PICARRO

SI2108 HYDROGEN CHLORIDE ANALYZER USER GUIDE

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1.Introduction

Intended Use

The Picarro SI2108 analyzer detects Hydrogen Chloride in parts per billion.

This manual describes analyzer operation only. For service tasks, refer to the *SI2000 Series Service Manual*, Picarro Document Number 40-0046.

Proper use of the SI2000 instruments do not include personal protection or monitoring of the occupied space. The SI2000 instruments are not safety devices.

Personal Protective Equipment

Any protective equipment shall be used in accordance with the instructions provided by the protective equipment supplier.

MSDS Required

Users must obtain the MSDS for sample gasses used in the Surrogate Gas Validation Procedure from their respective suppliers.

Warning Symbols and Text Conventions

This manual uses safety icons to emphasize important information in the text:

- *Italic* text identifies screen names and to emphasize important text or features.
- **Bold** text is for cautions, warning statements and text you should type or select in screens.

Icon notes and warnings provide information on dangers to either yourself or to the analyzer. The purpose of these icons is to provide a visual convention to alert you important information.

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

WARNING

LASER WARNING alerts you of a laser danger.

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.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in moderate or minor injury.

REMINDER is a helpful prompt to remember procedures listed in the text.

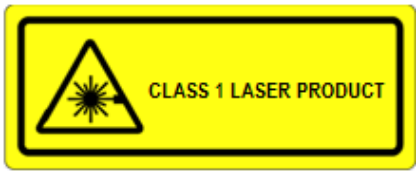
Laser Safety

WARNING

WARNING

This equipment is classified as a Class 1 laser product with an embedded 3B laser in accordance with EN 60825-1:2014.

The laser is a Class 3B when exposed.
Only trained service personnel are authorized to open the housing or service the laser in an approved laser safe service area using appropriate laser safety glasses.



General Safety

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

Only authorized persons may open the analyzer cover or perform internal maintenance. Contact Picarro for maintenance instructions and maintenance kits. Unplug the analyzer before working with the internal components. Failure to do so may result in electric shock and can damage the analyzer.

WARNING

This analyzer weighs 48 lbs. Lifting it is a two-person job. Use the technique described below when lifting the analyzer.

WARNING

HOT SURFACE: The heating block and metal tubes connected to the filter are HOT (up to 100°C). Let the heating block cool before attempting to change the filter.

2. Hazards

The hazards identified and explained in this section might be encountered during maintenance or service tasks.

Hazardous Voltage

There are two locations that the voltage potentials operate above 30 Volts RMS. The first location is in the rear of the instrument on power entry adapter in which the power cord plug plugs into. The second source is the power entry adapter in which the power cord plugs into the external pump. Refer to Manual Number 999085 included in the box for the Vacuubrand MD1 External Pump.

Safety Provisions

Enclosure, Overcurrent, Over Voltage, and Short Circuit Protection

Enclosures protect the operators of the tool from contact with hazardous voltages during normal operation of the system. If a short circuit, overcurrent condition, or over voltage occurs, the power supply will automatically shut down. The power supply shall return to normal operation after the faulty event is rectified.

Lockout/Tagout

Prior to performing service on the Gas Analyzer, perform Lockout/Tagout on the power cord connected to the instrument by disconnecting it at the wall and at the instrument and placing it within your lockable toolbox.

Location of Hazardous Voltages

Hazardous voltage warning labels are located at the power entry module on the DC Power Supply.

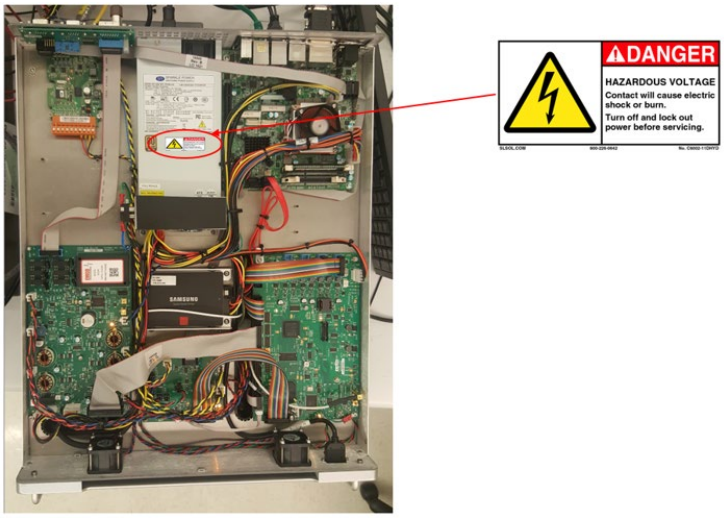


Figure 1: Hazardous Voltage and Warning Labels

Laser Hazards

WARNING: LASER HAZARD
Under normal operating conditions, the SI2000 Series Gas Analyzer is classified as a Class 1 Laser product, in accordance with Title 21 Code of Federal Regulations, Chapter 1, sub-chapter J.

WARNING: LASER BEAM
The Hot and Warm Box with the SI2000 Series Gas Analyzer contain the output fiber end of the fiber laser(s) used. The fiber laser(s) are Class 3B with an operating wavelength between 1200 – 2000 nm. The maximum output power is 80mW. The beam of this laser is, by definition, a safety hazard. Personnel are normally protected from exposure by the covers on the system. When these covers are removed for service tasks and the laser interlocks are bypassed, there is a potential for exposure.

Label Locations

The warning labels are located in the following positions.

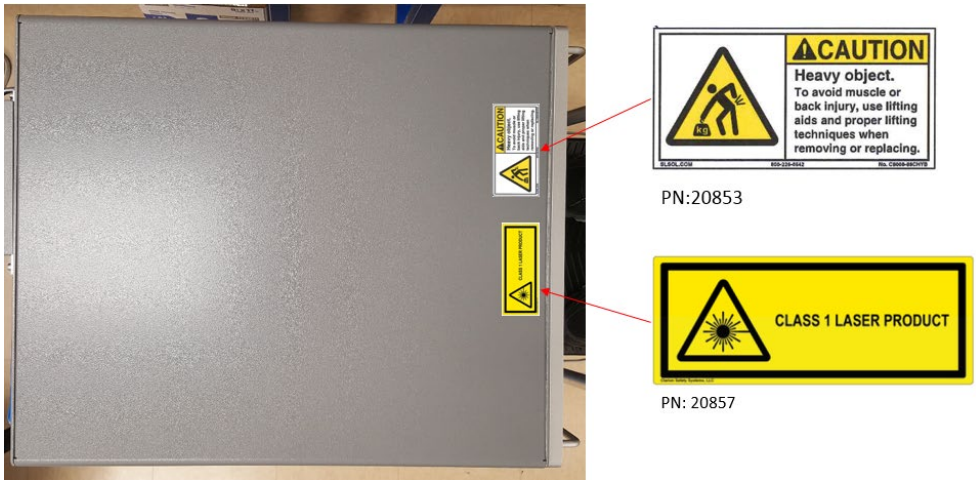


Figure 2: Warning labels on top panel of the analyzer

The SI2000 Series Gas Analyzers is classified as a Class 1 laser product when all panels and covers are on. A Class 1 Laser Product label is attached to the top panel of the instrument.

Figure 3: Warning labels on rear panel of the analyzer

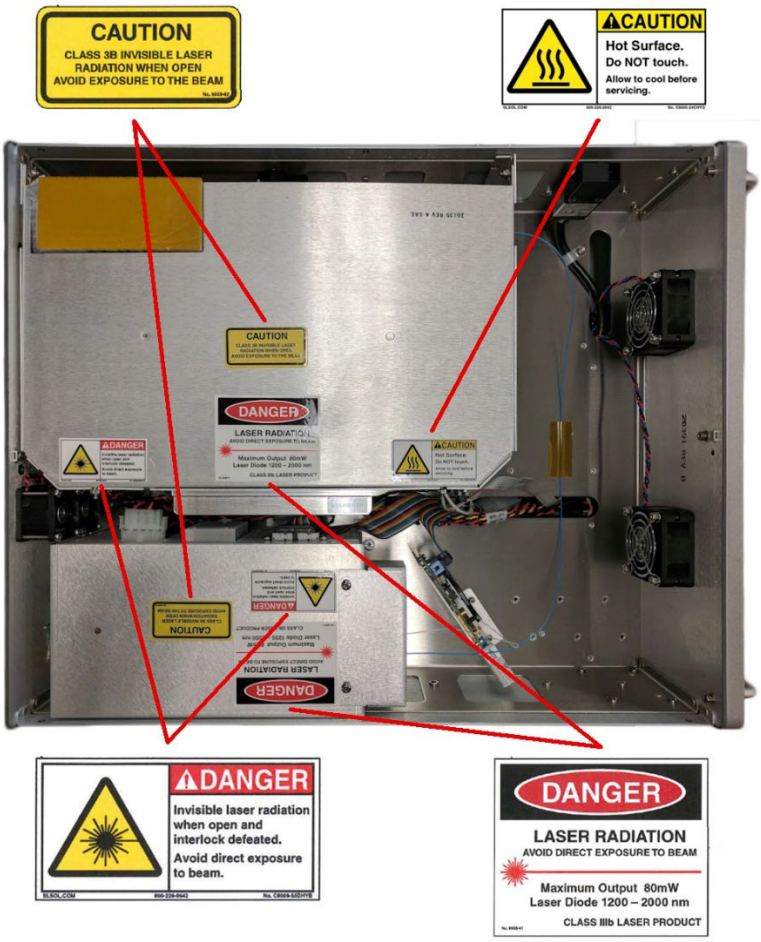


Figure 4: Laser Hazard Labels on the Hot and Warm Box

CDRH Certification

Figure 5: CDRH Label Classification

The SI2000 Series Gas Analyzers complies with 21 CFR chapter 1, sub-chapter J. This is stated on the silkscreen label on the rear panel of the Gas Analyzer.

Hazardous Material Content

The European Union has identified certain substances that are considered environmentally hazardous according to the WEEE (Waste for Electrical and Electronic Equipment) and RoHS Directives. At the end of life of the instrument, the SI2000 Series Gas Analyzers shall be dismantled, and the hazardous materials shall be identified, sort, and collected.

The WEEE directive sets minimum standards for recycling of electrical and electronic waste. Those standards must be met. Local practice may exceed the minimum standards.

The crossed out wheeled bin symbol represents that hazardous content is included in the equipment. The equipment and parts with hazardous content shall not be disposed of with unsorted municipal waste. It is required that electrical and electronic equipment be disposed of under separate collection.

Figure 6: Do Not Dispose Label

Hazardous Material in Electronic Equipment

- Lead is typically found in solder connections including PCBA terminations.
- Mercury can be found in electronic components such as switches, and relays.
- Lead, mercury and cadmium may be found in insulation of electrical cables.
- Hexavalent Chromium may be used as a coating on frames, screw and fasteners.

All parts with hazardous material shall be separated and disposed of to comply with applicable local laws and regulations including with European WEEE Directive.

3. Unpack the Analyzer

Inspect the Shipping Boxes

Picarro products are inspected and tested before leaving the factory. The shipping container system has been specially tested and proven to be safe for most dropping, crushing or spiking events.

Picarro shipping containers consist of:

- An inner box
- An outer box

Inspect the condition of the boxes upon arrival. The larger box includes the analyzer and most of the accessories. Even if the outer box shows damage, the inner box holding the analyzer is cushioned enough that it will protect the instrument under most circumstances.

If the equipment does appear to be damaged, photograph the damages and contact Picarro (email pictures if possible) as soon as possible.

Unpack the Shipping Boxes

The section describes the contents of the shipping boxes:

Figure 7 shows the box contents and the Table 1 and Table 2 list the box contents.

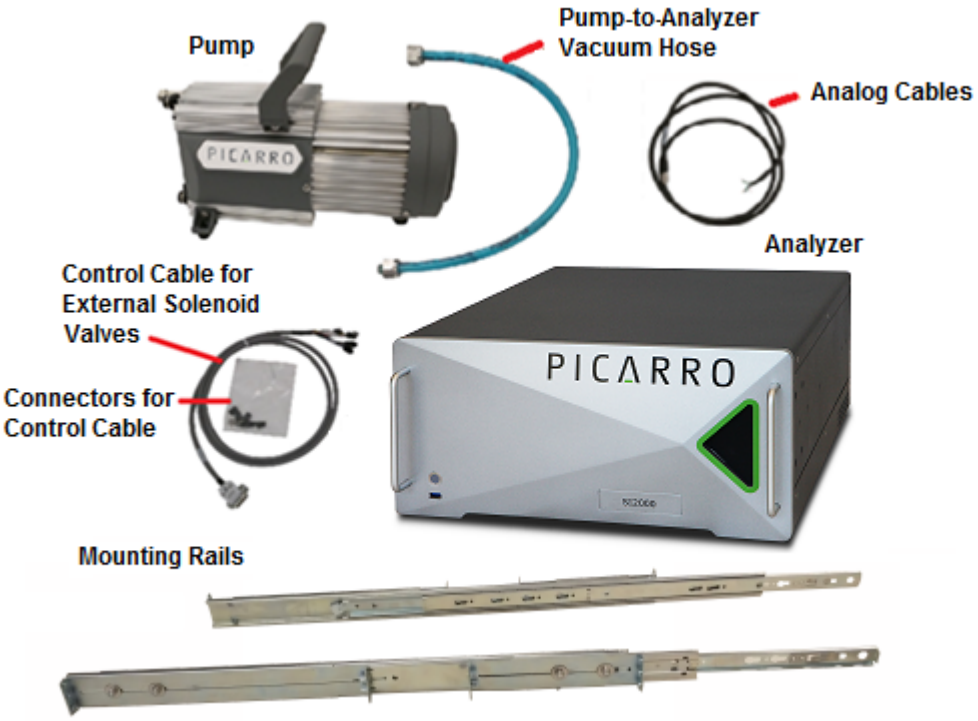


Figure 7: Box Contents

Table 1: Box 1 Contents

QTY	Item	Description
1	Analyzer Module	Includes all of the data acquisition, control, and communications hardware and firmware to perform all gas handling, spectral collection and analysis.
1	Slides	1 pair of slides and hardware for 19” rack mounting.
2	A/C Power Cables **NOT SHOWN**	2 power cables with connectors appropriate to your country are provided. The pump and analyzer automatically adjust to local voltage.
1	Accessories	1 Conformance of Calibration 1 Hardcopy User Manual (this document)

Table 2: Box 2 Contents

QTY	Item	Description
1	Pump Module	Provides vacuum required for sample gas sequencing into and out of the analyzer.

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

4. Analyzer Overview

Front and Back Panel Description

Figure 8 shows the analyzer front panel and Figure 9 shows the analyzer back panel.

