
Picarro G1301 Analyzer CO₂, CH₄, and H₂O

User's Guide



PICARRO INC.

Picarro G1301 Analyzer User's Guide

Thank you for purchasing a Picarro product. Your Picarro G1301 Analyzer is a quality product that has been designed and manufactured to provide reliable performance.

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

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

Contact information:

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Picarro, Inc. has prepared this manual for use by its customers as a guide for the proper installation, operation and/or maintenance of the Picarro G1301 Analyzer.

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Picarro G1301 Analyzer User's Guide
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INTRODUCTION

G1301 trace gas analyzers use optical absorption spectroscopy of the target gases to determine concentration. They are based on cavity ring down spectroscopy (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 G1301 analyzer is comprised of three components:

PVU The **P**ower **V**acuum **U**nit

Contains computer and converts AC power into DC power to drive the analyzer, and contains a diaphragm pump to draw the sample gas through the instrument.

DAS The **D**ata **A**cquisition **S**ystem

Contains the spectrometer and sample chamber, and sends spectroscopic information to the control computer.

Controls the operation of the system, and converts spectroscopic data into gas concentration data.

This manual contains information you need to safely install, operate, and maintain your Picarro G1301 Analyzer.

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





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

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

WARNING indicates an imminent danger to the user.

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

The conventions are listed as follows, showing the picture you will see.

NOTE	CAUTION	WARNING	REMINDER
			

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

SAFETY

The G1301 Analyzer complies with the following safety standards:

CE

IEC 61010-1:2001 Safety requirements for electrical equipment for measurement, control and laboratory use.

FDA/CDRH 21 CFR Parts 1040.10-11



WARNING: DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE! DO NOT OPERATE IN THE PRESENCE OF FLAMMABLE GASSES OR FUMES.



WARNING: DO NOT OPERATE IN A WET ENVIRONMENT.



NOTE: The G1301 Analyzer contains no user serviceable components. Do not attempt repairs; instead, report all problems to Picarro, Inc. Customer Service or your local distributor. Please contact Picarro, Inc. if you have any questions regarding the safe operation of this equipment.



CAUTION: The inlet gas connector on the back panel of the DAS, 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: The Picarro G1301 Analyzer contains HOT SURFACES inside the instrument. There are no user serviceable components within the G1301 Analyzer and so you should not open the analyzer or any enclosures within the analyzer.



CAUTION: The Picarro G1301 Analyzer utilizes HIGH VOLTAGES inside the instrument. There are no user serviceable components within the G1301 Analyzer and so you should not open any enclosures within the analyzer.



NOTE: Although the G1301 Analyzer components are can be optionally configured for rack mounting, they require supports in the rack, such as a shelf or side L-brackets, and cannot be safely supported by the front panel bolts alone. Please refer to the section on installation for details.



CAUTION: Some of the G1301 Analyzer components are heavy. To avoid injury, please use proper lifting procedure when moving or installing the equipment.

Laser Safety

The G1301 Analyzer is classified as a Class 1 Embedded Laser Product

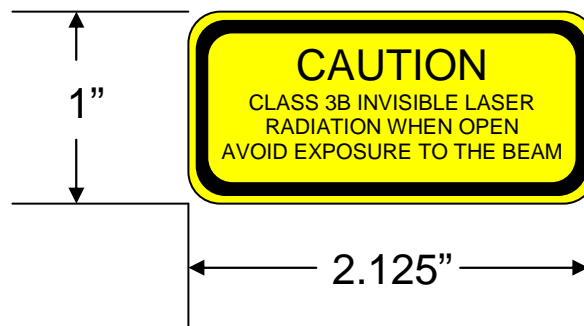


CAUTION: CLASS 3B INVISIBLE LASER RADIATION WHEN OPEN. AVOID EXPOSURE TO THE BEAM.

There are two lasers used inside the instrument. One emits a maximum of 50mW of CW light at 1603nm the other a maximum of 50mW of CW light at 1651nm. There are no user serviceable components within the G1301 Analyzer and so you should not open any enclosures within the analyzer. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN EXPOSURE TO CLASS IIIB LASER RADIATION, which can permanently damage eyes and skin.

Safety Labels

The following label is affixed to the main lid of the DAS unit.



GETTING STARTED

UNPACKING



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




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


- 1 - 19" DAS module - includes all of the data acquisition, control, and communications hardware and firmware to perform all gas handling, spectral collection and reporting to the Control-PC
- 1 - 19" PVU module - contains power supply and vacuum pump units that provide all DC power to the DAS, and the vacuum required for sample gas sequencing into and out of the DAS
- 1 - Flexible tubing - with 3/8" Swagelok fitting on each end to connect the vacuum pump in the PVU to the DAS
- 1 - USB Cable - connects the DAS with the Control-PC
- 1 - A/C power cables (North America only)
- 1 - Software CD
- 1 - Certificate of compliance
- 1 - User Manual

If any of these items is missing, contact Picarro for a replacement. Inspect each item to assure it is not damaged.




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

Unpacking the DAS:

<p>1) Break the tape seal on the large box.</p>	
<p>2) Remove the two top pieces of foam on top of the PVU, labeled top front (TF) and top rear (TR).</p>	
<p>3) Break the tape seal on the small inner box.</p>	

<p>4) Remove the two pieces of foam on the sides (white foam).</p>	
<p>5) Lift the DAS out of the small box, gripping from the sides (the DAS weighs about 30 lbs). 6) Remove the DAS from the bag. 7) Store the packing materials for future instrument shipment or storage.</p>	

Unpacking the PVU:

<p>1) Break the seal on the box.</p>	
<p>2) Remove the two top pieces of foam on top of the PVU, labeled top front (TF), and top rear (TR).</p>	
<p>3) Remove the accessory bag from the top of the PVU (vacuum tube, two AC power cables, USB cable, manual, and software CD).</p>	
<p>4) Lift the PVU out of the box, gripping from the sides. 5) Remove the PVU from the bag. 6) Remove the bubble wrap bag cover on the connector end of the umbilical. 7) Store the packing materials for future instrument shipment or storage.</p>	

INSTALLATION



This section describes the setup and installation of the G1301 Analyzer. Please read and understand this section thoroughly before proceeding with the installation.

