per-million. Cavity Ring-Down Spectroscopy (CRDS), on the other hand, is one thousand to one million more times sensitive.

The increased sensitivity of CRDS is due to the design of the sample cavity and the time-based measurement. In the cavity, a series of mirrors reflects the infrared light through the sample, increasing the path length. For a Picarro cavity of only 25 cm in length, the effective path length of the cavity can be over 20 kilometers.

In Picarro analyzers, light from a single-frequency laser enters a cavity where three mirrors reflect the laser light as seen in Figure 1. The light enters through the mirror closest to the laser, bounces off the angled mirror in the lower right corner of the cavity, travels to the hemispherical mirror at the top of the cavity, bounces toward the mirror in the lower left corner of the cavity, and then returns to the first mirror. This motion becomes a continuous traveling light wave, which is represented by the dark orange path in Figure 1.

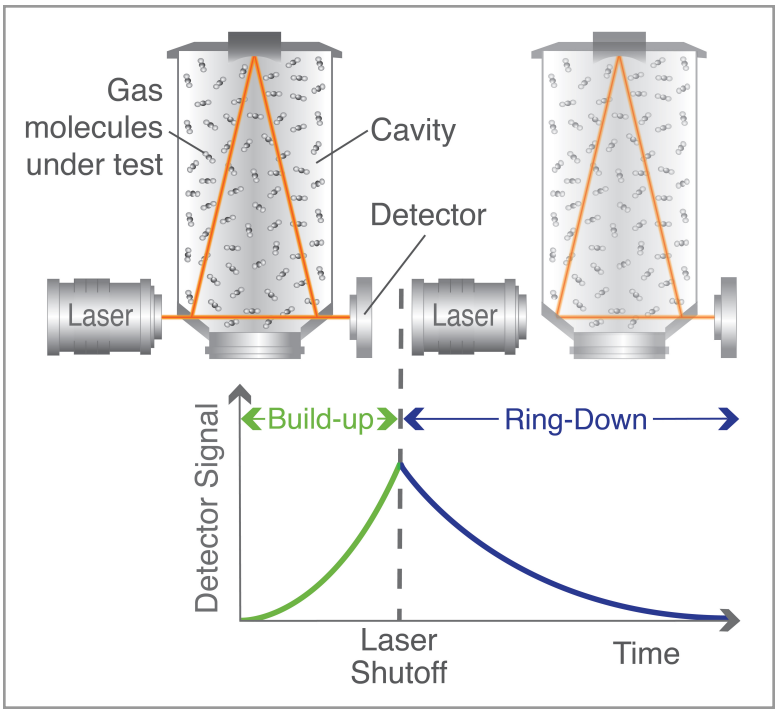


Figure 107 - Schematic of the Picarro CRDS analyzer cavity

When the laser is on, the cavity quickly fills with laser light. A small amount of the laser light is transmitted through the mirror closest to the photodetector, which turns the incident light into a signal that is directly proportional to the light intensity in the cavity.

When the photodetector signal reaches a threshold level (in a few tens of microseconds), the laser is turned off. The light contained within the cavity continues to bounce between the mirrors (about 40,000 times). Since the mirrors have slightly less than 100% reflectivity (99.999%), the light inside the cavity steadily leaks out of the cavity. The intensity of the light reaching the detector decreases, falling exponentially until it reaches zero. This decay, or "ring-down," is measured in real time by the photodetector.

I.2 Relating Ring-Down Time to Absorption Intensity

The time it takes to ring-down is inversely related to the total optical loss in the cavity, including the strength of molecular absorption at a given wavelength of light. For an empty cavity, the time it takes for the intensity to decrease by a given percent is determined solely by the reflectivity of the mirrors. A cavity containing gas that absorbs light will have a shorter ring-down time than an empty cavity. As the light circulates in a cavity with a gas sample, the molecular absorption by the gas results in a decrease of the light intensity.

Determining absorption intensity at a specific wavelength requires comparing the ring-down time of an empty cavity to the ring-down time of a cavity that contains gas. A cavity can be empty if it contains no gas; it will also appear empty if the molecules of the sample inside the cavity do not interact with the specific wavelength of light.

Picarro instruments gather measurements from an “empty” cavity by switching the light to wavelengths that are not absorbed by the target molecules. The analyzer subsequently measures ring-down times at wavelengths that are absorbed by the target gas. The analyzer automatically and continuously compares these two types of ring-down times, and the software uses those comparisons to calculate absorption intensities.

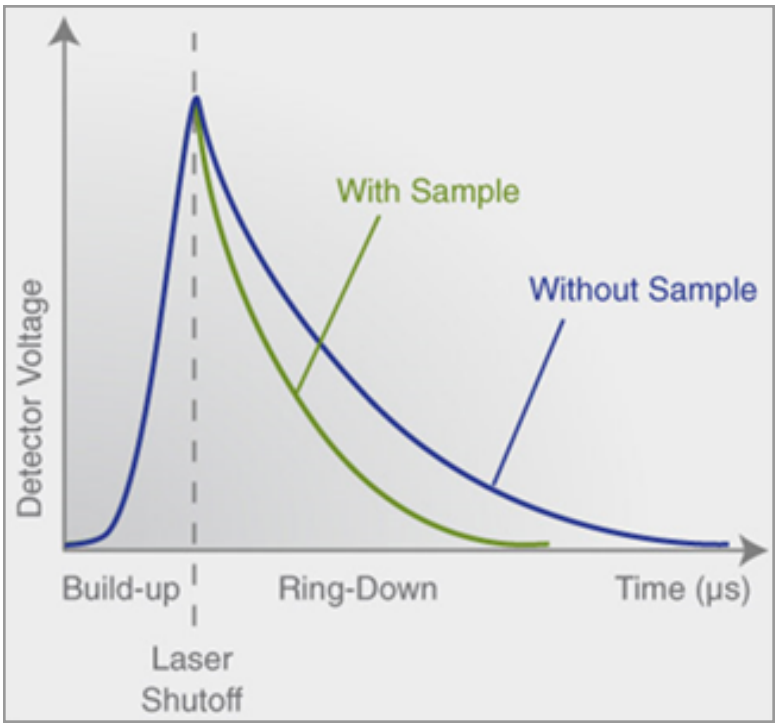


Figure 108 - Light intensity as a function of time in a CRDS system

I.3 Converting Absorption Intensity to Concentration

Plotting the absorbance at each measured wavelength generates an optical spectrum. This spectrum contains absorbance peaks that are unique to each molecule in the sample. The height of a particular absorption peak is proportional to the concentration of a molecule that generated the signal.