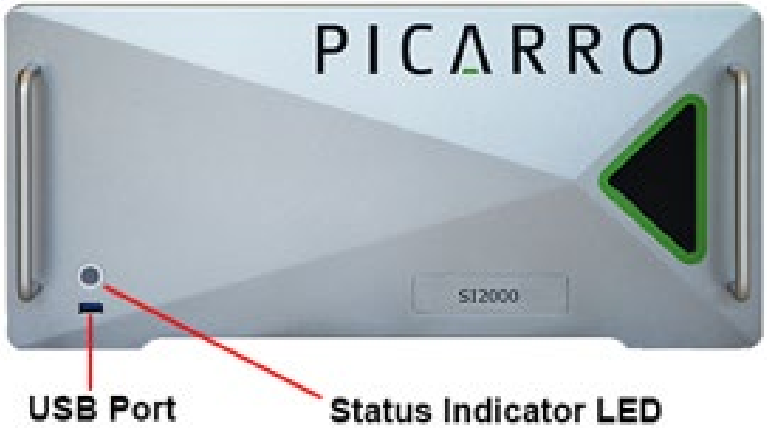
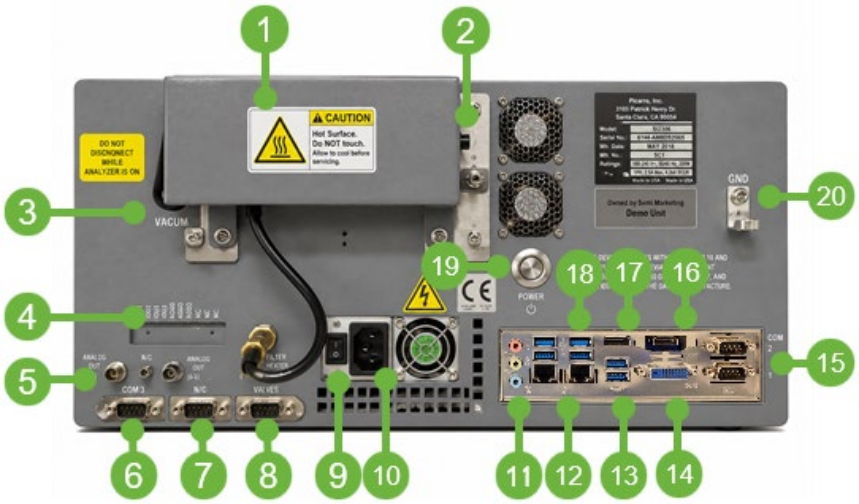


Figure 8: Analyzer Front Panel



1. **Filter (inside cover)**
2. **Gas Inlet**
3. **External Vacuum**
4. **4-20mA Output (optional)**
5. **Voltage Analog Output**
6. **COM3**
7. **Not Connected**
8. **Solenoid Valves**
9. **Main Power Switch**
10. **Power Connector**
11. **Audio**
12. **Ethernet**
13. **USB 3.0**
14. **DVI-D**
15. **COM1/COM2**
16. **HDMI 2.0**
17. **Display Port**
18. **USB 3.0**
19. **Soft Shutdown Button**
20. **Ground**

Figure 9: Analyzer Back Panel

CAUTION

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 analyzers functioning.

NOTE

The analyzer has a universal power supply that automatically adjusts to power sources ranging from 100-240 VAC, 50/60 Hz, 250 W max.

Front Panel Operating Status Indicator

The LED indicator on the front panel shows the current operating state of the analyzer. Figure 10 shows and describes the status indicator states. The status states and colors are linked to the System Alarm Panel on the CRDS Data Viewer Screen. See *Analyzer Operation* section.

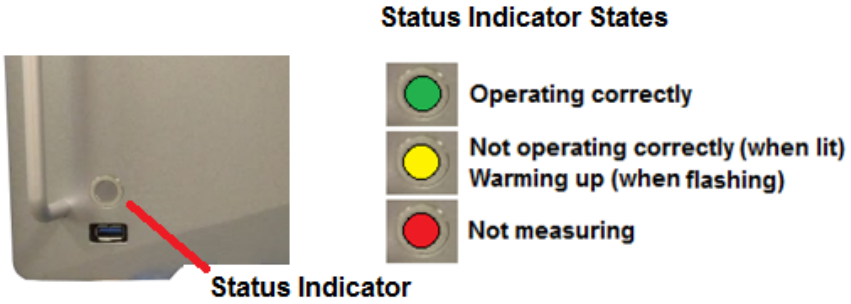


Figure 10: Status Indicator States

External Vacuum Pump

The figure below shows an example of an external vacuum pump.

Figure 11: Vacuum Pump

Specifications

- **Weight:** 48lbs. The analyzer must be lifted by two people.
- **Dimensions:**
  - Length: 24.38”
  - Width: 7.5”
  - Width with rails:17.75”
  - Height: 7.88
  - Height with feet: 8.38”
- **Temperature range:**
  - Storage: 0ºC - 70ºC
  - Operation: 0ºC - 35ºC
- **Ambient humidity range:** <99% R.H. non-condensing
- **Maximum altitude:** 10,000 ft (operation)
- **Front and rear clearance:** 6” for ease of connection
- **Power requirements:** 100-240 VAC, 50/60 Hz, 250 W max
- **Power supply voltage fluctuation**: ± 10% of nominal voltage
- **Liquid ingress protection:** None

WARNING

This analyzer is designed to be used in an indoor environment. Do not operate or store the unit outside or exposed to the elements.

WARNING

If the equipment is used in a manner not specified by Picarro, the protection provided by the equipment may be impaired.

5. Hardware Setup

Electrical Safety Task Type 2

Items/Tools Required:

- 9/16'' open end wrench
- 11/16'' open end wrench
- Pump
- Power Cord

CAUTION

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

CAUTION

The host solution in which the instrument and pump are being installed inside of must have sample gas and CDA purge isolation valves provided by the host to system.

CAUTION

The host solution in which the instrument and pump are being installed inside of must have main overcurrent protection devices and main disconnect devices rated for at least 10,000 RMS symmetrical amperes interrupting capacity (AIC).

CAUTION

The host solution in which the instrument and pump are being installed inside of must have an EMO. Activation of the host system EMO must shut off power and CDA to the instrument and pump. The location of the EMO button must be within 3 meters of the instrument.

CAUTION

The host solution or facility in which the instrument and pump are being installed inside of must have lockable shutoff valves for the sample and CDA lines.

CAUTION

The host solution in which the instrument and pump are being installed inside of must have adequate overcurrent protection for the power supply to the instrument, pump, and voltage supply (maximum of 7A).

CAUTION

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

Sample or CDA lines connected to the ¼" Swagelok connectors must not exceed 3 psig.

CAUTION

Any light emitted from the Status Indicator, regardless of color or state, shown in Figure 10 indicates one or more lasers are on.

CAUTION

NOTE

Analyzer performance may degrade (increased measurement intervals, or increased measurement noise) while exposed to RF Radiation in an Industrial Environment between the frequencies of 80MHz - 1GHz at a field strength of 10V/m per IEC 61326-1-2013. Make sure normal operation conforms to the datasheet for the analyzer during the initial start-up sequence after the installation procedure is completed.

WARNING

This analyzer weighs 48 lbs. Lifting it is a two-person job. Use the technique described below when lifting the analyzer.

Use this technique to lift heavy objects:

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

The figure below shows the warning label positions on the top and back of the analyzer.

Figure 12: Warning Label Positions

Procedure

1. Remove the analyzer and the external vacuum pump from the shipping containers.
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 rackmounts alone.

4. Unpack the analyzer accessories (vacuum line, AC power cables, manual, and conformance of calibration).
5. Remove the caps from the analyzer gas connection inlet and vacuum connection ports. Save the caps from the analyzer and pump. Reinstall the caps when the analyzer is stored, moved or shipped.

NOTE

Store the certificates in a safe place. They may be required if you call us for service or questions.

6. Remove the caps from external vacuum pump. Save the caps for later use. Reinstall the caps when the pump is stored, moved, or shipped.
7. Connect the vacuum hose between the external vacuum port and the external vacuum pump. Hand tighten the nut, then make an additional $^{1}/_{4}$ turn with an $^{11}/_{16}$" wrench (not supplied).
8. Connect the AC power cable to the analyzer and to the external vacuum pump.
9. Refer to Picarro's *SI2000 Series Service Manual* 40-0046 for service instructions.

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.

CAUTION

When working with hazardous gases, attach a tube to the external vacuum pump exhaust port and direct the exhaust to a safe place for venting the mixture of sample gases.

Figure 13: Analyzer and Pump Connections

NOTE

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

Refer to Manual Number 999085 included in the box for the Vacuubrand MD1 external pump safety, operation, specification, and service Instructions.

6. Analyzer Operation

This section describes the GUI and explains how to operate the analyzer using the GUI.

1. Switch on the external vacuum pump.
2. Switch on the main power to the analyzer.

CAUTION

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

The software starts and the analyzer displays the opening screen.

On a cold start, upon reaching this screen, there will be a 30-second countdown, after which the analyzer will automatically start in DCRDS mode, or the previous selection, if manually overridden. The user can click anywhere, or click any key on the keyboard to stop the countdown.

Use the buttons on the opening screen to select the activity you want. The *Files* and bottom buttons are password protected to prevent accidental shutdown or configuration changes. From the opening screen select:

- **HCl (DCRDS)** to start the HCl analyzer in DCRDS operation
- **HCl** to start the HCl analyzer in normal operation
- **Files** to copy data to an external device (user credentials required)
- **Config** to perform configuration tasks (only accessible by Admin level users)
- **Service** to perform service tasks (for trained personnel only)
- **Power Off** for a soft shutdown (user credentials required)

Figure 14: Opening Screen

The Data Viewer (Main Screen)

Single click on either the **HCl (DCRDS)** or **HCl** button and wait about 30 seconds while the acquisition software initializes. A “Loading” window will pop up, listing the apps that are being started. When initialization is complete the *DCRDS* or *CRDS Data Viewer* screen displays.

This section describes the data viewer. This is the analyzer main screen. The data viewer shows a graph for HCl and H_2O.

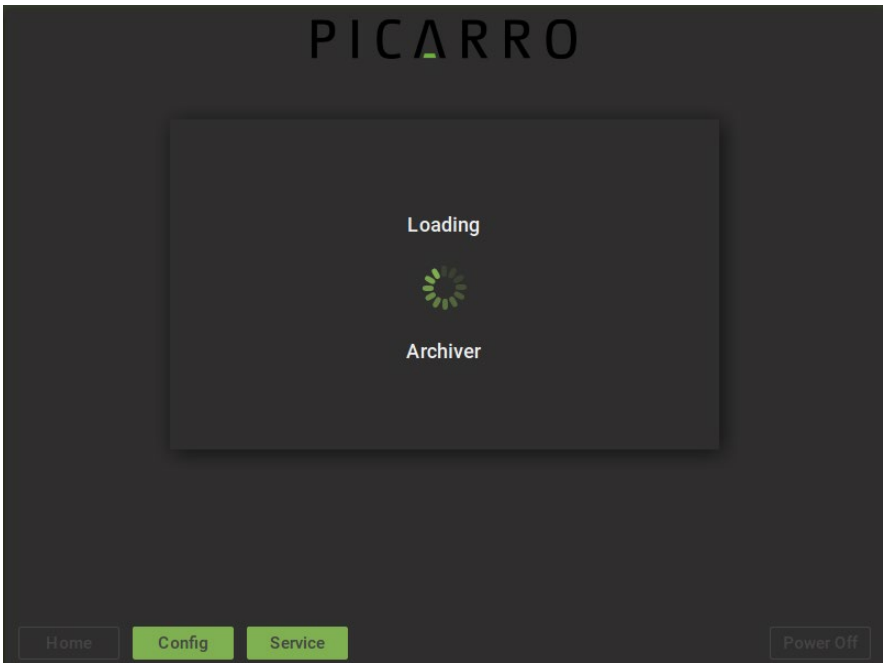


Figure 15: Loading Screen

After the Data Viewer has loaded, the analyzer will have to warm up before starting measurements. During this warmup period, the *System Alarm* box will flash yellow. The data shown will be *Cavity Pressure* and *Cavity Temperature*. After the analyzer has warmed up, data screens will switch to showing HCl and H2O concentrations. *System Alarm* box will become solid green and *'Measuring…'* message will appear in the Measurement Status box.

Analyzer initialization is complete when the Data Viewer screen displays, and sampling begins. The figure below shows the Data Viewer for Hydrogen Chloride and Water Vapor.

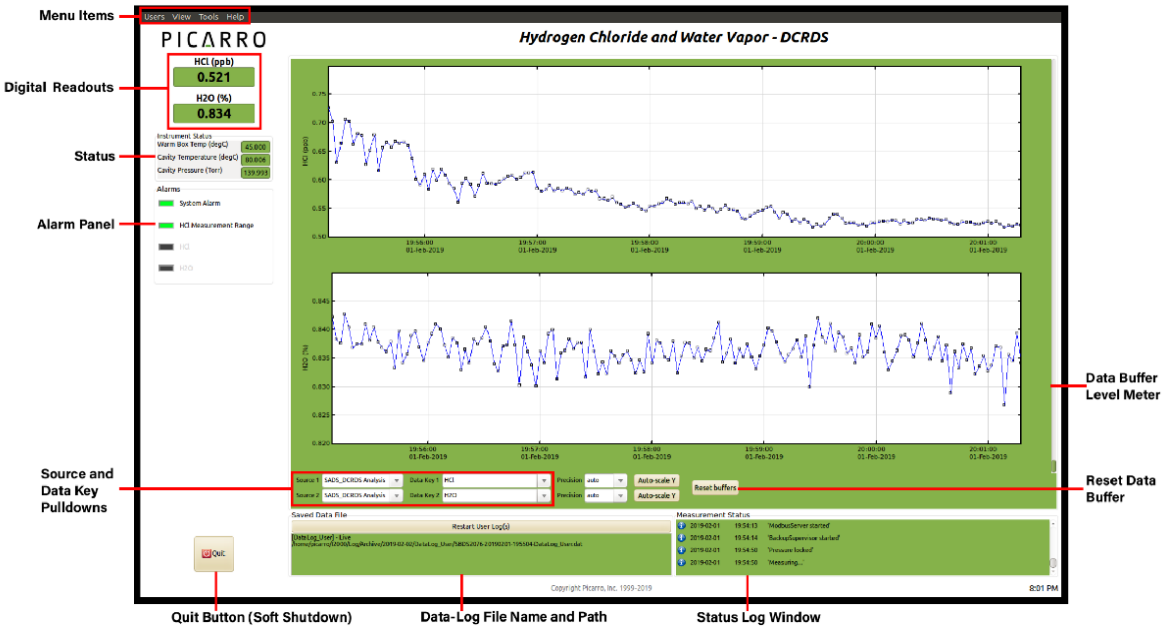


Figure 16: Data Viewer

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/Archive/YYYY-MM-DD/DataLog_User/

- *YYYY* = year
- *MM* = month
- *DD* = day

Further details can be found in the File Management section.

Data Viewer Field Descriptions

Users Menu

Left clicking on the *Users* menu shows the drop-down *User Login*. Depending on your level of access, different menu items will be enabled.

Figure 17: Users Drop-Down Menu

View Menu

This menu item has three choices:

- *Lock/Unlock time access* when zoomed: This is a toggle. When locked, forces the data windows to display the same time scale during zoom.
- *Show/hide statistics*: Toggles the measurement statistics display.
- *Show/hide instrument status*: Toggles the instruments status display.

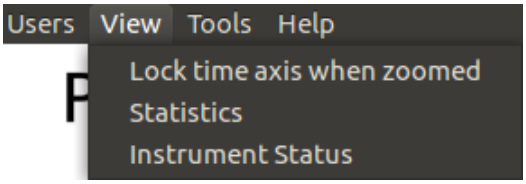


Figure 18: View Drop-Down Menu

Tools Menu

Use the tools drop-down menu to *Show/Hide Valve Sequencer GUI*. This option toggles the display of the external valve sequencer window.

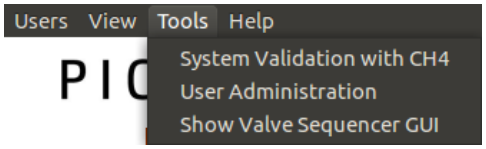


Figure 19: Tools Drop-Down Menu

Help Menu

Click *About* to display the version number of the analyzer.

Alarm Panel

Click on an item in the alarms panel to view the Setting Alarm dialog for that item. This panel is used to monitor the status of the internal analyzer alarms.

System Alarm monitors the current analyzer status, such as pressure, temperature, and measurement.