The Picarro G1301 Analyzer consists of three modules, the DAS and PVU. The Power Interconnect Cable provides electrical connection between the DAS and PVU modules, with the flexible tubing providing the gas flow. A USB cable provides the communication interface between the DAS and the computer.

The G1301 Analyzer can be controlled and monitored via either the interactive graphical user interface (GUI) or the RS-232 command interface. A computer monitor, keyboard and mouse are required if the interactive GUI interface is desired. Details of the RS-232 command interface are included in a separate reference document.

Thermal Considerations



CAUTION: It is imperative that the analyzer have adequate ventilation and/or cooling to maintain the ambient temperature below 35°C when operating. Failure to provide adequate airflow and/or cooling to the analyzer will result in overheating of the analyzer causing a shutdown and possibly causing damage to the analyzer.

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

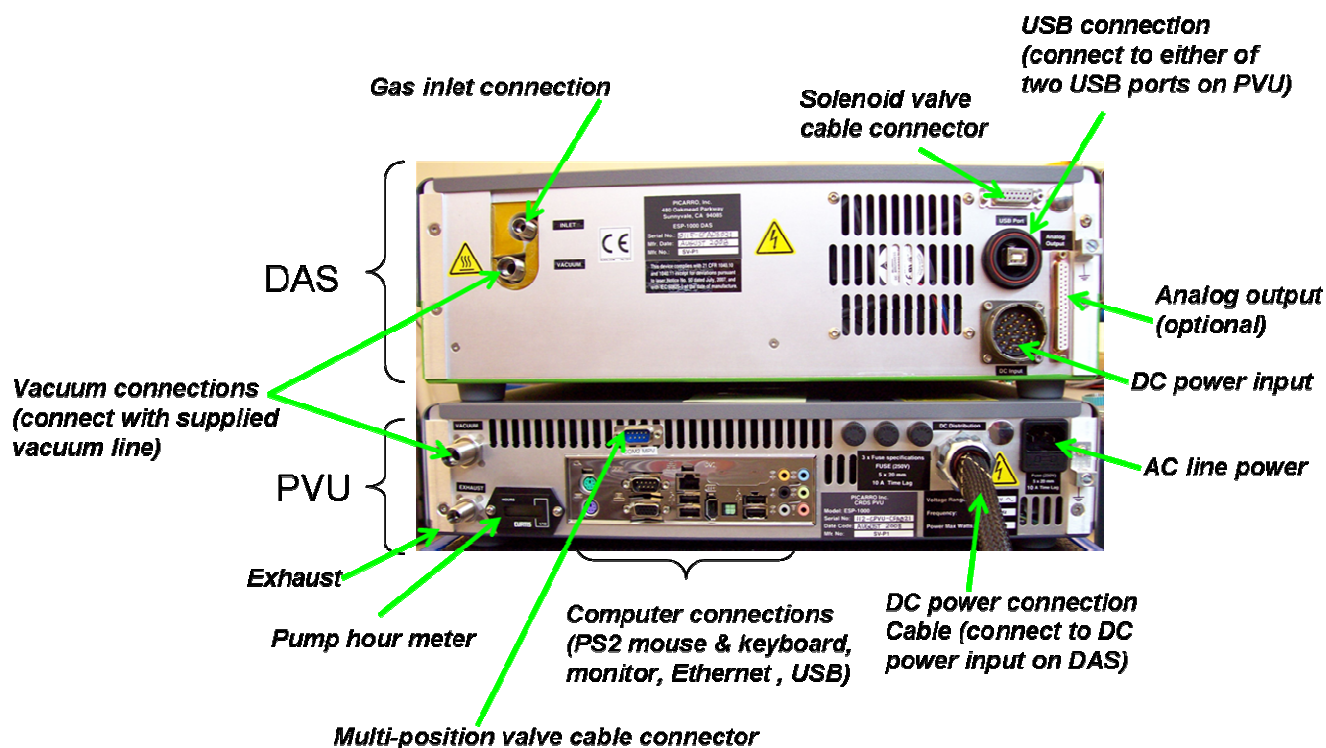


NOTE: A fan on the front face of the analyzer draws air through the analyzer where it then exits from the rear panel. Adequate clearance must be provided at the front and rear panels of the analyzer to ensure proper airflow. Take care to ensure that this warm air is exhausted from any enclosure in which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



CAUTION: Allow analyzer to equalize to room temperature before starting the installation process.

Installation and Start-up Procedure



- 1) Remove the PVU from its bag
- 2) Place the PVU in a 19" rack or on a bench top.



Warning: The G1301 cannot support itself using the front panel alone. The instrument *must* be supported by a shelf or rails in the rack.

- 3) Place the DAS on top of the PVU. (The PVU should not be placed on top of the DAS, since it is not designed to support the weight of the PVU.)
- 4) Unpack the accessories. (Vacuum tube, AC power cable, locking USB cable, manual, certificate of compliance, and software CD).
- 5) Remove caps from DAS inlet and vacuum ports.
- 6) Remove caps from PVU vacuum and exhaust port.
- 7) Attach gas line between the DAS vacuum port and PVU vacuum port. (Hand tighten the nut, then an additional 1/8th turn with a 11/16" wrench.)



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

- 8) Attach the DC distribution cable to the DAS. Align keys and insert connector. It is keyed to only connect one way, with the largest key on the top. Turn collar clockwise while pushing in until fully latched (about ¼ turn).