The height of the peak is calculated by subtracting the maximal absorbance from the baseline absorbance. Figure 109 shows a plot of ideal optical spectra with a clean, uniform baseline on either side of the absorption peak.

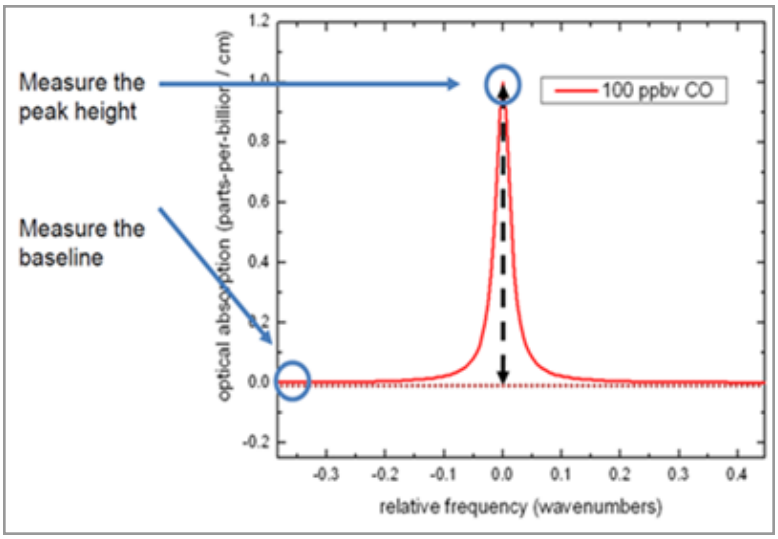


Figure 109 - Absorption Spectral Curve

However, optical spectra often contain several absorption lines, nested closely together. A particular absorption peak may be visible between lines, but the absorption may not return to the baseline before it rises in response to another molecule. Picarro analyzers calculate the baseline underneath a poorly resolved peak by modeling the absorption peaks from other surrounding molecules and subtracting contributions from neighboring peaks to the absorption intensity.

I.4 Spectral Precision and High Sensitivity Measurements

Picarro analyzers contain two features that provide high spectral precision:

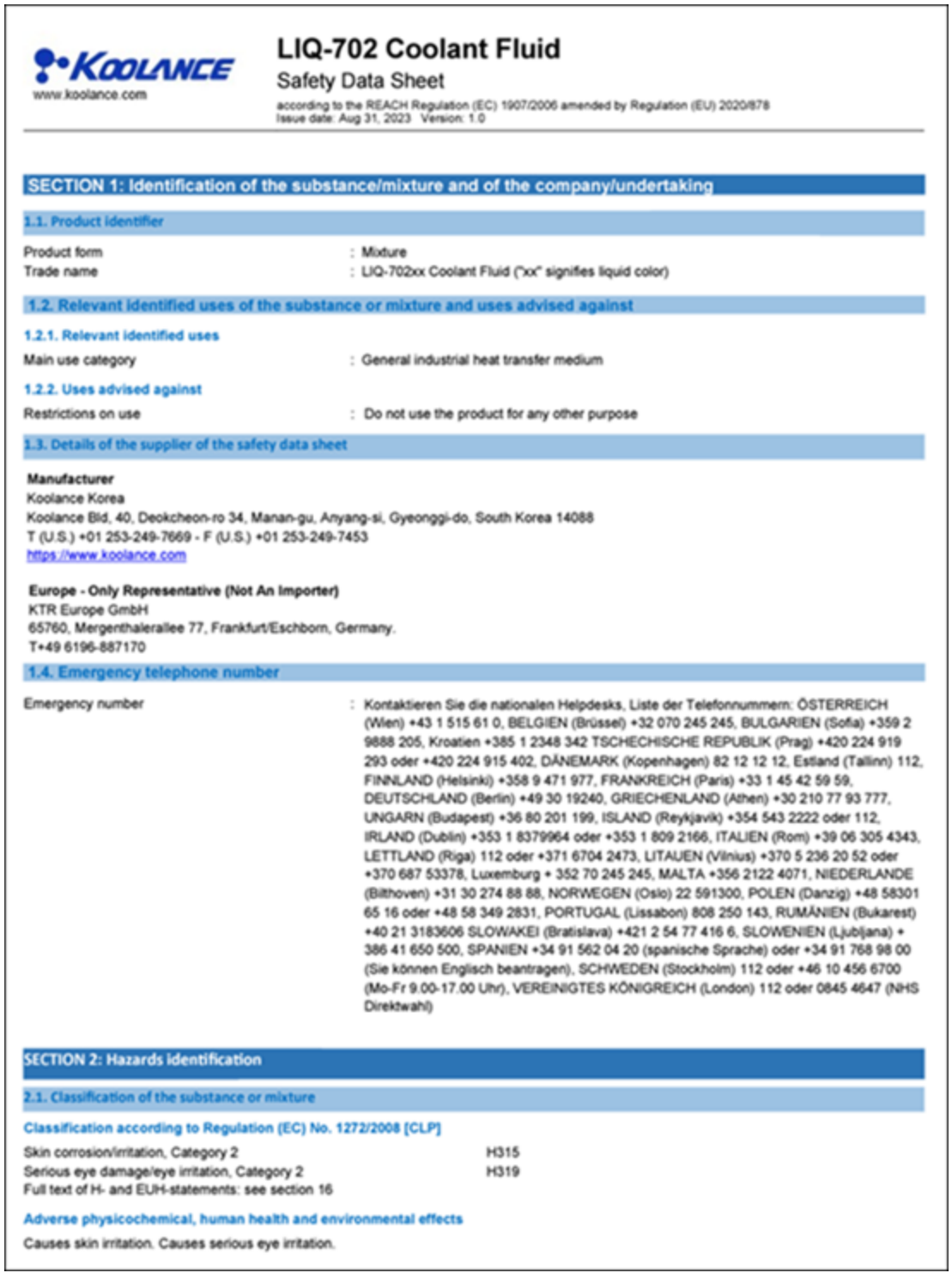
- Proprietary wavelength monitor (WLM) that measures the absolute laser wavelength to a precision that is a few orders of magnitude narrower than the spectral linewidth: Picarro's patented WLM measures absolute laser wavelength to a precision more than 1,000 times narrower than the observed Doppler-broadened linewidth for small gas-phase molecules. The instruments lock the laser to the WLM, and then the monitor tunes to wavelengths known to be maximally and minimally absorbed by the target molecule. The result is closely clustered absorption intensities, measured at wavelengths just before peak absorption, at peak absorption, and just after peak absorption, as the absorbance returns to the baseline.
- Precise temperature and pressure control in the sample cavity: Accurate absorption measurements at precisely known wavelengths account for little unless the temperature and pressure of the CRDS measurement cavity are known. The observed line intensity and shape depend on the temperature and pressure inside the sample cavity. Small temperature and pressure instabilities can result in large concentration errors due to fluctuating peak heights and baselines. To completely minimize instrument measurement drift, temperature and pressure must be actively stabilized to constant values.