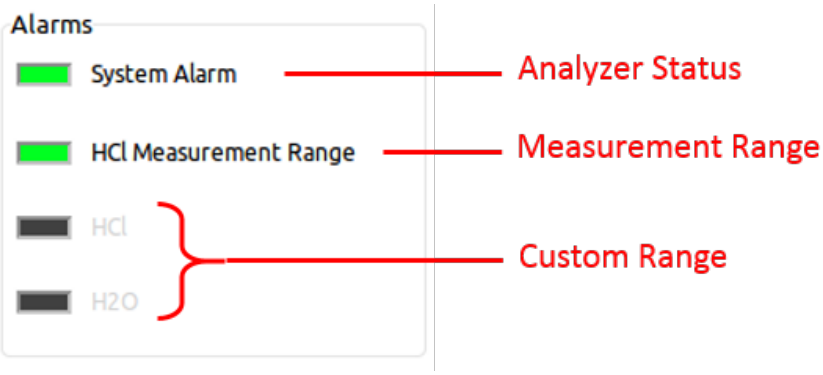


Figure 20: Alarm Panel

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 points for a gas, click on the indicator next to that gas. The Alarm Set dialog will be displayed. You can read or change the alarm settings and allow the user 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

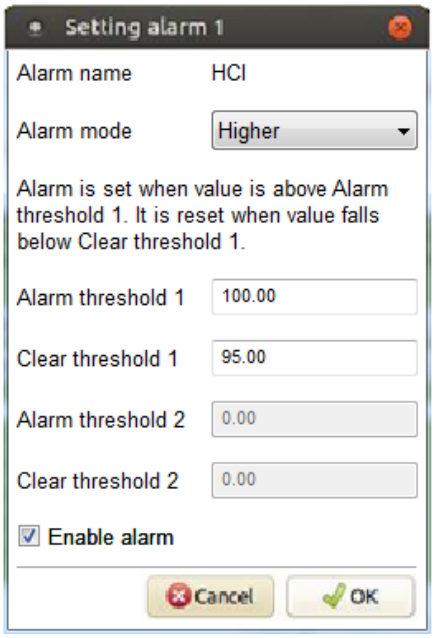


Figure 21: Alarm Set Dialog

To set the alarm, type the desired threshold values and click **OK**.

If you don't need to change the alarm value, click **Cancel**. The dialog box will disappear, and the alarm value will remain unchanged.

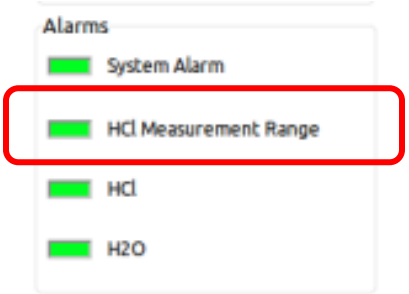


Figure 22: Measurement Range Indicator

The **Measurement Range Indicator** in the Alarms panel can display as Green, indicating that the target gas is measuring within the intended measurement range, or Red when measuring outside the intended range for that gas.

Digital Readouts

The digital readouts show the latest value recorded for the selected data key for each data window. The changes in the data key are reflected in the digital readout in the data window view. If the *Show 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 all data in view.

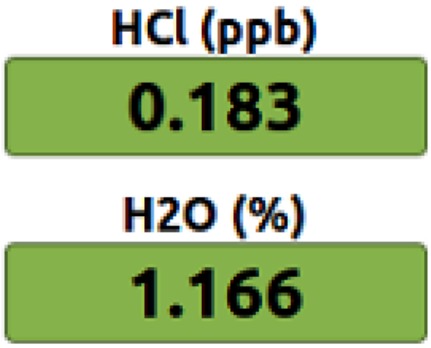


Figure 23: Digital Readout Panel

Restart User Log

The analyzer automatically records all data collected and saves it for later analysis. These files are called DAT files after their extension (.dat). Click *Restart User Log(s)* to start recording a new data file.

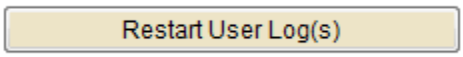


Figure 24: Restart User Log(s)Button

Data Log Filename and Path

The filename and path of the active data log is displayed in this panel.

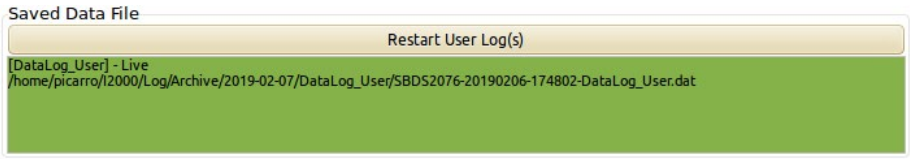


Figure 25: Data Log Filename Panel

Data Window

The data window displays graphs of streams of data vs. system time, with a format of hh:mm:ss and YYYY-MM-DD

- Select which data streams are displayed using combinations from the *Data Source* and *Data Key* drop-down menus.
- Adjust the number of significant figures displayed using the *Precision* menu.
- Adjust the auto-scaling of the Y axis using the *Auto-Scale* drop-down.

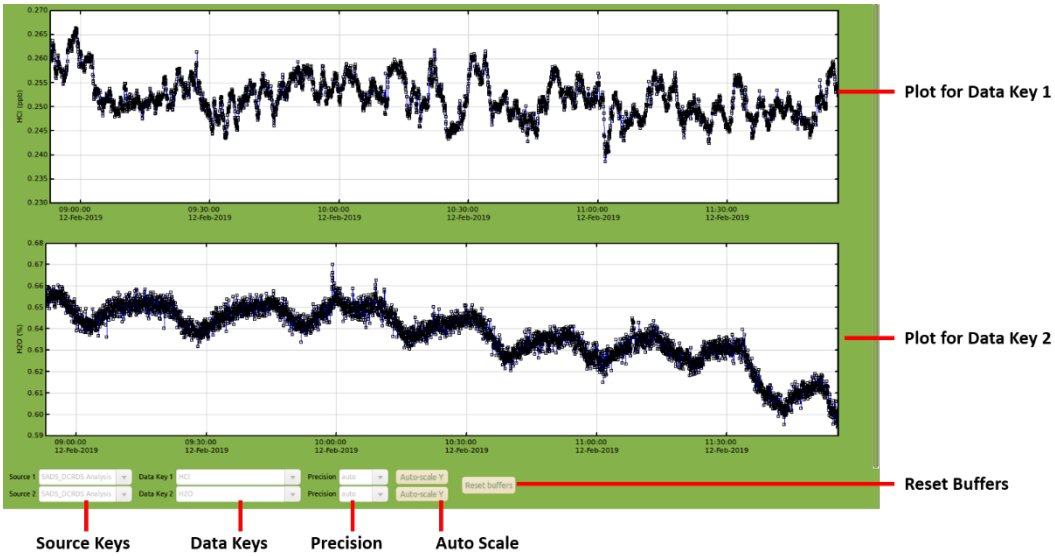


Figure 26: Data Window

Instrument Status

Enable the *Show Instrument Status* using the *View* menu on the main toolbar digital readouts for these parameters are displayed to the left of the data windows.

- Warm box temperature in ^{0}C
- Cavity temperature in ^{0}C
- Cavity pressure in Torr

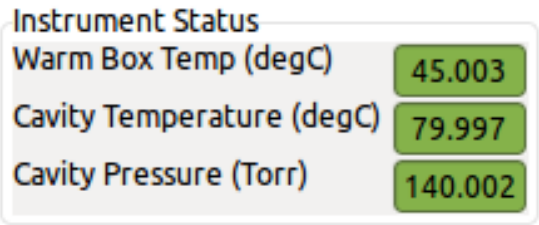


Figure 27: Instrument Status

Data Source Drop-Down Menus

Use these menus to select the data stream that is viewed in the *data plot*. Left click on the arrow next to a source to view the available data streams:

- *Instrument Analysis* shows gas concentrations.
- *Sensors* displays data from the analyzer's sensors.

Figure 28: Source Key Drop-Down Menu

Data Key Drop-Down Menus

Left-click on the drop-down menu for a data key to get the test options available for that key. When you select an option, the analyzer generates a data plot for that option.

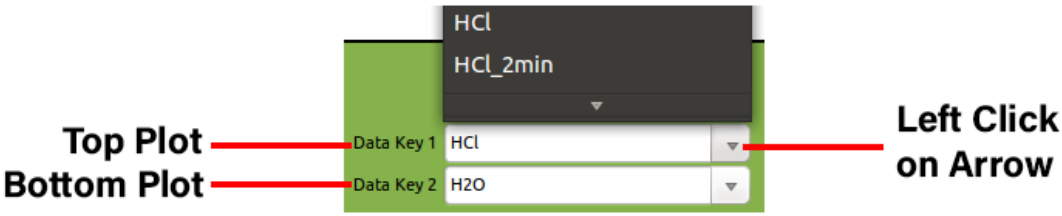


Figure 29: Data Key Drop-Down Menu

Precision Drop-Down Menu

Click on these drop-down menus to select the precision displayed on the y-axis of the data plot, between 0 and 4 digits of precision or *auto*. This affects *only* the data plot displayed in the *data window*, not the data stored in any files.

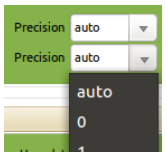


Figure 30: Precision Drop-Down Menu

Status Log Window

Click here to display analyzer status messages, in this format: *YYYY-MM-DD hh:mm:ss generic message text*. These messages include all messages sent to the DAS (*Refer to Figure 16, Data Viewer*).

Reset Data Buffer Button

Click here 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. Clicking this button has no effect on any of the data log files stored by the analyzer (*Refer to Figure 16, Data View*).

Data Buffer Level Meter

The green bar to the right of the *Data Window* shows the amount of GUI buffer memory used to retain historical data collected by the analyzer. When the maximum number of data points is collected, and the buffer is full, old data is removed from the buffer as new data is collected. This affects *only* the data displayed in the *data window*, not the data stored in any files.

This buffer automatically resets when the analyzer starts and can be emptied at any time by clicking the *Reset buffers* button in the lower-right-hand corner of the GUI.

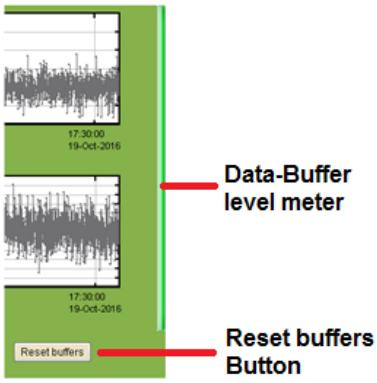


Figure 31: Data Buffer Level Meter and Reset Buffer Button

Zoom in a Data Window

Zoom in on a section of the data window to get a detailed view of the graph. To zoom an area of a data window:

1. Move the cursor over the graph you want to magnify. The cursor changes from an arrow to a magnifying glass.
2. Drag the magnifying glass over the section you want to zoom while holding down the left button. A box appears to show the zoom area.
3. Release the left button and boxed area will automatically scale to fill the data window.

- To auto-scale the y-axis of either graph, use the auto-scale buttons below the graph.
- To lock or unlock the time axes of each graph during zooming, select that menu item in the *View* menu.

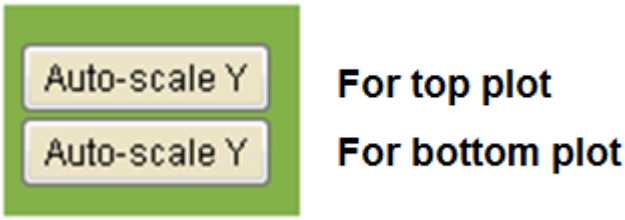


Figure 32: Auto-Scale Buttons

File Transfer

File Manager

1. On the home page, click on files
2. Login using user credentials
3. Plug in an external USB drive
4. 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
5. Using the upper left-hand corner drop down menu, select the type of file
    - Data, Screenshot, User History, Validation Report
6. Highlight and select the desired files
7. Click copy to copy or move to transfer file to USB drive
8. Unmount the USB drive when file transfer/copy is complete

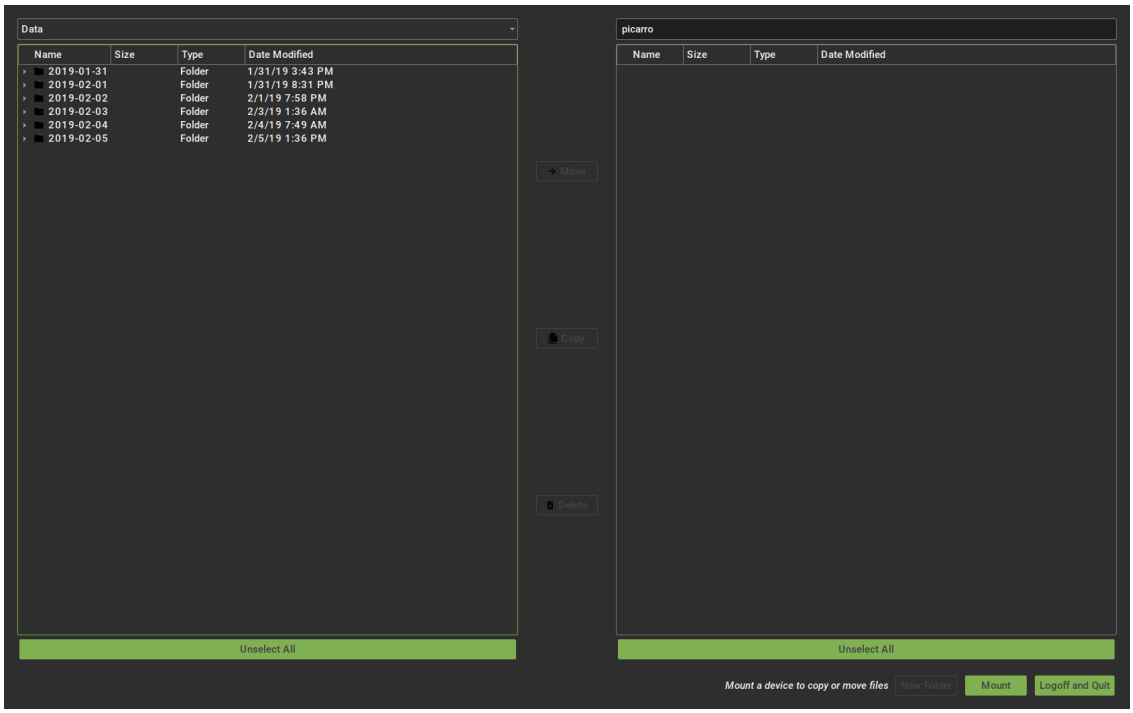


Figure 33: Transfer Files

Configuration Menu

To access the configuration menu:

1. From the home screen, click on the **Config** button to configure the analyzer.
2. You will be prompted to log in, and must use an account with appropriate access.

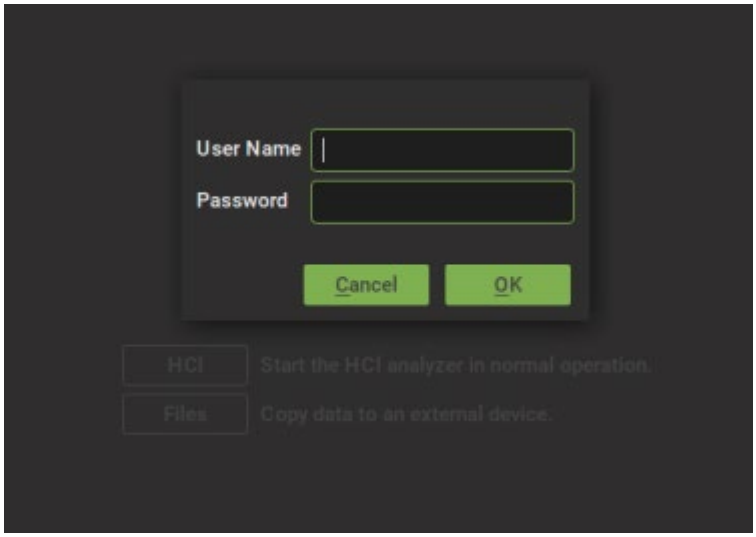


Figure 34: The Config Login Dialog

3. The *Configuration* Menu displays.

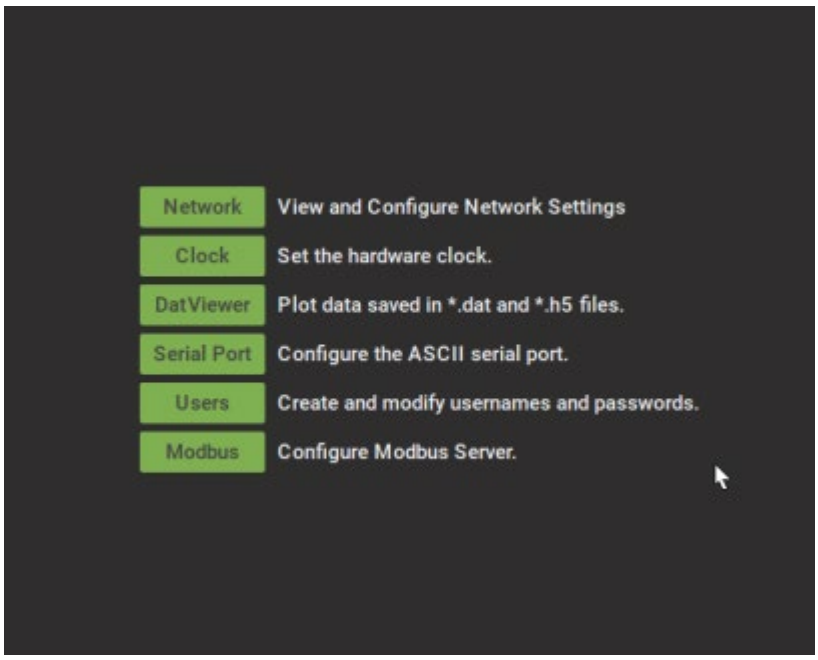


Figure 35: The Config Menu

Network

Click on **Network** to view the Network Settings Tool. You will be prompted to log in again.