Note: The G1301 Analyzer can be controlled and monitored via either the interactive graphical user interface (GUI) or the RS-232 command interface. A computer monitor, keyboard and mouse are required if the interactive GUI interface is desired. It is recommended that at least the initial installation be done using the GUI.

- 9) Attach a tube to the PVU port labeled “Exhaust” and the safe place to vent the mixture of sample and dilution gases.
- 10) It is recommended that you startup the instrument before attaching a gas line to the inlet port.



Warning: Do not connect a USB hub to the computer because it can interfere with the operation of the G1301.



Warning: WHEN CONNECTING THE USB CABLE TO THE DAS, MAKE SURE THE WHITE ARROW ON THE CABLE IS ORIENTED CORRECTLY - THE ARROW SHOULD BE ON TOP, AS SHOWN IN THE PHOTOS BELOW:





Note: Do not supply power to the PVU until all other system connections have been made.

11) Computer setup

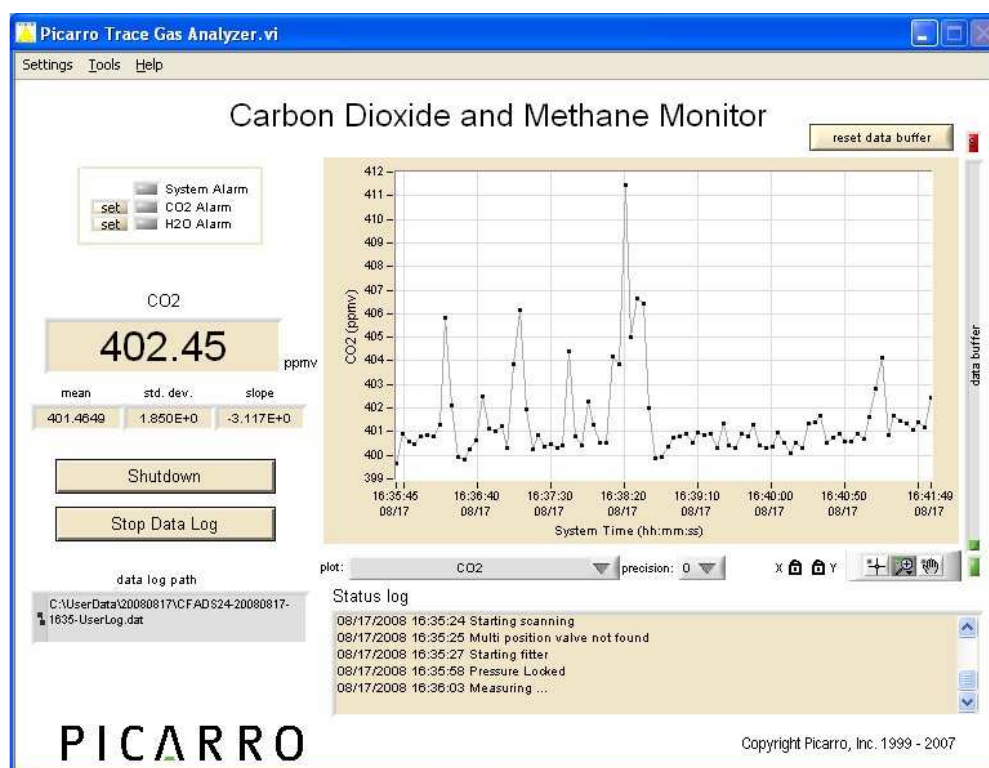
- a. Attach a mouse, keyboard and a display to the computer connections on the back of the PVU.
 - b. Plug the USB cable into the DAS USB Port by aligning the white arrow on the cable connector with the matching arrow on the DAS connector. The cable should insert easily. Screw down the locking nut on the connector. Plug the other end into an open USB port on the computer.
 - c. With most configurations, the analyzer will start a few seconds after AC power is supplied. The G1301 Analyzer will start automatically if all connections in previous sections were made correctly.
- 12) The software to operate the instrument will automatically start after the operating system has loaded.
- 13) The user interface will appear a few seconds after the instrument software starts (see the following figure on the following page).



Note: The analyzer should only be operated using the AC voltages for which it was originally configured (typically 120V AC). Reconfiguration is required if it will be operated at other voltages. Please contact Picarro for additional details. The voltage your instrument is configured to operate at is marked on the rear of the PVU.



Note: As the instrument is starting up, it is normal for there to be a delay in reporting data. This can take several minutes depending on how long it takes for the internal temperature to reach its operating point. Additionally, the data selection pulldown menu will not be populated with the appropriate items until data is actually being reported in the graph.



- 14) The status log section of the user interface describes the state of the instrument as it becomes ready to make measurements. The instrument status is also displayed on the DAS front panel. The sequence of steps the instrument goes through are:
- Starting up:** The computer has started communication with the instrument.
 - Loading calibration:** The instrument is loading the calibration data needed to operate.
 - Waiting: Temperature WB:** The system is waiting for the warm box to reach operating temperature. 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.
 - Starting gas flow:** The pump has been started, and the gas flow is being started.
 - Pressure Locked:** The cavity pressure has successfully locked to the operating pressure.
 - WLM Calibration:** A calibration of the wavelength monitor is in progress.
 - Waiting: Temperature HB:** The system is waiting for the cavity temperature to reach its operating temperature.
 - Loading: scan config:** The system is loading the spectral scanning profiles.
 - Starting fitter:** The spectral analysis program has started.
 - Starting scanning:** Spectral scanning has started. Concentration measurements will be available in approximately 30 seconds. The instrument will continue to scan and report concentration measurements until the instrument is shutdown using the procedure below.