For precise temperature control, the sample cavity is surrounded by layers of thermally insulating material to provide a high degree of passive thermal stability. The cavity is further actively stabilized by means of a solid-state heating system locked to the output of a thermal sensor. This enables the temperature of the cavity to be within 20 mK of the set temperature.

For precise pressure control, the cavity pressure is monitored using a high-linearity pressure transducer. The system computer uses this pressure data in a feedback loop to control proportional valves that adjust the inlet and outlet gas flow of the cavity.

J SDS for Koolance LIQ-702

A PDF copy of this SDS from Koolance is available at koolance.com.



KOOLANCE
www.koolance.com

LIQ-702 Coolant Fluid

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878
Issue date: Aug 31, 2023 Version: 1.0

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture
Trade name : LIQ-702xx Coolant Fluid ("xx" signifies liquid color)

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Main use category : General industrial heat transfer medium

1.2.2. Uses advised against

Restrictions on use : Do not use the product for any other purpose

1.3. Details of the supplier of the safety data sheet

Manufacturer
Koolance Korea
Koolance Bld, 40, Deokcheon-ro 34, Manan-gu, Anyang-si, Gyeonggi-do, South Korea 14088
T (U.S.) +01 253-249-7669 - F (U.S.) +01 253-249-7453
https://www.koolance.com

Europe - Only Representative (Not An Importer)
KTR Europe GmbH
65760, Mergenthalerallee 77, Frankfurt/Eschborn, Germany.
T+49 6196-887170

1.4. Emergency telephone number

Emergency number : Kontaktieren Sie die nationalen Helpdesks, Liste der Telefonnummern: ÖSTERREICH (Wien) +43 1 515 61 0, BELGIEN (Brüssel) +32 070 245 245, BULGARIEN (Sofia) +359 2 9888 205, Kroatien +385 1 2348 342 TSCHECHISCHE REPUBLIK (Prag) +420 224 919 293 oder +420 224 915 402, DÄNEMARK (Kopenhagen) 82 12 12 12, Estland (Tallinn) 112, FINNLAND (Helsinki) +358 9 471 977, FRANKREICH (Paris) +33 1 45 42 59 59, DEUTSCHLAND (Berlin) +49 30 19240, GRIECHENLAND (Athen) +30 210 77 93 777, UNGARN (Budapest) +36 80 201 199, ISLAND (Reykjavik) +354 543 2222 oder 112, IRLAND (Dublin) +353 1 8379964 oder +353 1 809 2166, ITALIEN (Rom) +39 06 305 4343, LETTLAND (Riga) 112 oder +371 6704 2473, LITAUEN (Vilnius) +370 5 236 20 52 oder +370 687 53378, Luxemburg + 352 70 245 245, MALTA +356 2122 4071, NIEDERLANDE (Bilthoven) +31 30 274 88 88, NORWEGEN (Oslo) 22 591300, POLEN (Danzig) +48 58301 65 16 oder +48 58 349 2831, PORTUGAL (Lissabon) 808 250 143, RUMÄNIEN (Bukarest) +40 21 3183606 SLOWAKEI (Bratislava) +421 2 54 77 416 6, SLOWENIEN (Ljubljana) + 386 41 650 500, SPANIEN +34 91 562 04 20 (spanische Sprache) oder +34 91 768 98 00 (Sie können Englisch beantragen), SCHWEDEN (Stockholm) 112 oder +46 10 456 6700 (Mo-Fr 9.00-17.00 Uhr), VEREINIGTES KÖNIGREICH (London) 112 oder 0845 4647 (NHS Direktwahl)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Skin corrosion/irritation, Category 2 H315
Serious eye damage/eye irritation, Category 2 H319
Full text of H- and EUH-statements: see section 16

Adverse physicochemical, human health and environmental effects

Causes skin irritation. Causes serious eye irritation.

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2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms (CLP) :

GHS07

Signal word (CLP) : Warning

Hazard statements (CLP) : H315 - Causes skin irritation.
H319 - Causes serious eye irritation.

Precautionary statements (CLP) : P264 - Wash hands, forearms and face thoroughly after handling.
P280 - Wear protective gloves/protective clothing/eye protection/face protection/hearing protection.
P302+P352 - IF ON SKIN: Wash with plenty of water.
P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321 - Specific treatment (see supplemental first aid instruction on this label).
P332+P313 - If skin irritation occurs: Get medical advice/attention.

2.3. Other hazards

Contains no PBT/vPvB substances ≥ 0.1% assessed in accordance with REACH Annex XIII
Contains no PBT/vPvB substances ≥ 0.1% assessed in accordance with REACH Annex XIII

Component	
Propylene Glycol (57-55-6)	This substance/mixture does not meet the PBT criteria of REACH regulation, annex XIII This substance/mixture does not meet the vPvB criteria of REACH regulation, annex XIII
Potassium Phosphate Dibasic (7758-11-4)	This substance/mixture does not meet the PBT criteria of REACH regulation, annex XIII This substance/mixture does not meet the vPvB criteria of REACH regulation, annex XIII
Sodium Molybdate (7631-95-0)	This substance/mixture does not meet the PBT criteria of REACH regulation, annex XIII This substance/mixture does not meet the vPvB criteria of REACH regulation, annex XIII
Meta-toluic Acid (99-04-7)	This substance/mixture does not meet the PBT criteria of REACH regulation, annex XIII This substance/mixture does not meet the vPvB criteria of REACH regulation, annex XIII