Figure 36: Log in to access Network Settings Tool

User this menu to:

- Select ethernet adapter
- Select IP address type
- If *Static IP* is selected, enter the applicable address, netmask, gateway, and/or DNS server
- View the network connection status and active IP address

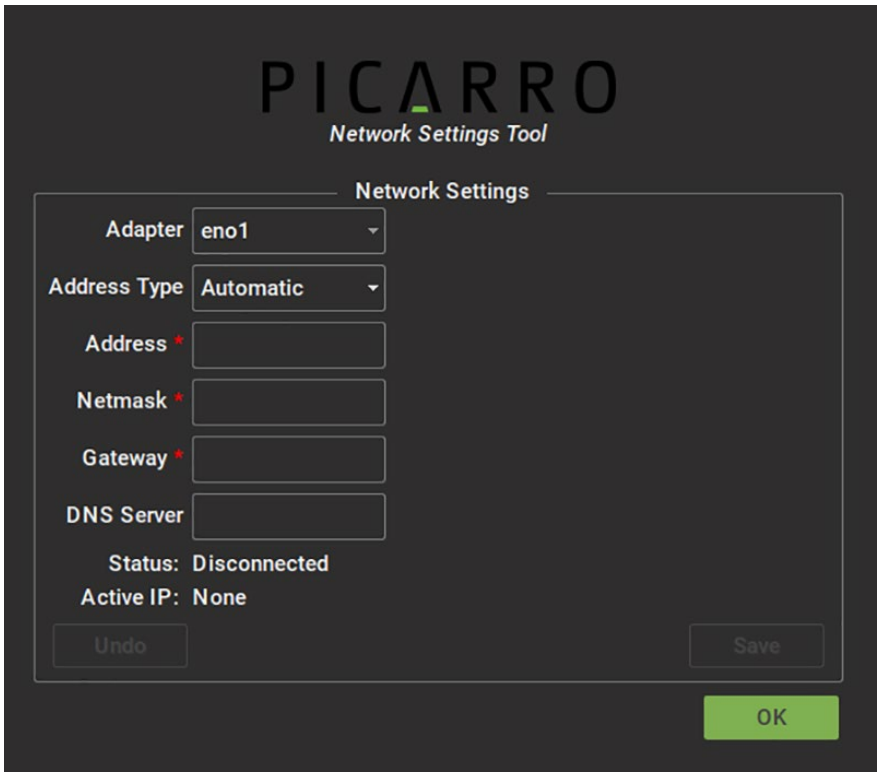


Figure 37: The Network Settings Tool

Clock

Click on **Clock**, the *Set Time and Time Zone* dialog displays.

Use this dialog to:

- Set the clock for a new time zone.
- Manually set the correct time.

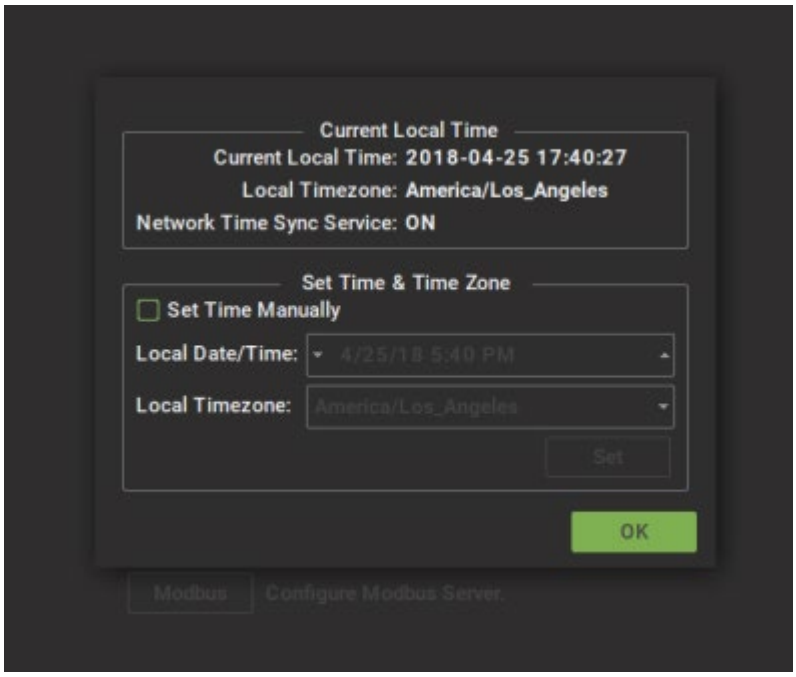


Figure 38: The Clock Set Dialog

Set the Local Time Zone

1. Click on the **Local Timezone** drop-down and select the location you want. The *Local Date/Time* field changes to the date and time for the location you selected.
2. Click **Set** to save the changes and return to the config menu.

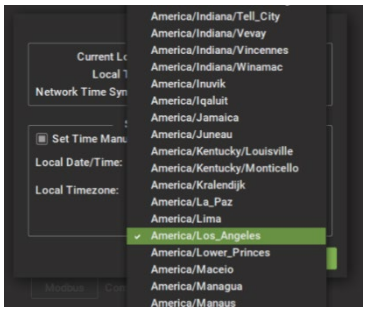


Figure 39: The Clock Set Menu

Manually Set the Time

Use the *Set Time Manually* check box to manually reset the clock to the correct date and time when the clock is set to the wrong time.

1. Check the **Set Time Manually** check box.
2. Click **Set** to save the changes and return to the config menu.

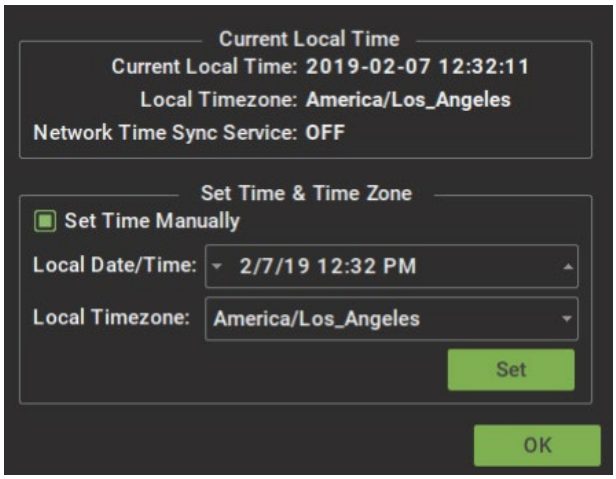


Figure 40: The Clock Set Dialog

Serial Port

Click on Serial Port on the Config screen to access the Serial Port Dialog. The serial port dialog lets you change the baud rate.

Figure 41: The Serial Port Dialog

To Change the baudrate:

1. Click on the *Baudrate* dialog.
2. Select the baudrate from the menu options.
3. Click **Save**.
4. Click **OK**.

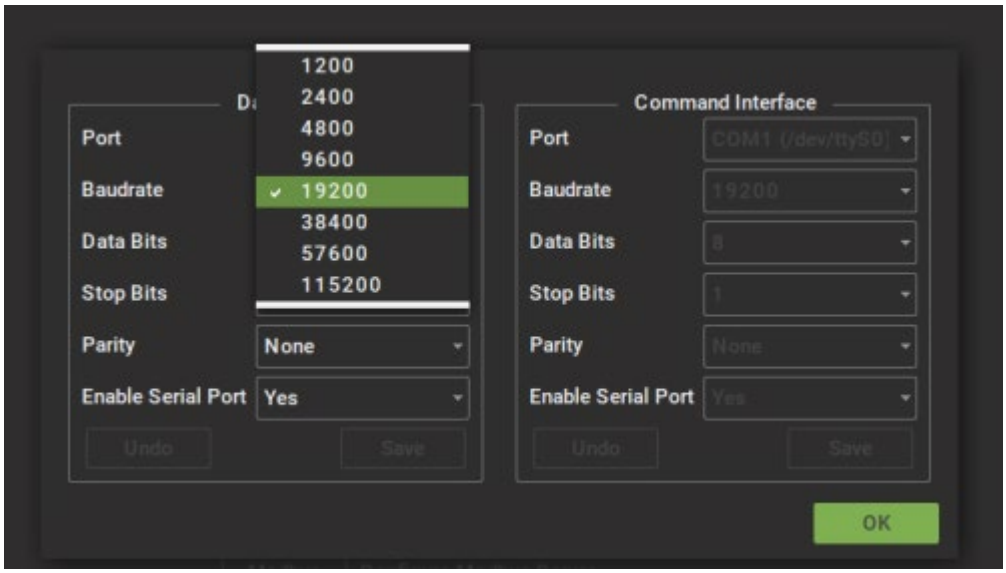


Figure 42: Baudrate Options

User Management

The User Management Tool can only be accessed by an Admin-level user. Access the User Management tool from either of two locations:

- From the qtLauncher, navigate to the Config screen, then click Users.
- From the Data Viewer, click Tools, then User Administration.

Actions that can be performed from the User Management Tool include:

1. Edit user accounts
    a. Change user password
    b. Change user role
    c. Disable or enable user
    d. Create a new user
2. Set user policies
3. View user actions

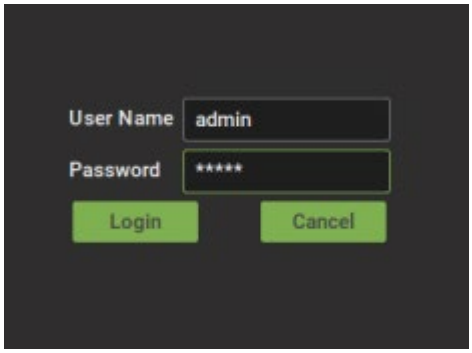


Figure 43: Users Login

NOTE

Tech, operator and admin are the default users and rolls that are shipped with the analyzer.

Table 3: Summary of User Access Levels

Function	Not Signed In	Operator	Technician	Administrator
View Data Viewer	•	•	•	•
Set Alarms		•	•	•
Configure Data Viewer (partial)		•	•	•
Quit Measuring		•	•	•
Shut Down (software shutdown)		•	•	•
System Validation			•	•
Configure Data Viewer (full access)			•	•
User Management				•
File Management		•	•	•
Valve Sequencer			•	•
Configuration Menus				•

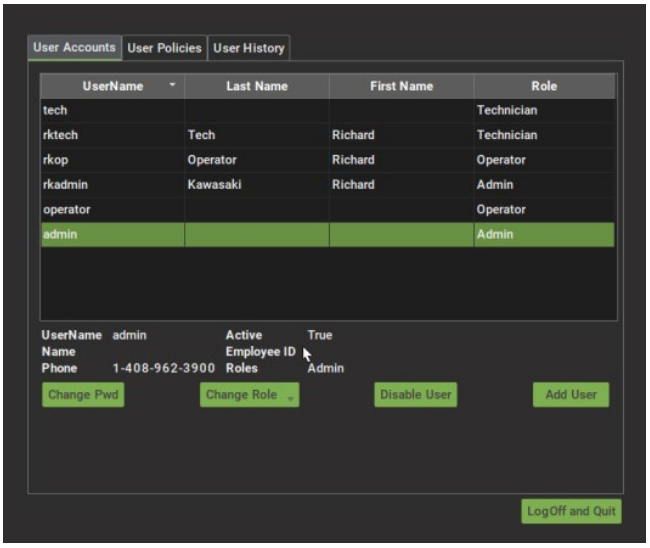


Figure 44: User Accounts Dialog

To change a password:

1. Click to highlight the user whose password you want to change.
2. Click Change Password.
3. Click on the user password you want to change.
4. The Change Password dialog displays.
5. Enter the new password.
6. Confirm the new password.
7. Click **Next** to save the password.

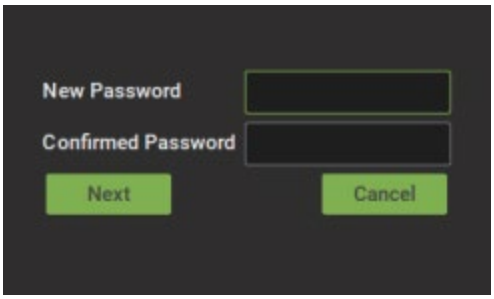


Figure 45: Change Password Dialog

To change a user's role:

1. Click to highlight the user role you want to change.
2. Click Change Role.
3. The Change Role drop-down menu displays.

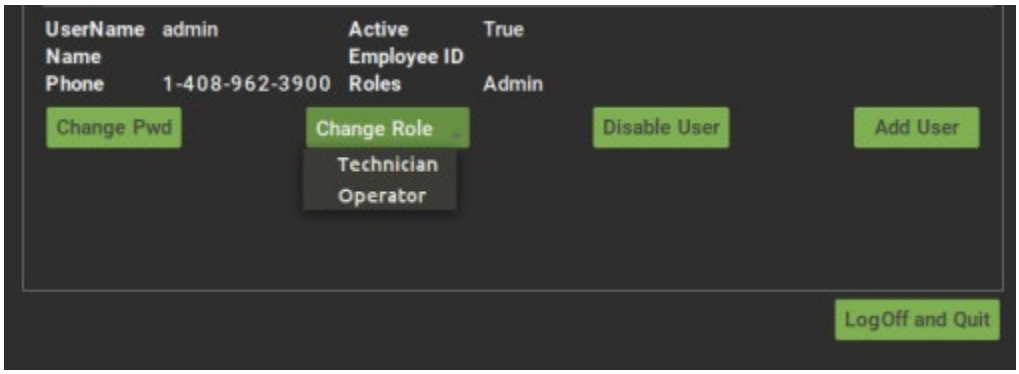


Figure 46: Change Role Drop-Down

4. Select the role for the user.
5. The *Confirm Action* dialog displays.
6. Click **OK** to confirm the changed role.

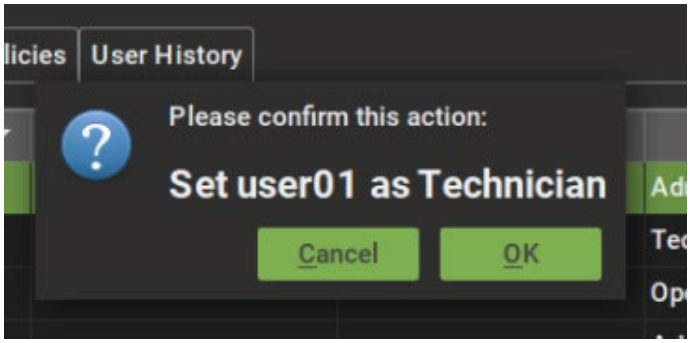


Figure 47: Change Role Confirmation

To Disable a user:

1. Click **Disable** User. The *Confirm Action* dialog displays.
2. Click **OK** to confirm the action.

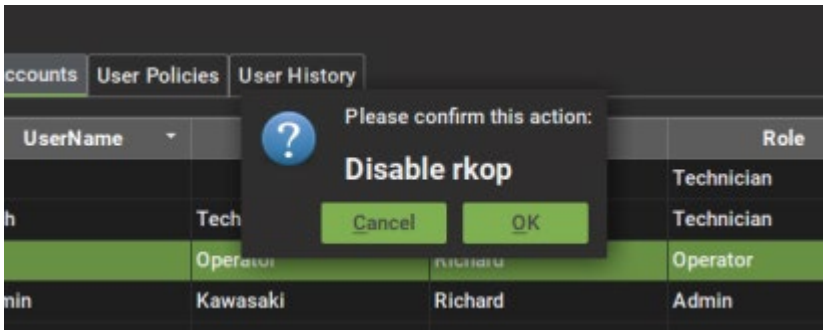


Figure 48: Disable Confirmation

To add a user:

1. Click **Add User**. The *Add User* dialog displays.
2. Fill in the fields in the *Add User* dialog.
3. Click **Next** to go to the next step.