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

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



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



CAUTION: EXCEEDING INLET GAS PRESSURE OR TEMPERATURE SPECIFICATIONS COULD RESULT IN DAMAGE TO THE INSTRUMENT. In the case of higher input pressure or flow, configuring a sampling flow by system is recommended. Use a 'tee' at the gas inlet and either return the remainder to the main gas stream or exhaust appropriately.



CAUTION: Do not disconnect the Power Interconnect Cable, USB cable, vacuum line between the DAS and PVU modules, or the AC power to the PVU while the analyzer is operating. Damage may be caused by current surges if power is applied while attaching or removing cables.

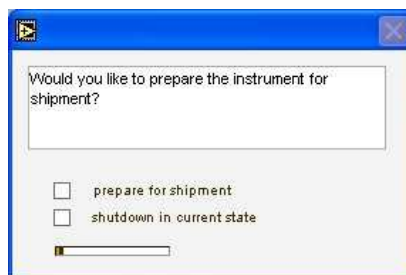


CAUTION: Analyzers which include the external valve control option are provided with a cable consisting of six electrical connections intended for controlling solenoid valves (typically 12VDC <1A max). It is important to **electrically isolate the solenoid valves from the analyzer's ground** to avoid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

Shutdown Procedure



CAUTION: A flow of clean, dry gas should always be directed through the instrument for several minutes prior to shutdown. 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

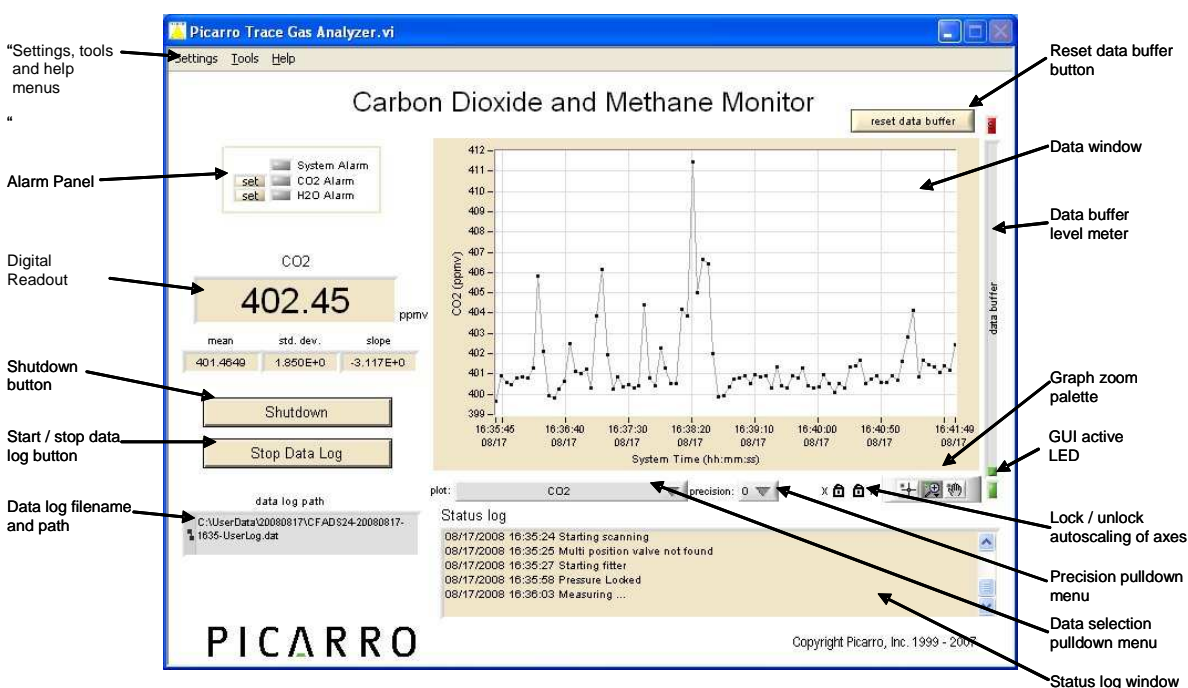


Note: There are two different shutdown states for the G1301 Analyzer. The most commonly-used mode is a quick shutdown procedure (“shutdown in current state”) to be used when the instrument will be off overnight or for a few days. If the instrument will be unused for a longer period of time, or requires transport, a different procedure (“prepare for shipment”) is used. The main difference between the two shutdown states is that in the first case, the analyzer gas cell is stored at sub-atmospheric pressure, whereas the second mode prefills the cavity with a clean dry gas prior to shutdown. The instrument should always be supplied dry gas before shutting down in either mode.

- 1) Prior to shutting down the instrument dry gas should be attached to the gas inlet port while the instrument is operating. This prevents condensation inside the system as it cools down to ambient. The water level in the gas sample can be checked during normal operation by selecting “H2O_CONC_(%v)” from the plot selection pull down menu. A minute or two of flow should be sufficient.
- 2) Press the “Shutdown” button
 - a. Choose from “prepare for shipment” and “shutdown in current state”
 - i. “prepare for shipment” will flow gas into the cavity until it reaches a pressure near atmospheric. It will then close the valves and shutdown the software.
 - ii. “shutdown in current state” will stop the gas flow and shutdown the software.
 - b. You are prompted to confirm the shutdown. Selecting the ok check box will initiate the shutdown procedure. Selecting cancel will abort the shutdown.
- 3) If “prepare for shipment” is chosen then the cavity pressure will increase until it reaches near atmospheric pressure. The status log, and the front panel display, will indicate the cavity pressure as it is filled.
- 4) The instrument software will then close. The instrument front panel display will say “Shutdown: turn power off”.
- 5) From the start menu choose “Turn off computer” and select “Turn Off”. When the computer is shutdown the instrument automatically powers off.