The mixture does not contain substance(s) included in the list established in accordance with Article 59(1) of REACH for having endocrine disrupting properties, or is not identified as having endocrine disrupting properties in accordance with the criteria set out in Commission Delegated Regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at a concentration equal to or greater than 0,1 %

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Water	CAS-No.: 7732-18-5 EC-No.: 231-791-2	70 – 75	Not classified
Propylene Glycol	CAS-No.: 57-55-6 EC-No.: 200-338-0	25 – 30	Skin Irrit. 2, H315 Eye Irrit. 2, H319
Potassium Phosphate Dibasic	CAS-No.: 7758-11-4 EC-No.: 231-834-5	≤ 1	Acute Tox. 4 (Oral), H302 Acute Tox. 3 (Inhalation:dust,mist), H331

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Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Sodium Molybdate	CAS-No.: 7631-95-0 EC-No.: 231-551-7	≤ 1	Acute Tox. 4 (Inhalation:dust,mist), H332 STOT RE 2, H373
Meta-toluic Acid	CAS-No.: 99-04-7 EC-No.: 202-723-9	≤ 1	STOT RE 2, H373 Aquatic Chronic 2, H411

Full text of H- and EUH-statements: see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove person to fresh air and keep comfortable for breathing.

First-aid measures after skin contact : Wash skin with plenty of water. Take off contaminated clothing. If skin irritation occurs: Get medical advice/attention.

First-aid measures after eye contact : Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

First-aid measures after ingestion : Call a poison center or a doctor if you feel unwell.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/effects after skin contact : Irritation.

Symptoms/effects after eye contact : Eye irritation.

4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Water spray. Dry powder. Foam. Carbon dioxide.

5.2. Special hazards arising from the substance or mixture

Hazardous decomposition products in case of fire : Toxic fumes may be released.

5.3. Advice for firefighters

Protection during firefighting : Do not attempt to take action without suitable protective equipment. Self-contained breathing apparatus. Complete protective clothing.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Emergency procedures : Ventilate spillage area. Avoid contact with skin and eyes.

6.1.2. For emergency responders

Protective equipment : Do not attempt to take action without suitable protective equipment. For further information refer to section 8: "Exposure controls/personal protection".

6.2. Environmental precautions

Avoid release to the environment.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Take up liquid spill into absorbent material.

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Other information : Dispose of materials or solid residues at an authorized site.

6.4. Reference to other sections

For further information refer to section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Ensure good ventilation of the work station. Avoid contact with skin and eyes. Wear personal protective equipment.

Hygiene measures : Wash contaminated clothing before reuse. Do not eat, drink or smoke when using this product. Always wash hands after handling the product.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store in a well-ventilated place. Keep cool.

Incompatible products : reducing materials.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

8.1.1 National occupational exposure and biological limit values

Propylene Glycol (57-55-6)	
Croatia - Occupational Exposure Limits	
Local name	Propane-1,2-diol
GVI (OEL TWA) [1]	474 mg/m³ ukupno pare i čestice 10 mg/m³ samo čestice
GVI (OEL TWA) [2]	150 ppm ukupno pare i čestice
Regulatory reference	Pravilnik o zaštiti radnika od izloženosti opasnim kemikalijama na radu, graničnim vrijednostima izloženosti i biološkim graničnim vrijednostima (NN 1/2021)
Ireland - Occupational Exposure Limits	
Local name	Propane-1,2-diol [Propylene glycol]
OEL TWA [1]	470 mg/m³ total (vapour and particulates) 10 mg/m³ particulates
OEL TWA [2]	150 ppm total (vapour and particulates)
Regulatory reference	Chemical Agents Code of Practice 2021
Latvia - Occupational Exposure Limits	
Local name	Propilēnglikols (1,2-propāndiols)
OEL TWA	7 mg/m³
Regulatory reference	Ministru kabineta 2007. gada 15. maija noteikumiem Nr. 325
Lithuania - Occupational Exposure Limits	
Local name	Propilenglikolis
IPRV (OEL TWA)	7 mg/m³
Regulatory reference	LIETUVOS HIGIENOS NORMA HN 23:2011 (Nr. V-695/A1-272, 2018-06-12)

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Propylene Glycol (57-55-6)	
Poland - Occupational Exposure Limits	
Local name	Propano-1,2-diol
NDS (OEL TWA)	100 mg/m³ pary i frakcja wdychalna
Remark	Frakcja wdychalna – frakcja aerozolu wnikająca przez nos i usta, która po zdeponowaniu w drogach oddechowych stwarza zagrożenie dla zdrowia.
Regulatory reference	Dz. U. 2018 poz. 1286
United Kingdom - Occupational Exposure Limits	
Local name	Propane-1,2-diol
WEL TWA (OEL TWA) [1]	474 mg/m³ 10 mg/m³
WEL TWA (OEL TWA) [2]	150 ppm
Regulatory reference	EH40/2005 (Fourth edition, 2020). HSE
Norway - Occupational Exposure Limits	
Local name	Propan-1,2-diol
Grenseverdi (OEL TWA) [1]	79 mg/m³
Grenseverdi (OEL TWA) [2]	25 ppm
Regulatory reference	FOR-2021-06-28-2248

Sodium Molybdate (7631-95-0)	
Belgium - Occupational Exposure Limits	
OEL TWA	0.5 mg/m³
France - Occupational Exposure Limits	
VME (OEL TWA)	5 mg/m³
VLE (OEL C/STEL)	10 mg/m³
United Kingdom - Occupational Exposure Limits	
WEL TWA (OEL TWA) [1]	5 mg/m³
WEL STEL (OEL STEL)	10 mg/m³
USA - ACGIH - Occupational Exposure Limits	
ACGIH OEL TWA	0.5 mg/m³ (Respirable fraction)

8.1.2. Recommended monitoring procedures

No additional information available

8.1.3. Air contaminants formed

No additional information available

8.1.4. DNEL and PNEC

No additional information available

8.1.5. Control banding

No additional information available

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8.2. Exposure controls

8.2.1. Appropriate engineering controls

Appropriate engineering controls:
Ensure good ventilation of the work station.