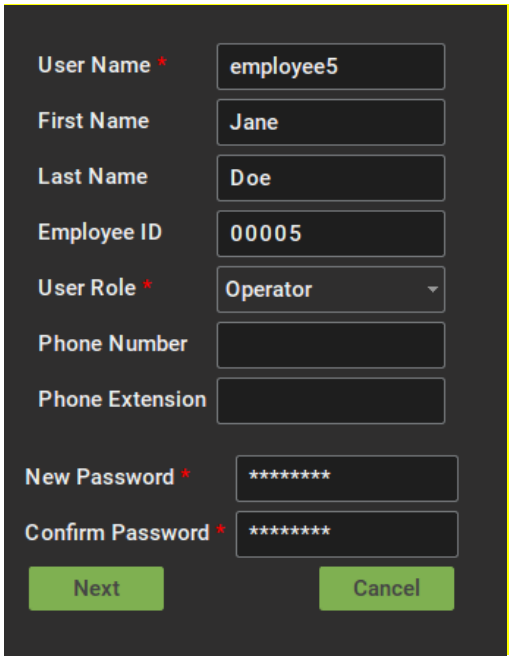


Figure 49: Add Users Dialog

4. The *New User Account Verification* dialog displays.
5. Review the user information and click **OK** to accept or **Cancel** to reject the new account.

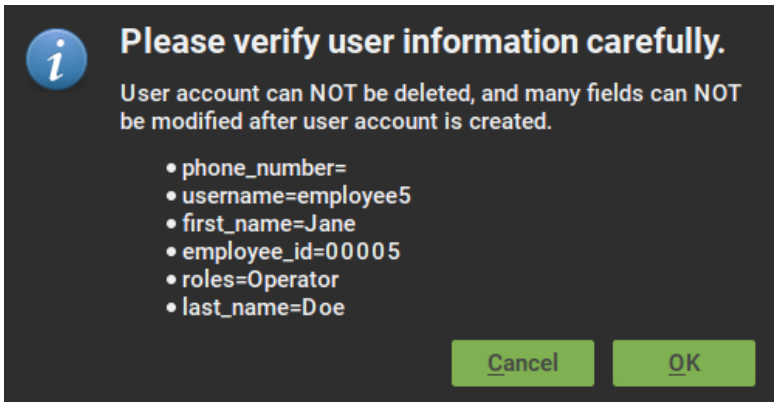


Figure 50: Add Users Account Verification

Setting User Policies

1. In the User Management window, click the **User Policies** tab.

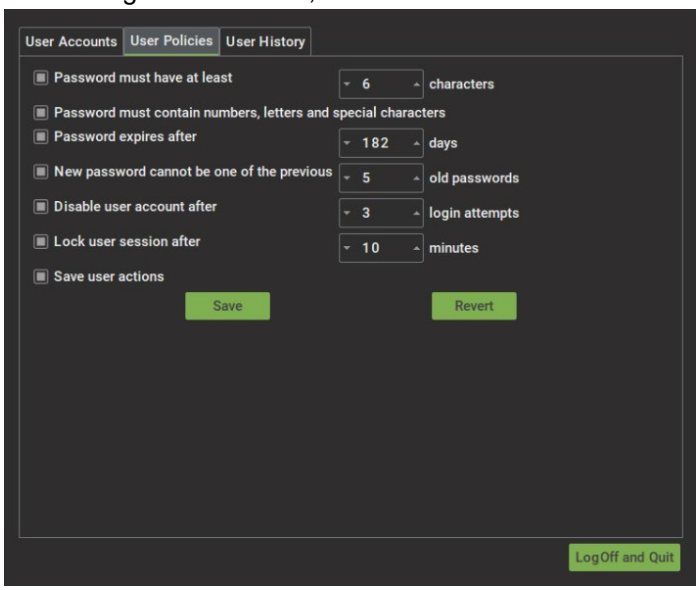


Figure 51: User Policies

2. Make the changes you want:

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. Password expiration is disabled by default.
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.
Save user actions	When enabled, user actions (such as logging in) will be saved in the User History.

3. Click **Save**. If you typed in a bad value and want to undo any changes and revert to the last saved configuration, click **Revert**.

View User History

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

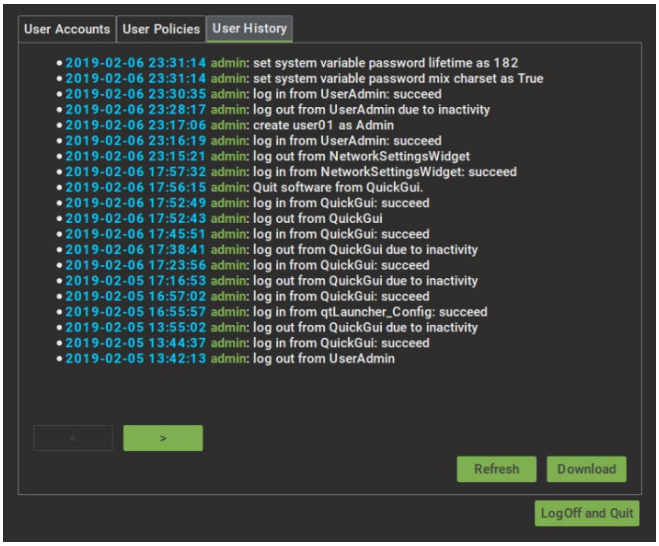


Figure 52: User History

2. Click the **<** and **>** buttons to navigate through the history (if the button is greyed 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 will direct you to the File Manager, which will prompt you to login again.

MODBUS Settings

From the Config Menu window, select **Modbus**.

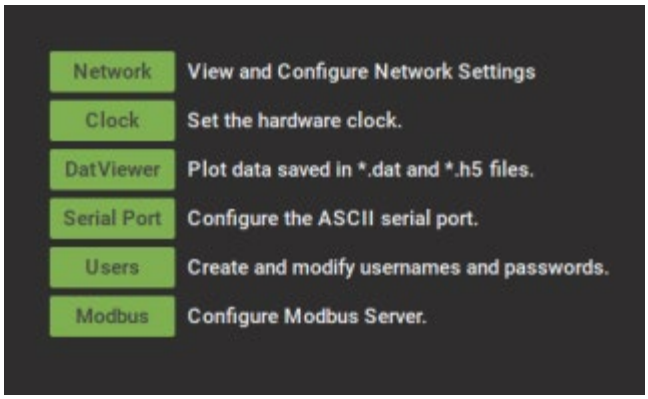


Figure 53: Config Menu

This will open the **Modbus Settings** window:

Figure 54: Modbus Settings

From this window, you can configure:

- The analyzer's Slave ID
- Modbus Communication Protocol: TCP/IP or RTU (See Appendix F: MODBUS Communication)
- TCP Port designation (if TCP/IP is selected)

Additionally, the window will display the CommandInterface Status. However, if Modus Type is set to "RTU", then the CommandInterface on COM 1 will be disabled.

Shutdown Procedure

To shut down the analyzer:

NOTE

You must be logged in to shut down the analyzer.

1. On the Menu Bar click on **Users** and choose User Login.

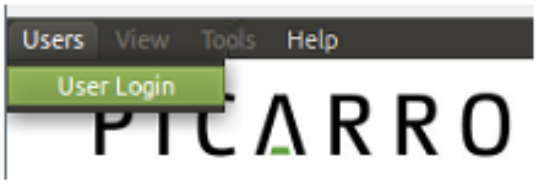


Figure 55: User Login Tab

2. Enter a valid username/password and click **OK**.

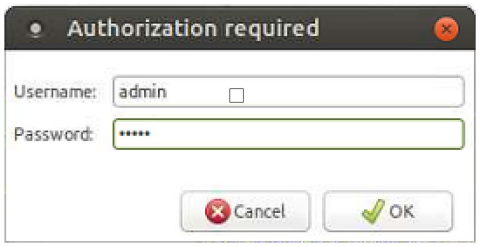


Figure 56: User Login Dialog

3. Click **Quit** on the data viewer screen.
4. The analyzer displays the *Stop Data Acquisition* dialog.
5. Click **Yes**.

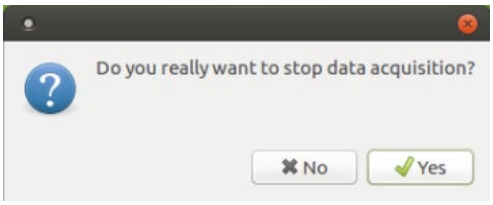


Figure 57: Analyzer Shutdown Dialog

6. Click **Power Off** in the bottom right of qtLauncher, enter credentials, and click **OK**.
   - Doing this will turn off the system completely

Recovery from Power Outage

When the power returns after an unplanned outage, the analyzer restarts automatically. The Picarro software:

- Closes files that were interrupted by the power outage.
- Opens new files for data collection.
- Data, analyzer diagnostics and other parameters recorded up to the time of power outage are retained.

If short power outages will be a routine operating environment, Picarro recommends using power conditioning or an uninterrupted power supply to help prevent damaging operating system and software corruption problems that can occur with repeated crashes.

7. File Management

The analyzer generates ASCII-format text output files. The data files are created every 60 minutes by default.

Data File Names

The file name is generated from the analyzer serial number, the date, and the time when the analyzer was started. For example:

Figure 58: Example Data File Name

SBDS2076-20190206-233509-DataLog_User.dat

SBDS2076 is the analyzer serial number

20190206 is the date, 2/6/2019, in format *yyyymmdd* (to allow chronological sorting of data files).

233509 is the time the file was started in Local Time, 23:35:09, formatted as *hhmmss* using a 24-hour clock.

Data File Location

The user data is contained in folders in the directory:

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

Data File Generation and Storage

Data files are created every 60 minutes and stored for 365 days by default before they are automatically deleted.

During data acquisition, the analyzer creates directories to store the data, filed by the date the data were acquired.

	DATE	TIME	FRAC_DAYS_SINCE_JAN1	FRAC_HRS_SINCE_JAN1	JULIAN_DAYS	EPOCH_TIME	ALARM_STATUS
2	2016-10-15	00:24:44.483	287.68384819	6904.412357	288.68384819	1476491084.484	0
3	2016-10-15	00:24:46.444	287.68387089	6904.412901	288.68387089	1476491086.445	0
4	2016-10-15	00:24:48.415	287.68389370	6904.413449	288.68389370	1476491088.416	0
5	2016-10-15	00:24:50.385	287.68391650	6904.413996	288.68391650	1476491090.386	0
6	2016-10-15	00:24:52.355	287.68393931	6904.414543	288.68393931	1476491092.356	0
7	2016-10-15	00:24:54.335	287.68396222	6904.415093	288.68396222	1476491094.336	0
8	2016-10-15	00:24:56.309	287.68398506	6904.415641	288.68398506	1476491096.309	0
9	2016-10-15	00:24:58.246	287.68400748	6904.416179	288.68400748	1476491098.246	0

Figure 59: Excerpt of Example Data File

Data files are closed every 60 minutes and moved to an archive directory and a new datafile is started.

The archive directory is /home/picarro/I2000/Log/Archive/YYYY-MM-DD and has the following subdirectories: DataLog_Private, DataLog_User, EventLogs, and WBCAL.

The directory /home/picarro/I2000/Log/Archive/YYYY-MM-DD-RDF contains the RDF files used for diagnostics by Picarro.

Private data contains more detailed data outside of just concentration data including parameters such as analyzer temperatures and pressure, setpoints and spectroscopic information. This information is generally not useful to the user but can be useful for diagnostic purposes.

For more information about how to include various columns of data from the DataLog private files, contact Picarro.

The currently active data file can be found in */home/picarro/I2000/Log/DataLogger/*.

To keep the data files easy to manage and to limit the size of individual files and directories, new files are automatically generated whenever the analyzer is operating. A new file will be created once the current file reaches 1 hour of data. A new folder will be created at 00:00 GMT.

8. Surrogate Gas Validation

Validation Overview

The Picarro Surrogate Gas Validation Tool guides users through one of three Validation Procedures that use zero air and/or the appropriate surrogate gas as a stable proxy for the target species.

Instrument Validation requires the following supplies:

- Up to four cylinders of input gases:
  - **1 Gas Validation:** 1 proxy standard cylinder
  - **2 Gas Span Validation:** One cylinder of zero air and one or two proxy standard cylinders
  - **3 or 4 Gas Linear Regression Validation:** One cylinder of zero air and two or three proxy standard cylinders
- **Up to four regulators** (one for each cylinder being used). Each regulator should be capable of accurately delivering 2–3 psig (0.1–0.2 bar) of line pressure.
- **Sufficient tubing to connect the regulator(s) to the instrument.** We recommend using ¼" OD PTFE or PFA tubing.
- Suitable adjustable or fixed wrenches for making gas-line connections.

Cylinder Editor

To create input options, select **Show Editors** and enter the requested information for each cylinder used.

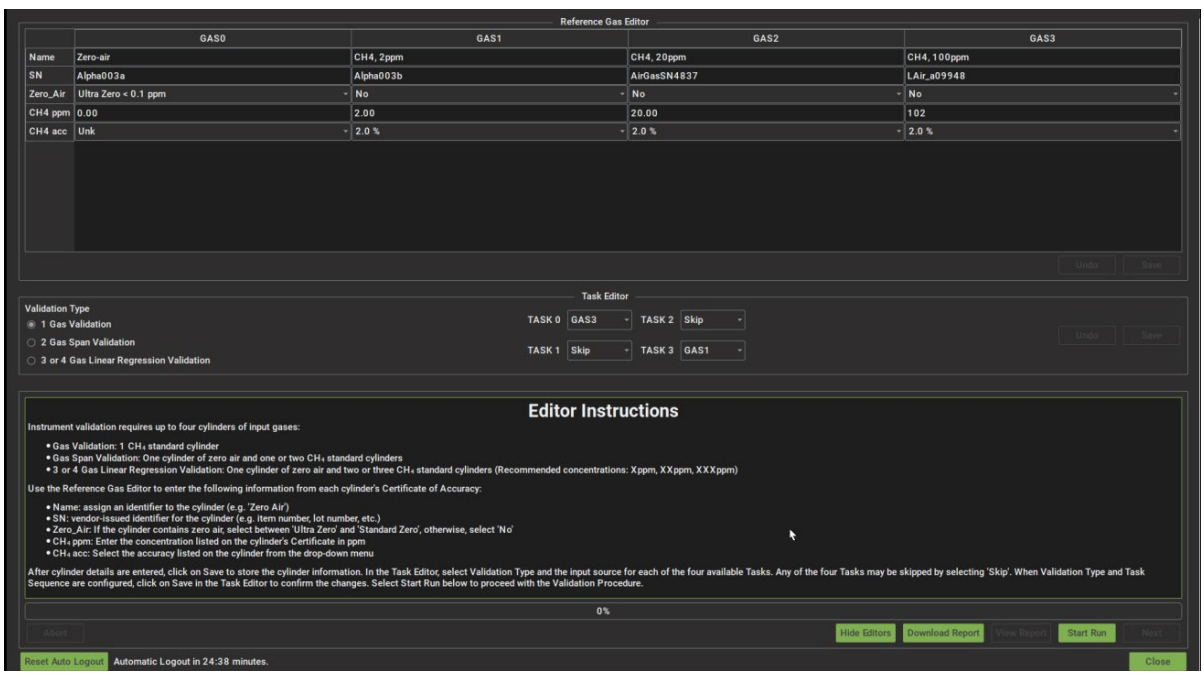


Figure 60: Editor dialog

After cylinder details are entered, select **Validation Type** and the input source for each of the four available **Tasks**. Any of the four Tasks may be skipped by selecting “Skip”.