OPERATING INSTRUCTIONS

Graphical User Interface (GUI)



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

“Settings” Menu

“Set Data Log interval”: allows for changes to the logging interval (i.e. how often data is saved to the output files: 1, 2, 5, 10 which corresponds to 1 of 1 lines (all lines) 1 of 2 lines (every other), 1 of 5 lines, etc.). This is useful to reduce the amount of data that is saved to the log files.

“Set Data Log Columns”: allow for the selection of the data that is to be saved to the -userlog.dat file.

“Change GUI mode”: Used to enter a service mode where more operational and measurement parameters are available to be displayed. This list will typically include instrument temperature, gas concentrations and valve settings.

“Tools” Menu

“Show/Hide Statistics”: allows users to see mathematical statistics in the digital display which are calculated from the data in the window. By scrolling or zooming into certain parts of the data, the statistics will be automatically recalculated for only that data that appears in the graph window.

“Open Valve Sequencer Window”: this allows the user to configure the valve sequencer (enabling live or programmed changes to the valve states).

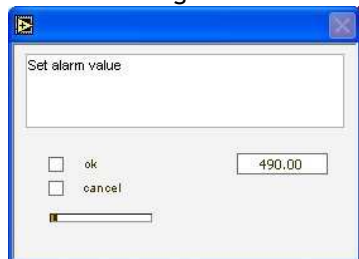
“Help” Menu

Selecting the “About GUI...” menu item brings up a timed dialog screen displaying the version numbers of the instrument.

Alarm Panel

The panel in the upper left-hand corner of the GUI is used to monitor the status of the internal instrument alarms. These indicators are “system alarm,” “CO2 Alarm,” and “H2O Alarm H₂O.” The “system alarm” LED is off (gray) during normal operation, and on (red) when there is an internal system error. For a description of what problems can trigger this system alarm, please contact Picarro. The other CO2 and H₂O alarm LEDs are off (gray) when the respective concentrations are below a certain value, and they are on (high) when the respective concentrations are above a certain value. To view the alarm set point, move the mouse pointer above the LED and a pop-up will appear indicating the alarm setting:

To change the alarm set point from the GUI, press the “set” buttons immediately to the left of the LEDs. Pressing one of these buttons will bring up the following timed dialog box:



Type the value you wish to set the alarm to and press the “ok” button, or press “cancel” if you do not wish to change the alarm value. If you do nothing, the dialog box will disappear and the alarm value will remain unchanged.

Shutdown Button

Use this button to shutdown the instrument. For a complete description of this procedure, see Chapter 6, Getting Started.

Start / Stop Data Log button

The G1301 Analyzer automatically records all data collected on the instrument and saves it for later analysis. These files are called -Data.dat files, which are described below. In addition, the user can record a separate data log file. Press this button if you would like the instrument to start recording a separate data file. A dialog box will appear prompting you for a filename and location. Press this button again to stop recording the data file.

Data Log Filename and Path

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

Results Filename and Path

The filename and path of the latest results file is displayed in this indicator. A new file and filename is generated after each startup and every midnight if the instrument is running.

Reset Data Buffer Button

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

Data Window

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



Concentration Reading

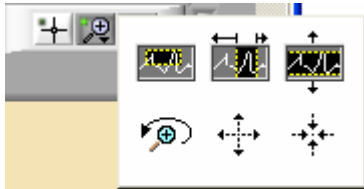
Depending on which data stream is selected using the *Data selection pulldown* menu, the latest value for the CO₂, CH₄, or H₂O concentration can be found in the yellow-tinted indicator just below the *Alarm Panel*.

Data buffer level meter

The meter to the right of the *Data Window* indicates how much of the internal memory of the GUI is used to retain historical data collected with the instrument. There is an internal limit of 8,000 points, or ~11 hours worth of data. Once 8,000 data points are collected, the buffer is full, and old data is removed from the buffer as new data is collected. This buffer affects *only* the data displayed in the *data window*, not data collected in the *data -UserLlog.dat* and *-Data.dat* files. This buffer is empty upon instrument startup, and can also be emptied by pressing the *reset data buffer button* in the upper-right-hand corner of the GUI.

Graph Zoom Palette

The Graph Zoom Palette is made up of three icons. The left-most icon, , has no effect on the operation of the GUI other than to change the shape of the cursor on the data window to a plus sign. The middle icon, , brings up a dialog box allowing the user to zoom in or out on the data window:





By selecting the upper three icons, and then clicking and dragging on the *data window*, the user can zoom in on a portion of the graph. By selecting the two icons in the lower right and lower middle, the user can zoom out or zoom in on the data by left-clicking and holding on the *data window*. The icon in the lower left allows the user to undo the last zoom action.

Note: The zooming functions on the *Graph Zoom Palette* require one or both of the axes on the *lock / unlock autoscaling of axes* to be in the unlocked position.

GUI active LED

This small LED blinks when the GUI is active.

Lock / Unlock Autoscaling of Axes

These two icons just to the left of the graph Palette,  , are used to control whether the data in the *data window* is autoscaled. If a lock icon is displayed, then the graph axes are continually adjusted to include all data in the data buffer. Conversely, if the icon is unlocked, the graph axis is fixed and will not change regardless of data in the buffer. The zooming functions on the *Graph Zoom Palette* require one or both of the axes to be in the unlocked position.

Precision Pulldown menu

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

Data Selection Pulldown menu

Click on this icon to select the data stream that is viewed in the *data window*. Data streams available on the GUI are listed in the following section describing data files.

Status Log Window

This window displays instrument status messages, in the following form: “MM/DD/YYYY hh:mm:ss generic message text.” These messages include all messages sent to the DAS front panel display.

File Management



Note: The G1301 processes concentration measurements in batches. Each batch, consisting of two individual concentration measurements, is processed in approximately ten seconds. These results then appear as a group on the GUI.

During operation, the G1301 analyzer generates two output files that are updated after each batch of concentration measurements is complete. The user output file is named CFADS##-yyyymmdd-hhmm-UserLog.dat.