8.2.2. Personal protection equipment

Personal protective equipment symbol(s):

8.2.2.1. Eye and face protection

Eye protection:
Safety glasses

8.2.2.2. Skin protection

Skin and body protection:
Wear suitable protective clothing

Hand protection:
Protective gloves

8.2.2.3. Respiratory protection

Respiratory protection:
In case of insufficient ventilation, wear suitable respiratory equipment

8.2.2.4. Thermal hazards

No additional information available

8.2.3. Environmental exposure controls

Environmental exposure controls:
Avoid release to the environment.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Colour	:	Not available
Odour	:	Not available
Odour threshold	:	Not available
Melting point	:	Not applicable
Freezing point	:	Not available
Boiling point	:	> 98 °C
Flammability	:	Non flammable.
Explosive limits	:	Not available
Lower explosion limit	:	Not available
Upper explosion limit	:	Not available
Flash point	:	118 °C (Cleveland open cup). No flash occurred under 93ºC (Tag closed cup)
Auto-ignition temperature	:	Not available
Decomposition temperature	:	Not available
pH	:	7 – 8 at 20ºC; Sample H2O = 1:5 (V/V)
Viscosity, kinematic	:	2.3 mm²/s at 20°C
Solubility	:	Soluble at 20ºC
Partition coefficient n-octanol/water (Log Kow)	:	Not available
Vapour pressure	:	Not available
Vapour pressure at 50°C	:	Not available
Density	:	1.042 g/cm³

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Relative density	:	Not available
Relative vapour density at 20 °C	:	1.03
Particle characteristics	:	Not applicable

Water (7732-18-5)	
Boiling point	100 °C
Vapour pressure	2300 Pa 25°C

Propylene Glycol (57-55-6)	
Boiling point	187.6 °C
Flash point	104 °C (Closed cup, 1000 hPa, EU Method A.9: Flash-Point)
Auto-ignition temperature	> 400 °C (1000 - 1001 hPa, EU Method A.15: Auto-ignition Temperature (liquids and gases), T2)
Vapour pressure	0.2 hPa (25 °C, EU Method A.4: Vapour Pressure)
Vapour pressure at 50 °C	1.8 hPa (Antoine equation)
Particle size	Not applicable (liquid)

Potassium Phosphate Dibasic (7758-11-4)	
Boiling point	Not applicable (melting point > 300 °C)
Flash point	Not applicable (solid)
Auto-ignition temperature	Not applicable
Vapour pressure	Not applicable (melting point > 300 °C)
Particle size	No data available in the literature

Sodium Molybdate (7631-95-0)	
Flash point	Not applicable

Meta-toluic Acid (99-04-7)	
Boiling point	263 °C
Flash point	159 °C (1013.25 hPa, EU Method A.9: Flash-Point)
Auto-ignition temperature	500 °C (T1)
Vapour pressure	0.00019 hPa (25 °C, OECD 104: Vapour Pressure)

9.2. Other information

9.2.1. Information with regard to physical hazard classes

No additional information available

9.2.2. Other safety characteristics

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

The product is non-reactive under normal conditions of use, storage and transport.

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10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

No dangerous reactions known under normal conditions of use.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

No additional information available

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Acute toxicity (oral) : Not classified
Acute toxicity (dermal) : Not classified
Acute toxicity (inhalation) : Not classified

Water (7732-18-5)	
LD50 oral	> 90000 mg/kg bodyweight
LD50 dermal	> 90000 mg/kg bodyweight

Propylene Glycol (57-55-6)	
LD50 oral rat	22000 mg/kg (Rat, Male / female, Experimental value, Oral)
LD50 dermal rabbit	> 2000 mg/kg bodyweight (24 h, Rabbit, Experimental value, Dermal, 14 day(s))
LC50 Inhalation - Rat	> 44.9 mg/l air Animal: rat, Guideline: other:, Remarks on results: other:

Potassium Phosphate Dibasic (7758-11-4)	
LD50 oral rat	> 2000 mg/kg bodyweight (OECD 420: Acute Oral toxicity – Acute Toxic Class Method, Rat, Female, Experimental value, Oral, 14 day(s))
LD50 oral	1700 mg/kg bodyweight
LD50 dermal rat	> 2000 mg/kg bodyweight (OECD 402: Acute Dermal Toxicity, 24 h, Rat, Male / female, Experimental value, Dermal, 14 day(s))
LD50 dermal	> 2500 mg/kg bodyweight
LC50 Inhalation - Rat	> 0.83 mg/l (OECD 403: Acute Inhalation Toxicity, 4 h, Rat, Male / female, Read-across, (maximum achievable concentration), Inhalation (dust), 14 day(s))

Sodium Molybdate (7631-95-0)	
LD50 oral rat	4000 mg/kg (Rat, Oral, Source: BIG)
LD50 oral	2689 mg/kg (OECD TG 401, GLP)
LD50 dermal rat	> 2000 mg/kg bodyweight Animal: rat, Guideline: OECD Guideline 402 (Acute Dermal Toxicity), Remarks on results: other:
LC50 Inhalation - Rat	> 2.1 mg/l (4 h, Rat, Inhalation)
LC50 Inhalation - Rat (Dust/Mist)	> 5.05 mg/l/4h

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Meta-toluic Acid (99-04-7)	
LD50 oral rat	> 2000 mg/kg bodyweight Animal: rat, Guideline: OECD Guideline 401 (Acute Oral Toxicity)

Propylene Glycol (57-55-6)	
pH	6.5 – 7.5 (50 %)

Skin corrosion/irritation	:	Causes skin irritation. pH: 7 – 8 at 20°C; Sample H2O = 1:5 (V/V)
Serious eye damage/irritation	:	Causes serious eye irritation. pH: 7 – 8 at 20°C; Sample H2O = 1:5 (V/V)
Respiratory or skin sensitisation	:	Not classified
Germ cell mutagenicity	:	Not classified

Potassium Phosphate Dibasic (7758-11-4)	
pH	9.2

Sodium Molybdate (7631-95-0)	
pH	9 – 10 (5 %)

Propylene Glycol (57-55-6)	
In vivo	Chromosomal abnormality test using mammalian bone marrow cells: Negative (rat, male)
In vitro	Bacterial reverse mutation test: Negative (TA92, TA94, TA98, TA100, TA1535, and TA1537, with metabolic activation system)

Carcinogenicity	:	Not classified
Reproductive toxicity	:	Not classified
STOT-single exposure	:	Not classified
STOT-repeated exposure	:	Not classified

Propylene Glycol (57-55-6)	
NOAEL (subchronic, oral, animal/male, 90 days)	443 mg/kg bodyweight Animal: cat, Animal sex: male

Potassium Phosphate Dibasic (7758-11-4)	
NOAEL (oral, rat, 90 days)	1000 mg/kg bodyweight Animal: rat, Guideline: OECD Guideline 422 (Combined Repeated Dose Toxicity Study with the Reproduction / Developmental Toxicity Screening Test)

Sodium Molybdate (7631-95-0)	
NOAEC (inhalation, rat, dust/mist/fume, 90 days)	> 0.1 mg/l air Animal: rat, Guideline: OECD Guideline 413 (Subchronic Inhalation Toxicity: 90-Day Study)
STOT-repeated exposure	May cause damage to organs through prolonged or repeated exposure.