When Validation Type and Task Sequence is confirmed, select **Start Run** below to proceed with the Validation Procedure.

Reference Gas Editor Fields and Explanations:

Use the Reference Gas Editor to enter the following information from each cylinder’s Certificate of Accuracy:

- Name (text entry): Assign an identifier to the cylinder (e.g. ‘Zero Air’ or ‘CH4, 20ppm’)
- SN (text entry): Vendor-issued identifier for the cylinder (e.g. ‘AirGasSN4837’)
- Zero Air (drop-down menu): If the cylinder contains Zero Air, select ‘Ultra Zero < 0.1 ppm’ or ‘Standard Zero < 1 ppm’, otherwise, select ‘No’
- CH4 ppm (text entry): Enter the concentration listed on the cylinder’s Certificate in ppm, e.g. ’1.854’
- CH4 acc (drop-down menu): Select the accuracy listed on the cylinder from the drop-down menu or select ‘Unk’ if unknown.

After cylinder details are entered, click on Save to store the cylinder information. If user clicks Start Run while changes in either editor have not been saved, a pop-up message will appear, and the user will be prompted to either Save or Undo the changes before clicking Start Run.

Task Editor Fields and Explanations:

Use the Task Editor to specify which validation method and gases to use:

- **1 Gas Validation** will compare the measured CH4 concentration directly to the value entered in the Reference Gas Editor.
- **2 Gas Span Validation** will compare across one cylinder of Zero Air and 1 or 2 CH4 cylinders.
- **3 or 4 Gas Linear Regression Validation** will compare measurements of 2 or 3 different concentrations of CH4 and a Zero Air. The report will also output a plot of the expected versus actual CH4 measurements.

Validation Procedure

1. Allow the system to reach operating temperature and pressure settings.
2. Log in as Admin or Tech user.
3. Select ‘Tools’, then ‘System Validation with CH4’.
4. Log in as Admin or Tech user again.
5. Click ‘Show Editors’ to view Reference Gas Editor and Task Editor.
6. Edit values as necessary to specify validation parameters. Attach regulators to the gas sources and adjust their output line pressure so they are within the range of 2–3 psi (0.1–0.2 bar). If values were changed, click ‘Save in each Editor to save them.
7. Select **Start Run.**
8. Follow instructions, only clicking ‘Next’ after completing the current step. Steps may include connecting or disconnecting bottles or waiting for the analyzer to measure.
9. Follow the prompts to finish measuring subsequent cylinders as applicable.

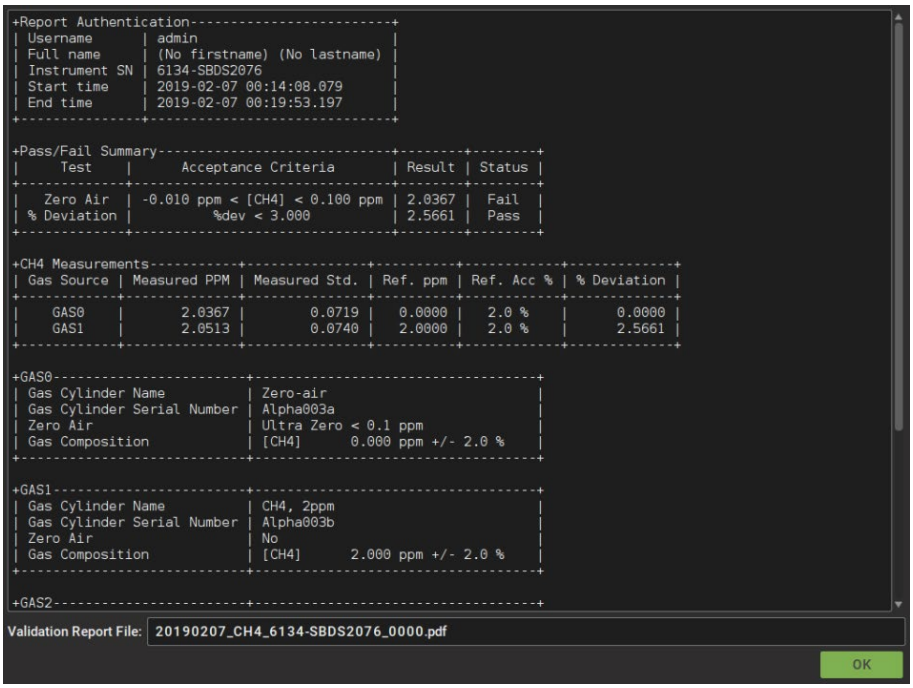
At any time in the process, click ‘Abort’ to end the run. No report will be created if Abort is selected.

CAUTION

When switching cylinders, follow these steps to avoid damaging the instrument:

- Do not turn off the gas valve before disconnecting the cylinder from the analyzer.
- Before connecting the next cylinder, make sure its regulator is set to 2–3 psi (0.1–0.2 bar) and open the regulator valve before connecting it to the analyzer INLET.

10. After the last task has completed, you will have the option to view or download the **Validation Report.** These reports can be accessed at any time from the File Manager.



```
+Report Authentication-------------------------+
| Username       | admin                        |
| Full name      | (No firstname) (No lastname) |
| Instrument SN  | 6134-SBDS2076                |
| Start time     | 2019-02-07 00:14:08.079      |
| End time       | 2019-02-07 00:19:53.197      |
+----------------+------------------------------+

+Pass/Fail Summary----------------------------+--------+--------+
|     Test     |      Acceptance Criteria       | Result | Status |
+--------------+--------------------------------+--------+--------+
|   Zero Air   | -0.010 ppm < [CH4] < 0.100 ppm | 2.0367 |  Fail  |
| % Deviation  |          %dev < 3.000          | 2.5661 |  Pass  |
+--------------+--------------------------------+--------+--------+

+CH4 Measurements-----------+---------------+----------+------------+-------------+
| Gas Source | Measured PPM | Measured Std. | Ref. ppm | Ref. Acc % | % Deviation |
+------------+--------------+---------------+----------+------------+-------------+
|    GAS0    |       2.0367 |        0.0719 |   0.0000 |   2.0 %    |      0.0000 |
|    GAS1    |       2.0513 |        0.0740 |   2.0000 |   2.0 %    |      2.5661 |
+------------+--------------+---------------+----------+------------+-------------+

+GAS0------------------------+---------------------------------+
| Gas Cylinder Name          | Zero-air                        |
| Gas Cylinder Serial Number | Alpha003a                       |
| Zero Air                   | Ultra Zero < 0.1 ppm            |
| Gas Composition            | [CH4]      0.000 ppm +/- 2.0 %  |
+----------------------------+---------------------------------+

+GAS1------------------------+---------------------------------+
| Gas Cylinder Name          | CH4, 2ppm                       |
| Gas Cylinder Serial Number | Alpha003b                       |
| Zero Air                   | No                              |
| Gas Composition            | [CH4]      2.000 ppm +/- 2.0 %  |
+----------------------------+---------------------------------+

+GAS2------------------------+---------------------------------+
```

Validation Report File: 20190207_CH4_6134-SBDS2076_0000.pdf

OK

Figure 61: System Validation Report

11. To copy the Validation Report to a USB flash-memory drive, click **Download Report**.

12. Downloading the report will prompt you to sign in to the File Manager, which you can use to copy the report to a USB drive.

13. After Validation is completed, disconnect the last cylinder, making sure to disconnect it before closing the cylinder’s valve.

If the Analyzer Does Not Pass

If the analyzer fails the validation test, check the nominal proxy gas concentration on page one of the report against the actual proxy gas concentration and uncertainty for your reference cylinders.

If there is a discrepancy, run the test again, correcting the discrepancies on the Cylinder Editor step.

If the analyzer did not pass and there is no discrepancy between the nominal values of the calibrants in the report and the values of the cylinders used during validation, contact Picarro.

9. Troubleshooting

This section lists problems that may occur during installation and operation of the analyzer, and step-by-step procedures that will provide resolution in most cases. If these instructions do not solve the problem, contact Picarro Technical Support.

Status State Indicator on the Analyzer Front Panel is Not On

Pressing the main power switch does not start the analyzer and the status indicator on the front panel is not on when the analyzer is on.

The indicator on the front panel shows the current operating state of the analyzer.

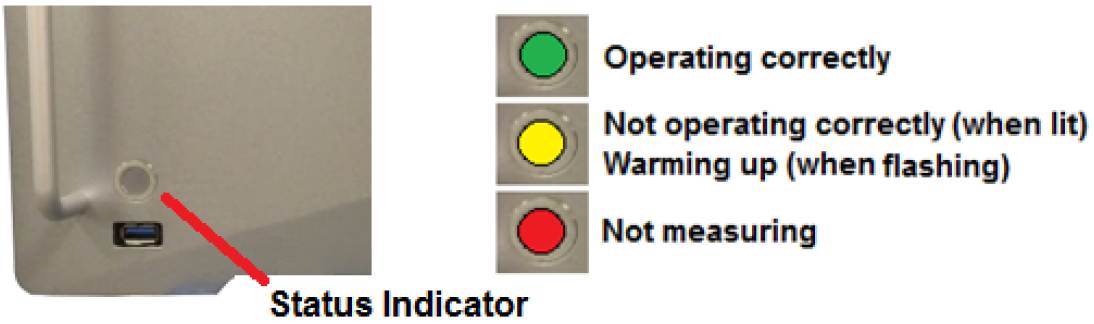


Figure 62: Status Indicator States

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.
3. Press and hold the rear panel power switch for at least 5 seconds as the analyzer may take several seconds to respond.

Cavity Pressure Cannot be Adjusted for Concentration Measurements

The cavity pressure is automatically locked to the correct value during normal operation.

The *Pressure Locked* message on the lower left corner of the GUI indicates that the cavity pressure is within operating parameters.

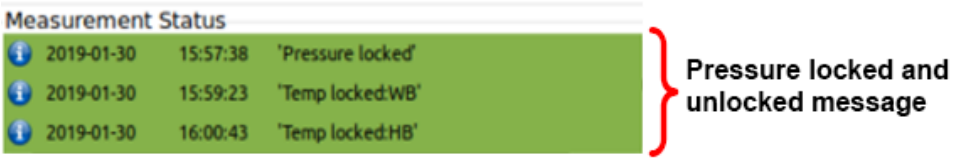


Figure 63: Status Log

If the cavity pressure is out of operating specification the GUI displays a *Pressure Unlocked* message.

The *Pressure Unlocked* message on the GUI could indicate that there is insufficient gas available at the analyzer gas inlet.

- Check the inlet plumbing to the analyzer.
- Ensure that the pressure/flow at the inlet is within specifications.

The *Pressure Unlocked* message could also indicate that gas cannot exhaust from the analyzer at a sufficient rate.

- Check the vacuum line between the analyzer and the power vacuum unit for leaks.
- Check the vacuum pump. Make sure it is functioning correctly.
- Check the gas pressure inlet for excessive pressure.

User Interface Program Does Not Update Graphs as Data is Collected

The computer may become unresponsive causing the programs that control the analyzer to stop functioning. If this happens and the computer responds to the mouse:

1. Wait until the computer is completely shut down.
2. After a few seconds, start the computer using the power button.

If the computer does not respond to the mouse:

1. Hold down the power switch on the rear panel for a few seconds until the computer and the analyzer turn off.
2. After another few seconds, restart the analyzer using the power button.

10. Appendix A: Status Log Messages

Normal Start Up Messages

Temperature Locked: WB

The system waits for the warm box (WB – the temperature-controlled electronics and wavelength monitor chamber) to reach operating temperature.

Temperature Locked: HB

The system waits for the hot box (HB – the temperature-controlled chamber containing the analyzer's optical cavity and gas handling system) is stabilized.

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

Preparing to Measure

Spectral scanning has started. Concentration measurements will be available in approximately 30 seconds. The analyzer continues to scan and report concentration measurements until the analyzer is shutdown using the procedure below.

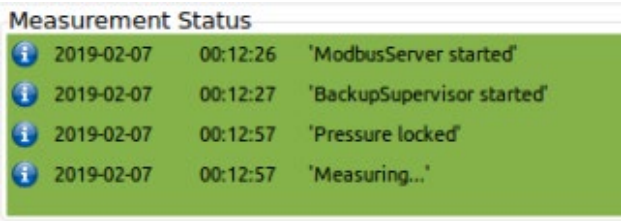


Figure 64: Sample Status Log Messages for Startup

Pressure Stabilizing/Locked

The valve control system begins to allow flow through the analyzer and stabilizes the pressure inside the cavity.

Measuring

This is the normal mode of operation after startup has completed.

11. Appendix B: Controlling External Valves

This section explains how to control external valves using the built-in External Valve Sequencer GUI.

If you are using the optional Picarro 16 Port Distribution Manifold (part number A0311) with the analyzer, see the corresponding user manual for instructions on using the External Valve Sequencer GUI.

Display the Show/Hide Valve Sequencer GUI

1. Start the analyzer by double-clicking the **Start** Analyzer shortcut on the desktop.
2. Wait for the analyzer to begin measuring.
3. On the status bar menu of the analyzer *Data Viewer* screen, select **Show/Hide Valve Sequencer GUI** drop-down
4. The External Valve Sequencer GUI displays.

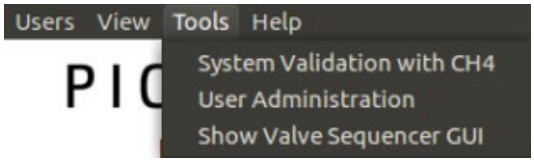


Figure 65: Show/Hide Sequencer Drop-Down

The External Valve Sequencer Window

This section describes the *External Valve Sequencer* window.

Figure 66: External Valve Sequencer Action Drop-Down Menu shows the *External Valve Sequencer* window status bar menu items and actions.

Figure 67: External Valve Sequencer Field Descriptions shows the *External Valve Sequencer load* and *save* files menu.

File Menu

- **Load a Valve Sequence File:** Click here to load saved files. File location will be*:/home/picarro/I2000/InstrConfig/ValveSequencer/Name of the Sequence File*
- **Action/Save Valve Sequence File:** Click here to save a valve sequence file.

Action Menu

- **Start Sequencer:** Click here to start a sequence.
- **Go to First Step:** Click here to run step one (automatically resets to 1 from whatever step is currently being sampled).
- **Reset All Valves:** Click here to change the current valve state to *All Off*.
- **Show/Hide Sequencer Interface:** This toggle shows or hides the *Sequencer Interface* window.