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

CFADS01-20070127-1029-UserLog.dat

CFADS01 is the instrument serial number

20070127 is the date, 1/27/2007, in format yyyymmdd (to allow easy chronological sorting of data files).

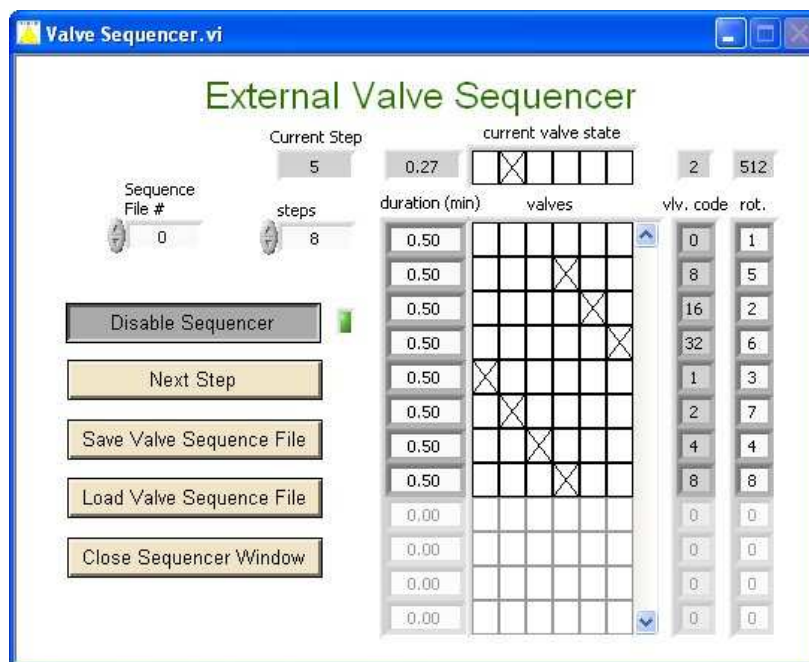
1029 is the time the file was started, 10:29 am, formatted as hhmm using a 24 hour clock.

During data acquisition, the analyzer creates directories in which to store the data, based on the date the data were acquired. The default location for these files is C:\UserData\ *The date of acquisition*, for example, the 20070205 data are stored in the subdirectory "C:\UserData\20070205\".

To keep the data files easy to manage and to limit the size of individual files and directories, the software automatically generates new files each time the instrument is powered up and also at midnight each night. When new files are created at midnight, their file name will contain the new date and a time of 00:00. For example if the system was started at 10:29 am on 2/5/2007 it would create a file named C:\UserData\20070205\CFADS01-20070205-1029-UserLog.dat. Then at midnight a new file will be created C:\UserData\20070206\CFADS01-20070206-0000-UserLog.dat.

External Valve Control

The analyzer has been equipped with a cable for control of external solenoid valves. It may be necessary to contact Picarro for additional information on how to safely configure the analyzer to utilize this feature. Analyzers are provided with a cable consisting of six electrical connections intended for controlling solenoid valves (typically 12VDC <1A max). It is important to **electrically isolate the solenoid valves from the analyzer's ground** to avoid electrical interference which could compromise the analyzer's accuracy. There is also an optional com port for controlling a multi-position (typically rotary) valve via serial commands. Contact Picarro for additional details on this feature.



External Valve Sequencer

When the “Open Valve Sequencer Window” is selected under “Tools” in the software, the screen above will appear. This allows the user to manually open or close different valves or to program in a sequence which can be executed later. The X in the “current valve state” window indicates a valve is open. The “duration” window shows how long that set of valve(s) is open. The “current step” field indicates (if the sequencer is running) which step is being executed in the list. The binary valve code and corresponding rotary valve position (if enabled) is shown for the desired valve combination. Multiple sequences can be saved in files and selected later with the Sequence File # selector. The sequences can be started or stopped with the Enable/Disable button, and a running sequence can be incremented by pressing Next Step. The valve sequence currently shown on the panel can be saved, or a previously saved sequence can be loaded with the Save/Load Valve Sequence File buttons. To increase the number of sequence items, increment the “steps” control.

Data Handling



Warning: Opening Results files or other instrument configuration or data files during operation of the instrument may result in a software conflict. To avoid conflicts it is best to copy the -UserLog file to a USB flash drive so that it can be imported and analyzed on another computer. Do not use a USB hub, only a flash drive. Data can be copied from the host computer by attaching a USB flash drive to an available USB port. After the host computer identifies the USB drive, Windows Explorer can be used to copy files to the flash drive. The data can then be processed by importing the file into a program suitable for data manipulation. The -UserLog file contains all of the output parameters that the user needs to analyze the measurement results of the instrument. The table below shows a few lines of a typical -UserLog file imported into Excel. The number of columns in the table is larger than shown below.

DATE	TIME	DAYS_SINCE_JAN	CO2	CO2_CORR	CH4	H2O	DAS_TEMP_(C)
6/26/2007	11:41:26	176.4455	379.1333	379.1333	2.4721	0.0081	29.3438
6/26/2007	11:41:27	176.4455	379.1333	379.1333	2.4721	0.0081	29.3203

OUTLET_PROPORTIONAL_VALVE	SOLENOID_VALVES	MULTI_POS_VALVE
41381.0	8	379.1333
41381.0	8	379.1333

Data columns descriptions:

DATE & TIME: The date and time the sample was reported

DAYS_SINCE_JAN: The fractional day since January 1 of the current year

CO2: The measured CO₂ Concentration in parts per million per volume

CO2 Corr: The measured CO₂ concentration in parts per million per volume with a water correction

CH4: The measured CH₄ concentration in parts per million per volume

H2O: The measured concentration of H₂O in the sample in percent volume

DAS_TEMP_(C): The DAS temperature in Celsius.