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Meta-toluic Acid (99-04-7)	
NOAEL (oral, rat, 90 days)	100 mg/kg bodyweight Animal: rat, Animal sex: female, Guideline: OECD Guideline 422 (Combined Repeated Dose Toxicity Study with the Reproduction / Developmental Toxicity Screening Test)
STOT-repeated exposure	May cause damage to organs through prolonged or repeated exposure.

Aspiration hazard : Not classified

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Viscosity, kinematic	2.3 mm²/s at 20°C

Potassium Phosphate Dibasic (7758-11-4)	
Viscosity, kinematic	Not applicable (solid)

11.2. Information on other hazards

No additional information available

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : The product is not considered harmful to aquatic organisms nor to cause long-term adverse effects in the environment.

Hazardous to the aquatic environment, short–term (acute) : Not classified

Hazardous to the aquatic environment, long–term (chronic) : Not classified

Not rapidly degradable

LIQ-702 Coolant Fluid	
LC50 - Fish [1]	8700 mg/l Pimephales promelas
EC50 - Crustacea [1]	7921 mg/l Daphnia magna
EC50 72h - Algae [1]	1634 mg/l Selenastrum capricornutu

Propylene Glycol (57-55-6)	
LC50 - Fish [1]	40613 mg/l (96 h, Oncorhynchus mykiss, Static system, Fresh water, Experimental value)
LC50 - Fish [2]	51400 mg/l Test organisms (species): Pimephales promelas
EC50 - Crustacea [1]	18340 mg/l Ceriodaphnia dubia (EPA 600/4-90/0-27, statistic test, fresh water)
EC50 72h - Algae [1]	24200 mg/l Test organisms (species): Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum)
EC50 72h - Algae [2]	19300 mg/l Test organisms (species): Skeletonema costatum
EC50 96h - Algae [1]	19000 mg/l Test organisms (species): Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum)
EC50 96h - Algae [2]	19100 mg/l Test organisms (species): Skeletonema costatum
ErC50 algae	24200 mg/l (OECD 201: Alga, Growth Inhibition Test, 72 h, Pseudokirchneriella subcapitata, Static system, Fresh water, Experimental value, GLP)

Potassium Phosphate Dibasic (7758-11-4)	
LC50 - Fish [1]	> 100 mg/l Test organisms (species): Oncorhynchus mykiss (previous name: Salmo gairdneri)
EC50 - Crustacea [1]	> 100 mg/l (OECD 202: Daphnia sp. Acute Immobilisation Test, 48 h, Daphnia magna, Static system, Fresh water, Read-across, Nominal concentration)

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Potassium Phosphate Dibasic (7758-11-4)	
EC50 72h - Algae [1]	> 100 mg/l Test organisms (species): Desmodesmus subspicatus (previous name: Scenedesmus subspicatus)
ErC50 algae	> 100 mg/l (OECD 201: Alga, Growth Inhibition Test, 72 h, Desmodesmus subspicatus, Static system, Fresh water, Read-across, Nominal concentration)

Sodium Molybdate (7631-95-0)	
LC50 - Fish [1]	644.2 mg/l (OECD 203: Fish, Acute Toxicity Test, 96 h, Pimephales promelas, Semi-static system, Fresh water, Experimental value)
EC50 72h - Algae [1]	356.9 mg/l (ISO 10253, Phaeodactylum, Static system, Salt water, Weight of evidence, Growth rate)

Meta-toluic Acid (99-04-7)	
LC50 - Fish [1]	82 mg/l (OECD 203: Fish, Acute Toxicity Test, 96 h, Oryzias latipes, Semi-static system, Fresh water, Experimental value)
EC50 - Crustacea [1]	75 mg/l (OECD 202: Daphnia sp. Acute Immobilisation Test, 48 h, Daphnia magna, Static system, Fresh water, Experimental value)
EC50 72h - Algae [1]	18 mg/l Test organisms (species): Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum)
EC50 72h - Algae [2]	10 mg/l Test organisms (species): Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum)
LOEC (chronic)	22 mg/l Test organisms (species): Daphnia magna Duration: '21 d'

12.2. Persistence and degradability

Propylene Glycol (57-55-6)	
Persistence and degradability	Biodegradable in the soil. Readily biodegradable in water.
Biochemical oxygen demand (BOD)	0.96 – 1.08 g O_2/g substance
Chemical oxygen demand (COD)	1.63 g O_2/g substance
ThOD	1.69 g O_2/g substance

Potassium Phosphate Dibasic (7758-11-4)	
Persistence and degradability	Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable (inorganic)
ThOD	Not applicable (inorganic)

Sodium Molybdate (7631-95-0)	
Persistence and degradability	Biodegradability: not applicable.
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable
BOD (% of ThOD)	Not applicable

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Meta-toluic Acid (99-04-7)	
Persistence and degradability	Biodegradability in soil: no data available. Readily biodegradable in water.

12.3. Bioaccumulative potential

Water (7732-18-5)	
Partition coefficient n-octanol/water (Log Pow)	-1.38

Propylene Glycol (57-55-6)	
BCF - Fish [1]	0.09 mg/l
Partition coefficient n-octanol/water (Log Pow)	-1.07 (Experimental value, EU Method A.8: Partition Coefficient, 20.5 °C)
Bioaccumulative potential	Not bioaccumulative.

Potassium Phosphate Dibasic (7758-11-4)	
Bioaccumulative potential	Not bioaccumulative.