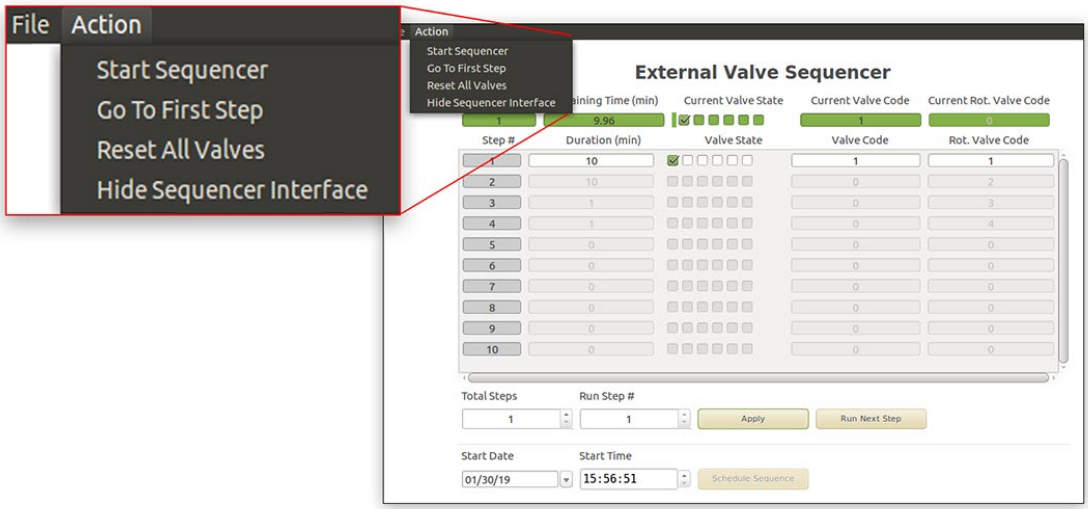


Figure 66: External Valve Sequencer Action Drop-Down Menu

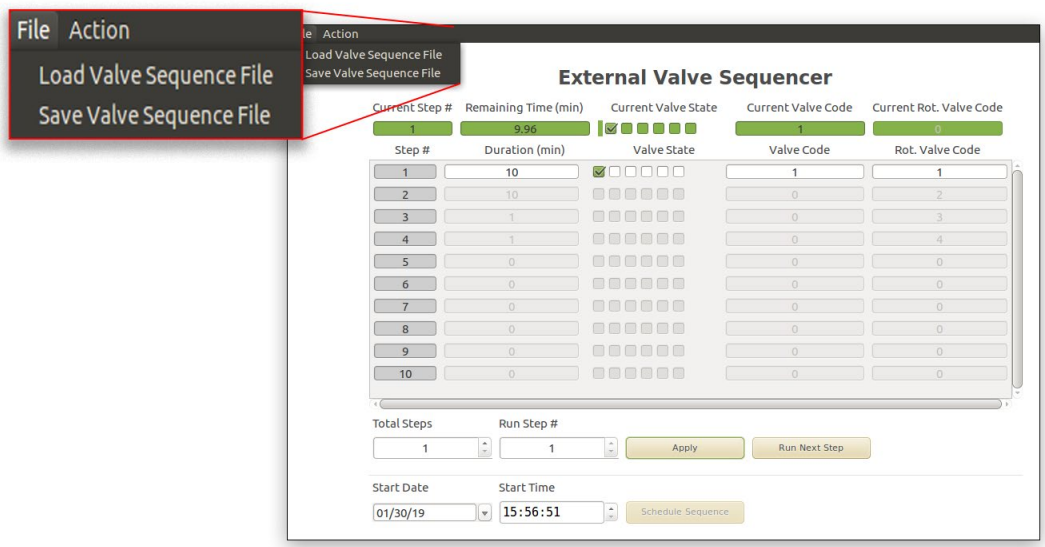


Figure 67: External Valve Sequencer File Drop-Down Menu

Current Status Fields

The top row on the menu (*see Figure 68*) gives the current status of the current step.

- **Current Step #:** Gives the number of the current step as defined by the setup
- **Remaining Time (min):** Time remaining on the current step
- **Current Valve State:** Check boxes indicate which valves are energized
- **Current Valve Code**: Binary code representing which valves are energized
- **Current Rot. Valve Code:** Used only with gas distribution manifold

Step Definition Fields

Use the step definition fields to define the test sequence.

- **Step #:** Enter the step number.
- **Duration (min):** Enter how long you want the step to last.
- **Rot. Valve Code:** Used only with the gas distribution manifold

Bottom Panel

Use the bottom section of the window to configure the sample.

- **Total Steps:** Use this field to enter the total number of steps in the test. When the last step is finished, the sequencer loops back to the first step.
- **Run Step #:** Shows the number of the step currently running. If a different step is desired, enter that step number and click on *Apply*.
- **Apply:** Click here to apply changes made using the *External Valve Sequencer* window.
- **Run Next Step:** Forces the next step in the sequence.
- **Start Date:** Use this field to enter the date to start the sequence.
- **Start Time:** Use this field to enter the time to start the sequence.
- **Schedule Sequence:** Click this button to have the sequence start automatically at the date and time specified in the *Start Date* and *Start Time* fields.

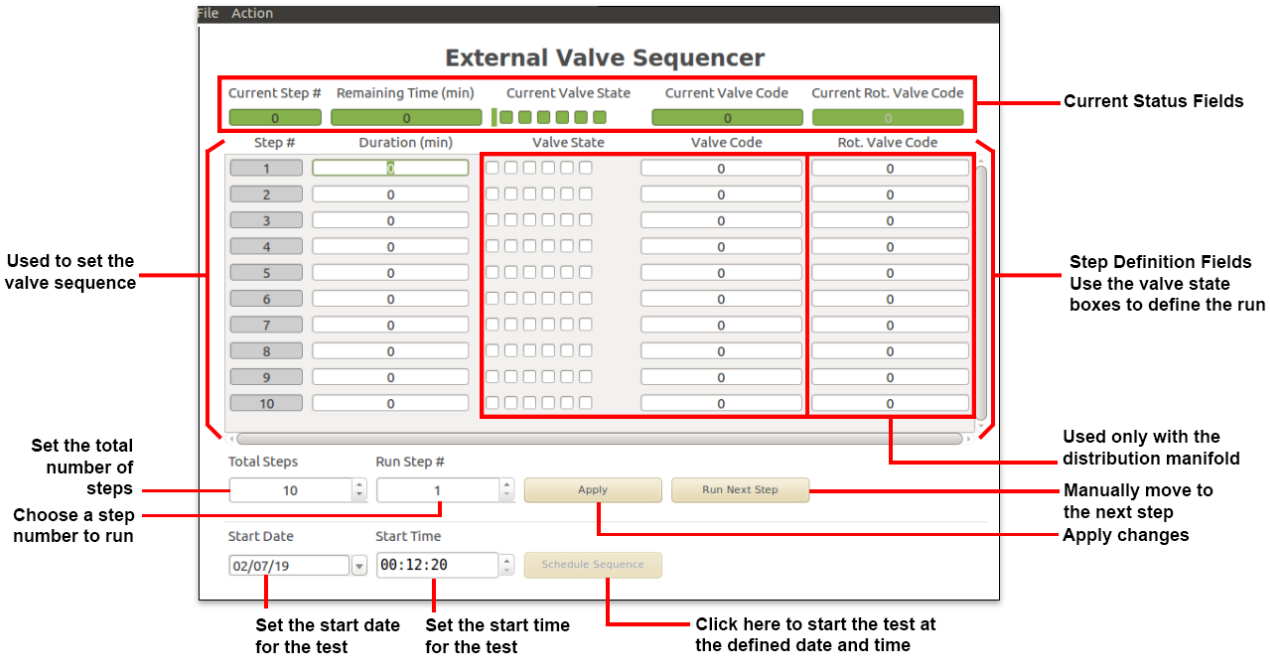


Figure 68: External Valve Sequencer Field Descriptions

Set Up a Test Sequence Using the Valve Sequencer Window

A variety of sequences can be created and saved *External Valve Sequencer* window. This section explains how to set up a test sequence using the *External Valve Sequencer* window.

To set up a sampling sequence:

1. On the Picarro analyzer GUI, go to **Tools**, then select *Show/hide valve sequencer.*
2. Use the *Rot. Valve Code* column to set the rotary selector valve position.
3. Enter the number (1-16) that corresponds to the desired valve position.
4. A value of 1 in the *Rot Valve* Code field corresponds to position 2 on the valve. Only one rotary position can be selected per step.
5. Enter the Step duration in the *Duration (min)* field, where the duration of the step is in minutes. If duration values are set to less than 0.1 minutes, they may not be carried out correctly.
6. Save the valve sequence as:
   /home/picarro/I2000/InstrConfig/ValveSequencer/Name of the Sequence File

Load and Run a Saved Sequence

Load saved sequence files by clicking File/Load Valve Sequence. All the Sequence Files are in

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

1. Click **Apply** to run the sequence.
2. To skip the next step click **Run Next Step** (even while in middle of running a step):
3. Click on the *Action* drop-down menu.
4. Reset all Valves by changing all the *Rot. Valve Code* fields to Zero.
5. Click on **Go to the First Step** (Whatever the step the user is at, step 1 will be played).
6. Click on **Start/Stop Sequencer** (While the sequence is running, it will read *Stop Sequencer*).
7. Click on **Hide Sequencer Interface** (this hides the *External Valve Sequencer* window).

12. Appendix C: Analog Signal Output

Overview

This analyzer is configured with an optional Electrical Interface Card (EIC) that provides 4 analog signals for monitoring various measurement results and analyzer parameters.

Two circular connectors, on the back panel of the analyzer (are available for analog output. The pinout for each connector is listed in the table below.

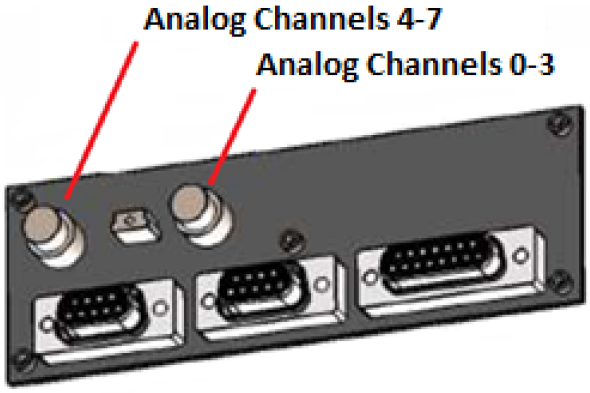


Figure 69: Analog Channel Connectors

Two external cables (for the analog channel connectors) are provided with the analyzer. The mating connector is part number HR25-7TP-8P(72)

Analog Signal Pin Mapping

Table 4 lists the analog pinouts and Figure 70 shows the analog pinout map.

Table 4: Analog Pinout Table

Pin	Function
1	GND 0
2	Channel 0
3	GND 1
4	Channel 1
5	GND 2
6	Channel 2
7	GND 3
8	Channel 3

Pin	Function
1	GND 4
2	Channel 4
3	GND 5
4	Channel 5
5	GND 6
6	Channel 6
7	GND 7
8	Channel 7

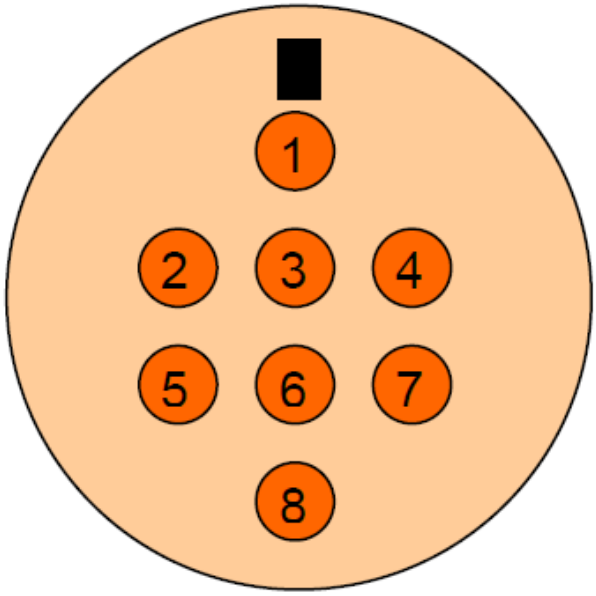


Figure 70: Analog Pin Map

Analog Output Configuration

+1 volt indicates 0 in all cases: Each channel has a +1 volt offset. Treat <=0 volts as an error. This helps prevent reading the wrong values because of improper wiring (ground loops).

Example for Channel 0: 1V = 20ppb with a 1V offset. 9v x 200 ppb/V = 180 ppb = 1.8 ppm.

Table 5 is the analog configuration master table.

Table 5 Analog Configuration Master Table

Channel	Parameter	Output Scale (<1V indicates error)	Conversion All channels have a +1V offset (+1V=0)	Indicating Range 1V to 10V or 0 to 90 ppb
0	HCl Concentration	0-10V	10 ppb/V	0 to 90 ppb
1	HCl Concentration	0-10V	200 ppb/V	0 to 1.8 ppm
2	H_2O Concentration	0-10V	2%/V	0 to 18%
3	DAS Temp	0-10V	10° C/V	0 to 90°C
4	None	NA	NA	NA
5	None	NA	NA	NA
6	None	NA	NA	NA
7	None	NA	NA	NA

13. Appendix D: Analog Current Signal Output

Overview

Four channels of output are available on the back of the analyzer by default, the settings for the four channels are as follows:

	Iout0	**Iout1**	**Iout2**	**Iout3**
Monitoring	HCl	H_2O	DAS Temperature	Cavity Pressure
Units	ppb	%	Degrees C	Torr
Min	0.0	0.0	0.0	0.0
Max	1000.0	20.0	100.0	1000.0

- HCl: displays the HCl concentration reading in parts per billion (ppb)
- H_2O: displays H_2O in percent (%)
- DasTemp: displays the internal logic board temperature in degrees Celsius
- CavityPressure: displays the cavity pressure in Torr

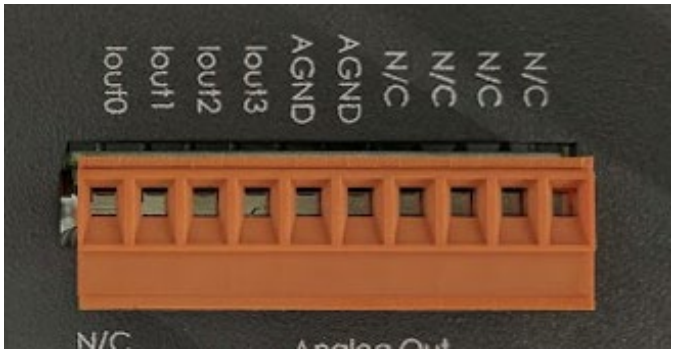


Figure 71: 4–20mA output with terminal connector in place

Connecting the 4–20mA Signal Output

1. Using your fingers, pull the 4–20 mA terminal connector straight back away from the analyzer.
2. Use a small slotted screwdriver to loosen the retaining screw for the desired terminal.
3. Insert the stripped end of the wire into the terminal.

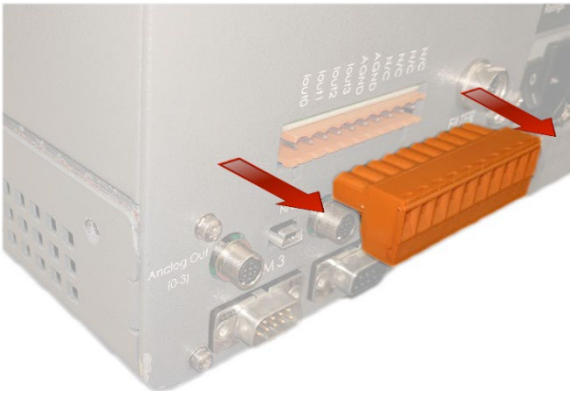


Figure 72: Removing the terminal connector

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.

Figure 73: Retaining screws at the bottom of the terminal connector

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 your shielded cable to the ground lug to avoid ground loops

14. Appendix E: Serial Communication Protocols

Overview

The Serial Port Menu is accessible from the Config Menu and displays the configurations of COM1 (used for Command Interface) and COM3 (used for Data Out). The COM1 port is preconfigured and its settings cannot be changed. The COM3 port can be enabled or disabled and the following settings can be configured:

- **Baud rate**: number of bit transfers per second
- **Data Bits**: number of data bits in a communication packet, or a single byte transfer
- **Stop Bits**: number of bits used to signal the end of a communication packet
- **Parity**: sets the parity bit to Even, Odd, Mark, Space, or None

After making any changes, select **Save** to apply the changes or **Undo** to revert to the previous configuration.