OUTLET_PRPORTIONAL_VALE: Value (arbitrary) of the state of the outlet valve

SOLENOID_VALVE: Binary number (1, 2, 4, 8, 16...) indicating which valve(s) are open

MULTI_POS_VALVE: Binary number indicating the state of the optional multi-position (rotary) valve

Serial Communication

The Picarro G1301 Analyzer supports an RS-232 physical command interface, which can be used to control the instrument and to retrieve concentration data. Not all features of the instrument are available on the serial interface. For details on how to use the serial command interface, please see the G1301 Programmer's Reference Manual.

Remote Data Access

Using the RemoteAccess.ini file, the Picarro G1301 Analyzer can be configured to automatically,

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

The Internet connection need not be permanent, and may be a dial-up connection accessible via an analog modem installed in the host computer. The task of sending data and/or synchronizing the clock on the analyzer is performed using the RemoteAccess.exe program. This program is run periodically using the Windows task scheduler at a user-configurable frequency. If a dial-up connection to the Internet is employed, it is used only on demand in order to minimize the connection time.

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

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

NTP

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

EMAIL

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

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

DIALUP

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

Example of “RemoteAccess.ini” File

[LOGGING]

Logfile=c:/temp/RemoteAccessLog

[NTP]

Server1=time-a.nist.gov
Server2=time-b.nist.gov
Server3=time-a.timefreq.bldrdoc.gov
Server4=time-b.timefreq.bldrdoc.gov
Server5=time-c.timefreq.bldrdoc.gov
Server6=time.nist.gov
Server7=time-nw.nist.gov
UpdateClock=1

[DIALUP]

ConnectionName=Picarro Dialup Access
Username=user
Password=password
Number=14085551212

[EMAIL]

Server=smtp.servername.org
Directory=c:/picarro/mailbox
From=instrument@picarro.com
To1=recipient1@site1.com
To2=recipient2@site2.com
Subject=CRDS data from Silverstone instrument
UseAuthentication=0

SPECIFICATIONS

The following specifications are for the Picarro G1301 Analyzer.

Absolute Maximum Ratings

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

Parameter	Min	Max	Units
Storage Temperature	–40	+40	°C
Storage Relative Humidity (non-condensing)	5	90	%
Ambient Operating Temperature	10	35	°C
Operating Relative Humidity (non-condensing)	5	95	%
Warm-Up Time from OFF (at 15 °C)		1	hour
Temperature Ramp		0.3	°C/min
Total Power Dissipation (steady state)		375	W

Sample Gas Requirements

Parameter	Value	Comment
Inlet gas temperature	< 15-45°C	
Inlet gas pressure	500 – 1000 Torr	
Inlet gas flow rate	< 0.4 L / min at 760 Torr	
gas type	oil free non-corrosive non-flammable non-condensing*	Samples with condensing levels of H ₂ O content may damage the analyzer.
Particle free	< 0.1 µm	

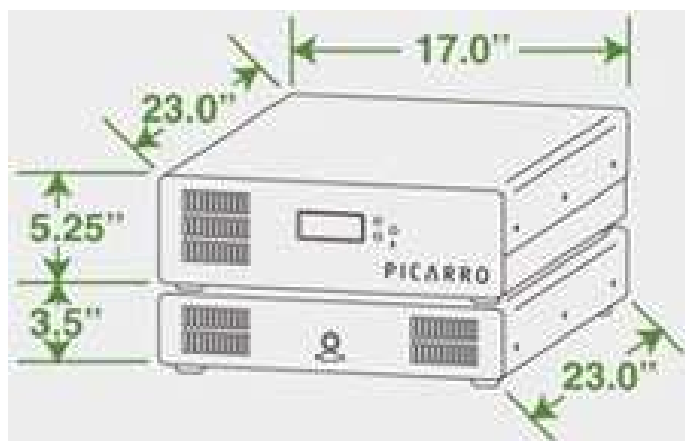
Performance Specifications

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

Physical specifications

Parameter	Value
Inlet / Outlet gas connectors	1/4" stainless steel Swagelok
W x H x D	See drawing below
AC power	100/110 VAC @ 50/60 Hz 220VAC @ 50 Hz

G1301 Dimensional Drawing:



SERVICE, MAINTENANCE AND TROUBLESHOOTING

Service and maintenance

The advanced rugged design of the G1301 Analyzers provides stable SERVICE-FREE and MAINTENANCE-FREE operation. With the exception of the fan filter, the G1301 Analyzer is not user serviceable. Should it appear to malfunction, please refer to the Troubleshooting Guide.

Vacuum Pump in PVU:

The pump is rated for 10,000 hours. It is advised that arrangements be made with Picarro, Inc. to service the pump as it approaches this number of operational hours. If the pump fails, please contact Picarro, Inc.

At the rear of the PVU is a meter that indicates the accumulated hours of operation of the vacuum pump. The hour meter only displays numbers when the vacuum pump is on. *Note: The pump is off while the instrument is warming up.* The vacuum pump is rated for 10,000 hours. The hours indicated should be recorded when the vacuum pump is serviced or replaced.



Fan Filters:

If the instrument is not used in a clean environment, then dust will gather on the fan filters at the front of the unit. It is recommended that the filter element be replaced or cleaned when a reasonable amount of dust is visible.

Troubleshooting guide

The following table lists problems that may be encountered during installation and operation of the G1301 Analyzer. The corresponding step-by-step procedures provide resolution in most cases. If, after attempting these procedures, the problem remains unresolved, please contact Picarro Customer Service at (408) 962-3900 or your Distributor.