Sodium Molybdate (7631-95-0)	
BCF - Fish [1]	4.9 (28 day(s), Oncorhynchus tshawytscha, Fresh water, Weight of evidence)
BCF - Other aquatic organisms [1]	164.3 (Mollusca, Fresh water, Weight of evidence)
Bioaccumulative potential	Low potential for bioaccumulation (BCF < 500).

Meta-toluic Acid (99-04-7)	
BCF - Fish [1]	3.162 mg/l (21-day Daphnia chronic toxicity no effect concentration)
Partition coefficient n-octanol/water (Log Pow)	2.37 (Practical experience/observation)
Partition coefficient n-octanol/water (Log Kow)	2.37
Bioaccumulative potential	Low potential for bioaccumulation (Log Kow < 4).

12.4. Mobility in soil

Propylene Glycol (57-55-6)	
Surface tension	71.6 mN/m (21.5 °C, 1.01 g/l, EU Method A.5: Surface tension)
Organic Carbon Normalized Adsorption Coefficient (Log Koc)	0.46 (log Koc, Calculated value)
Ecology - soil	Highly mobile in soil.

Potassium Phosphate Dibasic (7758-11-4)	
Surface tension	No data available in the literature
Ecology - soil	No (test)data on mobility of the substance available.

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Meta-toluic Acid (99-04-7)	
Ecology - soil	No (test)data on mobility of the substance available.

12.5. Results of PBT and vPvB assessment

LIQ-702 Coolant Fluid
Contains no PBT/vPvB substances ≥ 0.1% assessed in accordance with REACH Annex XIII

12.6. Endocrine disrupting properties

Adverse effects on the environment caused by endocrine disrupting properties : The mixture does not contain substance(s) included in the list established in accordance with Article 59(1) of REACH for having endocrine disrupting properties, or is not identified as having endocrine disrupting properties in accordance with the criteria set out in Commission Delegated Regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at a concentration equal to or greater than 0,1 %

12.7. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste treatment methods : Dispose of contents/container in accordance with licensed collector's sorting instructions.

SECTION 14: Transport information

In accordance with ADR / IMDG / IATA / ADN / RID

ADR	IMDG	IATA	ADN	RID
14.1. UN number or ID number				
Not regulated	Not regulated	Not regulated	Not regulated	Not regulated
14.2. UN proper shipping name				
Not regulated	Not regulated	Not regulated	Not regulated	Not regulated
14.3. Transport hazard class(es)				
Not regulated	Not regulated	Not regulated	Not regulated	Not regulated
14.4. Packing group				
Not regulated	Not regulated	Not regulated	Not regulated	Not regulated
14.5. Environmental hazards				
Not regulated	Not regulated	Not regulated	Not regulated	Not regulated
No supplementary information available				

14.6. Special precautions for user

Overland transport
Not regulated

Transport by sea
Not regulated

Air transport
Not regulated

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Inland waterway transport
Not regulated

Rail transport
Not regulated

14.7. Maritime transport in bulk according to IMO instruments

Not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations

REACH Annex XVII (Restriction List)

EU restriction list (REACH Annex XVII)		
Reference code	**Applicable on**	**Entry title or description**
3(b)	LIQ-702 Coolant Fluid ; Propylene Glycol	Substances or mixtures fulfilling the criteria for any of the following hazard classes or categories set out in Annex I to Regulation (EC) No 1272/2008: Hazard classes 3.1 to 3.6, 3.7 adverse effects on sexual function and fertility or on development, 3.8 effects other than narcotic effects, 3.9 and 3.10

REACH Annex XIV (Authorisation List)

Contains no REACH Annex XIV substances

REACH Candidate List (SVHC)

Contains no substance on the REACH candidate list

PIC Regulation (Prior Informed Consent)

Contains no substance subject to Regulation (EU) No 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of hazardous chemicals.

POP Regulation (Persistent Organic Pollutants)

Contains no substance subject to Regulation (EU) No 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants

Ozone Regulation (1005/2009)

Contains no substance subject to REGULATION (EU) No 1005/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 September 2009 on substances that deplete the ozone layer.

VOC Directive (2004/42)

DIRECTIVE 2004/42/CE Annex II : B/a (Vehicle refinishing products - Preparatory and cleaning) Maximum allowed concentration : 850 g/l VOC
Maximum content of VOC : 312.60 g/l VOC

Explosives Precursors Regulation (2019/1148)

Contains no substance subject to Regulation (EU) 2019/1148 of the European Parliament and of the Council of 20 June 2019 on the marketing and use of explosives precursors.

Drug Precursors Regulation (273/2004)

Contains no substance(s) listed on the Drug Precursors list (Regulation EC 273/2004 on drug precursors)

15.1.1. National regulations

France

Labelling of building products or products used for wall or floor coatings and paints and varnishes concerning their emissions of volatile pollutants (Order of 19 April 2011) :

Information on the level of emissions of volatile substances into interior air, presenting a risk of toxicity through inhalation, on a classification scale from A+ (very low emissions) to C (strong emissions)

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Occupational diseases	
Code	Description
RG 84	Conditions caused by liquid organic solvents for professional use: saturated or unsaturated aliphatic or cyclic liquid hydrocarbons and mixtures thereof; liquid halogenated hydrocarbons; nitrated derivatives of aliphatic hydrocarbons; alcohols; glycols, glycol ethers; ketones; aldehydes; aliphatic and cyclic ethers, including tetrahydrofuran; esters; dimethylformamide and dimethylacetamine; acetonitrile and propionitrile; pyridine; dimethylsulfone and dimethylsulfoxide

Germany

Employment restrictions : Observe restrictions according Act on the Protection of Working Mothers (MuSchG). Observe restrictions according Act on the Protection of Young People in Employment (JArbSchG).
Water hazard class (WGK) : WGK 1, Slightly hazardous to water (Classification according to AwSV, Annex 1).
Hazardous Incident Ordinance (12. BImSchV) : Is not subject of the Hazardous Incident Ordinance (12. BImSchV)

Netherlands

ABM category : B(4) - low hazard for aquatic
organisms SZW-lijst van kankerverwekkende stoffen : None of the components are listed
SZW-lijst van mutagene stoffen : None of the components are listed
SZW-lijst van reprotoxische stoffen – Borstvoeding : None of the components are listed
SZW-lijst van reprotoxische stoffen – Vruchtbaarheid : Koolance - Sodium Molybdate is listed
SZW-lijst van reprotoxische stoffen – Ontwikkeling : None of the components are listed