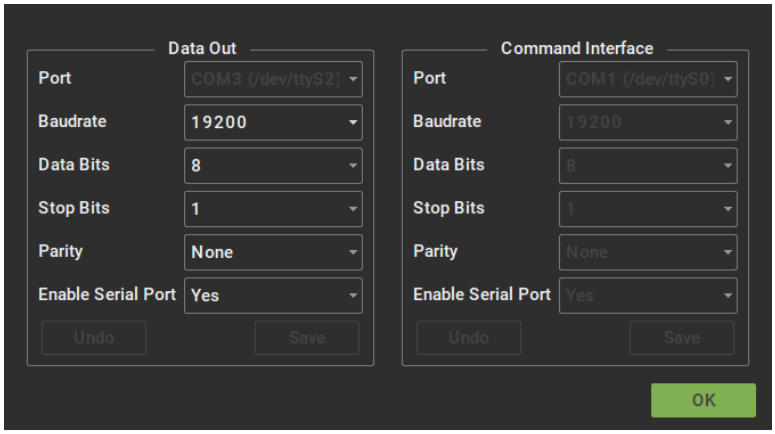


Figure 74: Default Serial Port Configuration

COM1 (Command Interface) Protocol

The headers below correspond to each column of data and are not included in the output:

Normal:

CavityPressure, CavityTemp, DasTemp, WarmBoxTemp, species, MPVPosition, OutletValve, solenoid_valves, HCl, H2O, CH4, HCl_raw, HCl_sigma, HCl_tau, bad_baseline, delta_loss_hcl, delta_loss_h2o, baseline_level, incomplete_spectrum

DCRDS:

CavityPressure, CavityTemp, DasTemp, WarmBoxTemp, species,MPVPosition, OutletValve, solenoid_valves, HCl, H2O, CH4, HCl_raw, HCl_sigma, HCl_tau, degraded_performance, delta_loss_hcl, delta_loss_h2o, baseline_level, incomplete_spectrum

Example Data output from using input: _meas_GetConc

139.9947;79.9997;36.9555;45.0036;63.0000;0.0000;50267.4692;2.0000;0.0342;0.6991;2.1150;-0.0196;0.0405;60.3577;0.0000;-0.0421;-0.0560;660.3983;0.0000

Output Frequency:

Data will be output when command is sent to COM1 via RS232

COM3 (Streaming) Protocol

The column headings for the streaming interface are as follows:

Normal:

Column0 = Time

Column1 = CavityPressure

Column2 = CavityTemp

Column3 = DasTemp

Column4 = WarmBoxTemp

Column5 = species

Column6 = MPVPosition

Column7 = OutletValve

Column8 = solenoid_valves

Column9 = HCl

Column10 = H2O

Column11 = CH4

Column12 = HCl_raw

Column13 = HCl_sigma

Column14 = HCl_tau

Column15 = bad_baseline

Column16 = delta_loss_hcl

Column17 = delta_loss_h2o

Column18 = baseline_level

Column19 = ymd

Column20 = hms

Column21 = incomplete_spectrum

DCRDS:

Column0 = Time

Column1 = CavityPressure

Column2 = CavityTemp

Column3 = DasTemp

Column4 = WarmBoxTemp

Column5 = species

Column6 = MPVPosition

Column7 = OutletValve

Column8 = solenoid_valves

Column9 = HCl

Column10 = H2O

Column11 = CH4

Column12 = HCl_raw

Column13 = HCl_sigma

Column14 = HCl_tau

Column15 = degraded_performance

Column16 = delta_loss_hcl

Column17 = delta_loss_h2o

Column18 = baseline_level

Column19 = ymd

Column20 = hms

Column21 = incomplete_spectrum

The data in columns 12-19 are reserved for diagnostic use by Picarro-authorized technicians.

Data Example

1480804195.51 139.9947 79.9997 36.9555 45.0036 63.0000 0.0000 50267.4692 2.0000 0.0342 0.6991 2.1150 -0.0196 0.0405 60.3577 0.0000 -0.0421 -0.0560 660.3983 0.0000 0.0000 0.0000

Output Frequency

Data will be output automatically in real time similar to the GUI display.

15. Appendix F: MODBUS Communication

Overview

Modbus Data Registers

This section describes the basic types of MODBUS registers.

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

Setup Notes for Modbus TCP

- 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 will not support privileged ports (0 to 1023), except for port 502.

Setup Notes for Modbus RTU

- 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 will be disabled.

MODBUS Register Maps

Overview

- 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 will return “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"

Input Registers

Most of the readings in Picarro analyzer are the float type and need 32-bit data. Each parameter utilizes 2 registers, out of which the first one will be storing MSB and the second one will be storing the LSB of the float number.

Address	Description	Units	Type	Comments
0-5	Time stamp		String	Long value return as 12byte string. Date will be in format YYMMDDHHMMSS
6-7	Concentration of measured gas # 1	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 6 is always Gas # 1
8-9	Gas # 1 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc
10-11	Gas #1, 30sec trailing average	ppb	float	
12-13	Gas #1, 2min trailing average	ppb	float	
14-15	Gas #1, 5min trailing average	ppb	float	
16-17	Gas #1, max (full scale range)	ppm	float	
18-19	Gas #1, min (MDL)	ppm	float	
20-21	Concentration of measured gas #2	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 20 is always Gas # 2
22-23	Gas #2 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc
24-25	Gas #2, 30sec trailing average	ppb	float	

26-27	Gas #2, 2min trailing average	ppb	float	
28-29	Gas #2, 5min trailing average	ppb	float	
30-31	Gas #2, max (full scale range)	ppm	float	
32-33	Gas #2, min (MDL)	ppm	float	
34-35	Concentration of measured gas #3	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 34 is always Gas # 3
36-37	Gas #3 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc
38-39	Gas #3, 30sec trailing average	ppb	float	
40-41	Gas #3, 2min trailing average	ppb	float	
42-43	Gas #3, 5min trailing average	ppb	float	
44-45	Gas #3, max (full scale range)	ppm	float	
46-47	Gas #3, min (MDL)	ppm	float	
48-49	Concentration of measured gas #4	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 48 is always Gas # 4
50-51	Gas #4 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc
52-53	Gas #4, 30sec trailing average	ppb	float	
54-55	Gas #4, 2min trailing average	ppb	float	
56-57	Gas #4, 5min trailing average	ppb	float	
58-59	Gas #4, max (full scale range)	ppm	float	
60-61	Gas #4, min (MDL)	ppm	float	
62-63	Concentration of measured gas #5	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 62 is always Gas # 5
64-65	Gas #5 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc

66-67	Gas #5, 30sec trailing average	ppb	float	
68-69	Gas #5, 2min trailing average	ppb	float	
70-71	Gas #5, 5min trailing average	ppb	float	
72-73	Gas #5, max (full scale range)	ppm	float	
74-75	Gas #5, min (MDL)	ppm	float	
76-77	Concentration of measured gas #6	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 76 is always Gas # 6
78-79	Gas #6 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc
80-81	Gas #6, 30sec trailing average	ppb	float	
82-83	Gas #6, 2min trailing average	ppb	float	
84-85	Gas #6, 5min trailing average	ppb	float	
86-87	Gas #6, max (full scale range)	ppm	float	
88-89	Gas #6, min (MDL)	ppm	float	
90-91	Concentration of measured gas #7	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 90 is always Gas # 7
92-93	Gas #7 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc
94-95	Gas #7, 30sec trailing average	ppb	float	
96-97	Gas #7, 2min trailing average	ppb	float	
98-99	Gas #7, 5min trailing average	ppb	float	
100-101	Gas #7, max (full scale range)	ppm	float	
102-103	Gas #7, min (MDL)	ppm	float	
104-105	Concentration of measured gas #8	ppb	float	The identity of this gas will vary analyzer to analyzer, but Reg 104 is always Gas # 8

106-107	Gas #8 ID	unitless	float	Code maps something like this: 0 = ammonia, 1 = H2S, 2 = HCl etc
108-109	Gas #8, 30sec trailing average	ppb	float	
110-111	Gas #8, 2min trailing average	ppb	float	
112-113	Gas #8, 5min trailing average	ppb	float	
114-115	Gas #8, max (full scale range)	ppm	float	
	Gas #8, min (MDL)	ppm	float	
200-201	Cavity Pressure	Torr	float	This section 200-298 is for public sensor data
202-203	Cavity Temperature	deg C	float	
204-205	DAS Temperature	deg C	float	
206-207	Etalon Temperature	deg C	float	
208-209	Warm Box Temperature	deg C	float	
210-211	Outlet Valve	dig counts	float	
212-213	Instrument cal slope, gas #1		float	
214-215	Instrument cal offset, gas #1		float	
216-217	User cal slope, gas #1		float	
218-219	User cal offset, gas #1		float	
220-221	Instrument cal slope, gas #2		float	
222-223	Instrument cal offset, gas #2		float	
224-225	User cal slope, gas #2		float	
226-227	User cal offset, gas #2		float	
228-229	Instrument cal slope, gas #3		float	
230-231	Instrument cal offset, gas #3		float	

232-233	User cal slope, gas #3		float	
234-235	User cal offset, gas #3		float	
236-237	Instrument cal slope, gas #4		float	
238-239	Instrument cal offset, gas #4		float	
240-241	User cal slope, gas #4		float	
242-243	User cal offset, gas #4		float	
244-245	Instrument cal slope, gas #5		float	
246-247	Instrument cal offset, gas #5		float	
248-249	User cal slope, gas #5		float	
250-251	User cal offset, gas #5		float	
252-253	Instrument cal slope, gas #6		float	
254-255	Instrument cal offset, gas #6		float	
256-257	User cal slope, gas #6		float	
258-259	User cal offset, gas #6		float	
260-261	Instrument cal slope, gas #7		float	
262-263	Instrument cal offset, gas #7		float	
264-265	User cal slope, gas #7		float	
266-267	User cal offset, gas #7		float	
268-269	Instrument cal slope, gas #8		float	
270-271	Instrument cal offset, gas #8		float	
272-273	User cal slope, gas #8		float	
274-275	User cal offset, gas #8		float	

386	Error code		int	Error for each control command of COIL. NO_ERROR = 0 ERROR_HANDLER_ERROR = 1 ERROR = 2 NO_SUDO_USER_PRIVILEGE = 3 NO_USER_EXIST = 7 USERNAME_PASSWORD_INCORRECT = 9 USER_DISABLED = 10 ADMIN_RIGHT_REQUIRES = 11 PASSWORD_LENGTH_ERROR = 12 PASSWORD_FORMATE_ERROR = 13 PASSWORD_REUSE_ERROR = 14
387	Measurement status		int	ledState = 0 red, system error, gas conc. measurements invalid ledState = 1 solid yellow, need service, gas conc. measurements might be ok ledState = 2 blinking yellow, not in reporting mode by system ok, like during warmup ledState = 3 green, system ok, gas conc. measurements accurate

Holding Registers

Address	Description	Units	Type	Comments
0-3	System time		int	Integer representing milliseconds from 1AD January 1st to now
4-7	User Name		String	
8-11	Password		String	
200-201	User data 1		Float	
202-203	User data 2		Float	
204-205	User data 3		Float	
206-207	User data 4		Float	
208-209	User data 5		Float	
210-211	User data 6		Float	
212-213	User data 7		Float	
214-215	User data 8		Float	
216-217	User data 9		Float	
218-219	User data 10		Float	
220-221	User data 11		Float	

222-223	User data 12		Float	
224-225	User data 13		Float	
226-227	User data 14		Float	
228-229	User data 15		Float	
230-231	User data 16		Float	
232-233	User data 17		Float	
234-235	User data 18		Float	
236-237	User data 19		Float	
238-239	User data 20		Float	

Discrete Input Registers

Address	Description	Units	Comments
5	Pressure locked		
6	Cavity temperature locked		
7	Warm box temperature locked		
72	Incomplete spectrum for Gas#1		
73	Incomplete spectrum for Gas#2		
74	Incomplete spectrum for Gas#3		
75	Incomplete spectrum for Gas#4		
76	Incomplete spectrum for Gas#5		
77	Incomplete spectrum for Gas#6		
78	Incomplete spectrum for Gas#7		
79	Incomplete spectrum for Gas#8		
80	Bad baseline for Gas#1		
81	Bad baseline for Gas#2		
82	Bad baseline for Gas#3		
83	Bad baseline for Gas#4		
84	Bad baseline for Gas#5		
85	Bad baseline for Gas#6		
86	Bad baseline for Gas#7		
87	Bad baseline for Gas#8		
88	Degraded Performance for Gas#1		
89	Degraded Performance for Gas#2		
90	Degraded Performance for Gas#3		
91	Degraded Performance for Gas#4		
92	Degraded Performance for Gas#5		
93	Degraded Performance for Gas#6		

94	Degraded Performance for Gas#7		
95	Degraded Performance for Gas#8		

Coil Registers

Address	Description	Units	Comments
115	Quit host application		
116	Shutdown Instrument		It will take approximately 2 min to shutdown
150	Get system time		After this please read Sync Time holding register
153	User login (Coming in near future)		Before executing this command, user need to set user name and user password holding register
154	Update user password (Coming in near future)		Before executing this command follow below steps 1) Login as admin using User Login functionality if not login already Set user name and password holding register
155	User logout (Coming in near future)		
200	Get User data 1		
201	Set User data 1		
202	Get User data 2		
203	Set User data 2		
204	Get User data 3		
205	Set User data 3		
206	Get User data 4		
207	Set User data 4		
208	Get User data 5		
209	Set User data 5		
210	Get User data 6		
211	Set User data 6		
212	Get User data 7		
213	Set User data 7		
214	Get User data 8		
215	Set User data 8		
216	Get User data 9		
217	Set User data 9		
218	Get User data 10		
219	Set User data 10		
220	Get User data 11		
221	Set User data 11		
222	Get User data 12		
223	Set User data 12		
224	Get User data 13		
225	Set User data 13		
226	Get User data 14		
227	Set User data 14		
228	Get User data 15		

229	Set User data 15		
230	Get User data 16		
231	Set User data 16		
232	Get User data 17		
233	Set User data 17		
234	Get User data 18		
235	Set User data 18		
236	Get User data 19		
237	Set User data 19		
238	Get User data 20		
239	Set User data 20		

Note:

- Data is in big-endian format if it utilizes more than one Modbus register
- If input register functionality is not available for analyzer type, analyzer will return value as NaN for float values
- Registers in Red are coming in near future
- Memory map is continuous memory, so if user try to read address for which functionality is not available it will return 0 (for example reading address 0 for coil register)
- If user tries to read address outside of maximum register memory map, request will be exception (for example reading address 156 for coil register)

Gas ID Map

The Gas ID input registers return a two-digit code to identify the gas species being measured.

Address	Species	Description
00	H_2O	Water
01	NH_3	Ammonia
02	H_2S	Hydrogen sulfide
03	CO_2	Carbon dioxide
04	CH_4	Methane
05	CO	Carbon monoxide
06	C_2H_2	Acetylene
07	C_2H_4	Ethylene
08	N_2O	Nitrous oxide
09	CH_2O	Formaldehyde
10	HF	Hydrogen fluoride
11	O_2	Oxygen

12	HCl	Hydrogen chloride
13	C_2H_6	Ethane
14	H_2O_2	Hydrogen peroxide

Gas min max values:

Note: For the proxy gases, this is not the limit of the instrument but spans the concentrations we use for testing internally (and likely what we will recommend for system validation). For the main gases, I have put our intended "operating range" but internally for span testing we may use higher concentrations than those listed.

SI2103/AJDS

NH3: 0-10ppm

H2O: 0-5% (5% H2O would be 50000 ppm)

CO2: 0-1000ppm

SI2108/SBDS

HCl: 0-2ppm

H2O: 0-5% (5% H2O would be 50000 ppm)

CH4: 0-200ppm

SI2205/MBDS

HF: 0-1ppm

H2O: 0-5% (5% H2O would be 50000 ppm)

O2: 0-50ppm

SI2306/AMADS/AMBDS

HF: 0-1ppm

NH3: 0-10ppm

H2O: 0-5% (5% H2O would be 50000 ppm)

O2: 0-50ppm

CO2: 0-1000ppm

SI2104/BDDS

H2S: 0-10ppm

H2O: 0-5% (5% H2O would be 50000 ppm)

CO2: 0-1000ppm

PICARRO

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.

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