1. Power LED on analyzer does not illuminate

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

- (a) Check that the interconnection cable between the power vacuum unit and the analyzer is in place and that the plug at the end of the cable is securely mated with the socket on the analyzer. The plug shield should be rotated clockwise to lock the plug into the socket.
- (b) Check that the USB cable between the rear of the computer and the rear of the analyzer is in place and securely plugged in at both ends. Ensure that the plug at the rear of the analyzer is in the correct orientation, with the arrow (or USB logo) facing upwards, and that it is securely screwed onto the analyzer socket. Note that the power supplies in the power vacuum unit are activated in response to a signal from the computer carried on the USB cable.
- (c) Check that the fuse located in the power vacuum unit next to the IEC (AC power) cable is operational. If the analyzer still fails to turn on, contact Customer Service.

2. User interface program does not start

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

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

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

- (b) Check that the USB cable between the rear of the computer and the rear of the analyzer is in place and securely plugged in at both ends, since communications problems may also result from a bad connection. Ensure that the arrow (or the USB logo) on the plug is facing upwards when inserting it into the socket on the rear of the analyzer, and that it is securely screwed onto the analyzer socket. Follow the procedure in (a) to shut down and restart the instrument if the cable has been reconnected.

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

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 not correct.

- (a) The “Pressure low” message indicates that there is insufficient gas available at the inlet of the analyzer. Check the inlet plumbing to the analyzer and ensure that the pressure at the inlet is within the specifications.

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

4. Vacuum pump stalls, and fails to reduce cavity pressure to the operating point

Context: Under normal operation, the vacuum pump is turned on during the instrument startup procedure after the warm chamber temperature has stabilized. The pump may stall and not operate even though it is receiving power if the pressure at its inlet is too low. If the pump is stalled, there is no gas flow through the cavity.

- (a) Confirm that power is being applied to the vacuum pump by observing the hour meter liquid crystal display on the rear panel of the power vacuum unit. The display is switched on only if power is being applied to the vacuum pump. Next, check the flow meters on the front of the power vacuum unit to establish if there is gas flow through the pump. If power is being applied to the pump but there is no gas flow, the pump is stalled.
- (b) If the pump is stalled, disconnect one end of the tube between the analyzer and the power vacuum unit to allow air into the inlet of the vacuum pump. The pump should start operating. Reconnect the tube after the pump restarts. If the pump still fails to operate, contact Customer Service.

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

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

- (a) Resetting the computer and the instrument requires that the computer be shut down and restarted. If the computer responds to the mouse, a normal Windows shutdown may be carried out: use the Start menu, select the red Shut down button and select “Shut down” in the drop-down box under “What do you want the computer to do?” Wait for the shutdown to complete normally and for the computer and analyzer to turn off completely. After a few seconds, restart the computer by momentarily depressing the power button.

- (b) If the computer does not respond to the mouse, hold down the power switch on the front panel for a few seconds until the computer and the instrument turn off. After another few seconds, restart the analyzer by momentarily depressing the power button.
- (c) It is possible that the USB cable connecting the DAS and the control PC has become damaged. Replace this cable with another standard USB cable (type A-B), and restart the system.

6. USB Connection in Windows warning: “Unrecognized Device” or similar USB connection problem

Context: The USB cable can, in some circumstances, be physically forced to connect upside-down (see below). If this occurs during improper installation, the computer will show a USB connection error. If the USB connector is verified to be plugged in correctly and a USB error persists, contact Picarro for technical assistance.

Note: WHEN CONNECTING THE USB CABLE TO THE DAS, MAKE SURE THE WHITE ARROW ON THE CABLE IS ORIENTED CORRECTLY - THE ARROW SHOULD BE ON TOP, AS SHOWN IN THE PHOTOS BELOW:



Transportation and Storage

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

Packing the DAS

- 1) Shutdown the instrument using the shutdown button, using the “prepare for shipment” option. Clean dry gas should be attached to the instrument prior to shutting down. (This prevents condensation inside the system during storage or shipment).
- 2) Disconnect the all tubing and electrical connections from the DAS and PVU. (DC umbilical, vacuum line, USB cable, inlet gas line, PVU AC power cord, monitor, mouse and keyboard).
- 3) To prevent contamination and possible damage to the connector threads, place caps on all gas connections. (DAS inlet, DAS vacuum, PVU vacuum, PVU exhaust).
- 4) Place the DAS and PVU each in a plastic bag with a package of desiccant. Seal the bags with tape.
- 5) Place the two pieces of edge foam on the bottom of the large box.
- 6) Place the small box inside the large on top of the edge foam.
- 7) Place on sheet of foam on the bottom of the small box.
- 8) Lower the DAS into the small box.
- 9) Place the four side pieces of foam in the box.
- 10) Place one sheet of foam on top of the DAS.
- 11) Seal the small box.
- 12) Place the two pieces of edge foam between the small box and the large one.

Packing the PVU

- 1) Place two pieces of foam in the bottom of the box, labeled bottom front (BF), and bottom rear (BR).
- 2) Place the PVU in a plastic bag with a package of desiccant. Seal the bag with tape, with the DC distribution cable sticking out of the bag.
- 3) Cover the connector end of the distribution cable with a bubble wrap bag, and seal with tape.
- 4) Low the PVU onto the two pieces of foam in the box.
- 5) Place the two top pieces of foam on top of the PVU, labeled front top (TR), and top rear (TR).
- 6) Place the system accessories in a bag. (vacuum tube, two AC power cables, manual, and software CD)
- 7) Tape the accessory bag to the top of the PVU, between the foam.
- 8) Seal the box.



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

LIMITED WARRANTY

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

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



NOTE: DISCLAIMER

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

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

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

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

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

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

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

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

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

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

Contact information:

Website: www.picarro.com

Email: customersupport@picarro.com

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

Picarro, Inc. has prepared this manual for use by its customers as a guide for the proper installation, operation and/or maintenance of the Picarro G1301 Analyzer.

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Picarro G1301 Analyzer User's Guide