Switzerland

Storage class (LK) : LK 10/12 - Liquids
CH - VOC (SR 814.018) : 0.000000000000000 %

15.2. Chemical safety assessment

No chemical safety assessment has been carried out

SECTION 16: Other information

Abbreviations and acronyms:	
ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
ATE	Acute Toxicity Estimate
BCF	Bioconcentration factor
BLV	Biological limit value
BOD	Biochemical oxygen demand (BOD)
COD	Chemical oxygen demand (COD)
DMEL	Derived Minimal Effect level
DNEL	Derived-No Effect Level
EC-No.	European Community number
EC50	Median effective concentration
EN	European Standard
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association
IMDG	International Maritime Dangerous Goods
LC50	Median lethal concentration

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Abbreviations and acronyms:	
LD50	Median lethal dose
LOAEL	Lowest Observed Adverse Effect Level
NOAEC	No-Observed Adverse Effect Concentration
NOAEL	No-Observed Adverse Effect Level
NOEC	No-Observed Effect Concentration
OECD	Organisation for Economic Co-operation and Development
OEL	Occupational Exposure Limit
PBT	Persistent Bioaccumulative Toxic
PNEC	Predicted No-Effect Concentration
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail
SDS	Safety Data Sheet
STP	Sewage treatment plant
ThOD	Theoretical oxygen demand (ThOD)
TLM	Median Tolerance Limit
VOC	Volatile Organic Compounds
CAS-No.	Chemical Abstract Service number
N.O.S.	Not Otherwise Specified
vPvB	Very Persistent and Very Bioaccumulative
ED	Endocrine disrupting properties

Data sources : ECHA (European Chemicals Agency).

Full text of H- and EUH-statements:	
Acute Tox. 3 (Inhalation:dust,mist)	Acute toxicity (inhalation:dust,mist) Category 3
Acute Tox. 4 (Inhalation:dust,mist)	Acute toxicity (inhalation:dust,mist) Category 4
Acute Tox. 4 (Oral)	Acute toxicity (oral), Category 4
Aquatic Chronic 2	Hazardous to the aquatic environment – Chronic Hazard, Category 2
Eye Irrit. 2	Serious eye damage/eye irritation, Category 2
H302	Harmful if swallowed.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H331	Toxic if inhaled.
H332	Harmful if inhaled.
H373	May cause damage to organs through prolonged or repeated exposure.
H411	Toxic to aquatic life with long lasting effects.
Skin Irrit. 2	Skin corrosion/irritation, Category 2
STOT RE 2	Specific target organ toxicity – Repeated exposure, Category 2

The classification complies with : ATP 12

Safety Data Sheet (SDS), EU

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

K Limited Warranty

Limited Warranty for Picarro Products and Peripherals. Picarro warrants that during the Warranty Period the Picarro Products and Peripherals will be free from substantial defects in material and workmanship under normal uses, and will substantially conform to Picarro's published Specifications for the Product. "Specification" means the then current user guide, technical specification or other product documentation prepared by Picarro (and does not include marketing collateral). This limited warranty extends only to the original end-user ("Customer") of the Product.

Warranty Period. The Warranty Period commences upon shipment of the Product and the Warranty Period continues for a period of 13 (thirteen) months (for shipments directly to customers) or 15 (fifteen) months (for shipments to a Picarro partner).

Warranty Remedies. Customer's sole and exclusive remedy and the entire liability of Picarro and its suppliers under this limited warranty will be, at Picarro's option, repair of the Product; or shipment of a replacement Product within the warranty period and according to Picarro's replacement process; or a refund of the purchase price if the Product is returned to Picarro, freight and insurance prepaid. Picarro replacement parts used in Product replacement may be new or equivalent to new.

In the event Picarro repairs or replaces the Product under this warranty, then the Warranty Period will be extended for the longer of a) ninety (90) days, or b) the period of time during which Customer has been unable to use the Product based upon the date on which the Customer or partner first reported to Picarro the problem giving rise to the warranty claim.

As part of the Limited Warranty, during the Warranty Period Picarro may provide: (1) telephone and email technical support, including remote log-in capabilities during Picarro's regular support hours and (2) software updates that Picarro generally makes available without additional cost. Picarro will provide all parts and services required to repair or replace the Product, provided that repairs will be performed remotely or at Picarro's factory. Picarro reserves the right to use local, authorized partners to assist in providing warranty repairs and/or factory returns and End Customer will cooperate with such local partners.

Picarro's obligations hereunder are conditioned upon the return of the defective Product in accordance with Picarro's then-current Return Material Authorization (RMA) procedures. Customer or partner will pay for shipping of the Product to Picarro, and following repair of the Product Picarro will pay for return shipment to the Customer or partner under Incoterm DDP. Any other costs of shipment will be Customer's or partner's responsibility. Customer must follow instructions provided by Picarro for packaging and shipping the Product.

Warranty Restrictions. The above Product warranty does not apply if the Product (a) has been altered, except by Picarro or by Customer with Picarro's prior written approval, (b) has not been installed and used in accordance with Picarro's Specification, (c) has been subjected to abnormal physical or electrical stress, abnormal environmental conditions, misuse, negligence, or accident; (d) is licensed for beta, evaluation, testing or demonstration

purposes; and (e) does not extend to recovery or replacement of any data from any medium. The Warranty Periods for spare parts, consumables and RMA repairs are not included in this document and are described under the Support Service Terms document.

Disclaimer: Picarro disclaims all other warranties, either express or implied, including warranties of fitness for a particular purpose. Except as set forth in this document, or as otherwise expressly agreed in writing by Picarro, there are no other warranties applicable to Picarro Products.

About Picarro

Picarro is a leading provider of solutions to measure greenhouse gas (GHG) concentrations, trace gases, and stable isotopes across many scientific applications, along with the energy and utilities markets. Our patented Cavity Ring-Down Spectroscopy (CRDS) is at the heart of all Picarro instruments and solutions, enabling the detection of target molecules at part per billion or better resolution.

Product Support

Utilize Picarro support resources for product support. Join the Picarro community to ask questions and get answers, search the document library for datasheets and user manuals, download software, and purchase products and replacement parts.
Access to online community forums and software downloads are available only for registered Picarro customers with login credentials. If you do not have an account, you can register by using the community and software download links below.

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Contact Picarro for questions regarding specific applications and additional information.

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